Volume I

Final Environmental Impact Statement for the Bellefonte Conversion Project

EXECUTIVE SUMMARY

Tennessee Valley Authority
October 1997

Changes to the DEIS are highlighted in the FEIS

FINAL ENVIRONMENTAL IMPACT STATEMENT
OCTOBER 1997

BELLEFONTE CONVERSION PROJECT

Responsible Federal Agency: Tennessee Valley Authority

Abstract: The Tennessee Valley Authority (TVA) proposes to convert and operate the unfinished Bellefonte Nuclear Plant as a fossil-fueled power plant. The proposed action would undertake conversion of completed and partially completed facilities; modification and addition of equipment; construction of new facilities; and subsequent operation of facilities at the Bellefonte Nuclear Plant to produce electricity using fossil fuels. Operation of the proposed Bellefonte facility as a fossil-fueled power plant would produce up to 2,895 megawatts of electric power, dependent on the conversion option selected.

The environmental consequences of five alternatives for conversion of Bellefonte were evaluated. The five alternatives are: (1) Pulverized coal (PC), (2) Natural gas combined cycle (NGCC), (3) Integrated gasification combined cycle (IGCC), (4) IGCC with chemical coproduction (IGCC/C), and (5) Combination of NGCC and IGCC/C (Combination). NGCC is TVA's preferred conversion option. Some characteristics of these alternatives are given in the table below.

	PC	NGCC (Preferred)	IGCC	IGCC/C	Combination
Total Electric Capacity (MW)	2,400 Base	2,206 - Base 2,406 - Peaking	2,720 Base	450 Base	2,565 - Base 2,895 - Peaking
Fuel(s)	Coal (Fuel Oil startup)	Natural Gas (Fuel Oil backup)	Coal, Petroleum Coke (Fuel Oil startup)	Coal, Petroleum Coke (Fuel Oil startup)	Coal, Petroleum Coke, Natural Gas (Fuel Oil backup)
Footprint (acres)	190	46	190	225	225
Coproducts	Gypsum	None	Sulfur, Slag	Sulfur, Slag, Chemicals	Sulfur, Slag, Chemicals
Peak Construction Employment	1,612	550	2,155	2,898	3,362

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INTRODUCTION

This Final EIS (FEIS) has been prepared to provide the public and TVA decisionmakers with a description of environmental impacts associated with the proposal to convert the partially completed Bellefonte Nuclear Plant to a fossil plant. Consistent with EPA's guidelines for complying with the National Environmental Policy Act (NEPA), the public and environmental officials are invited to comment on this FEIS. As shown in Table 1 below, the TVA Board of Directors will make a decision respect to the proposed action following the preparation of this Final EIS.

Table 1. Milestones for Bellefonte Conversion EIS

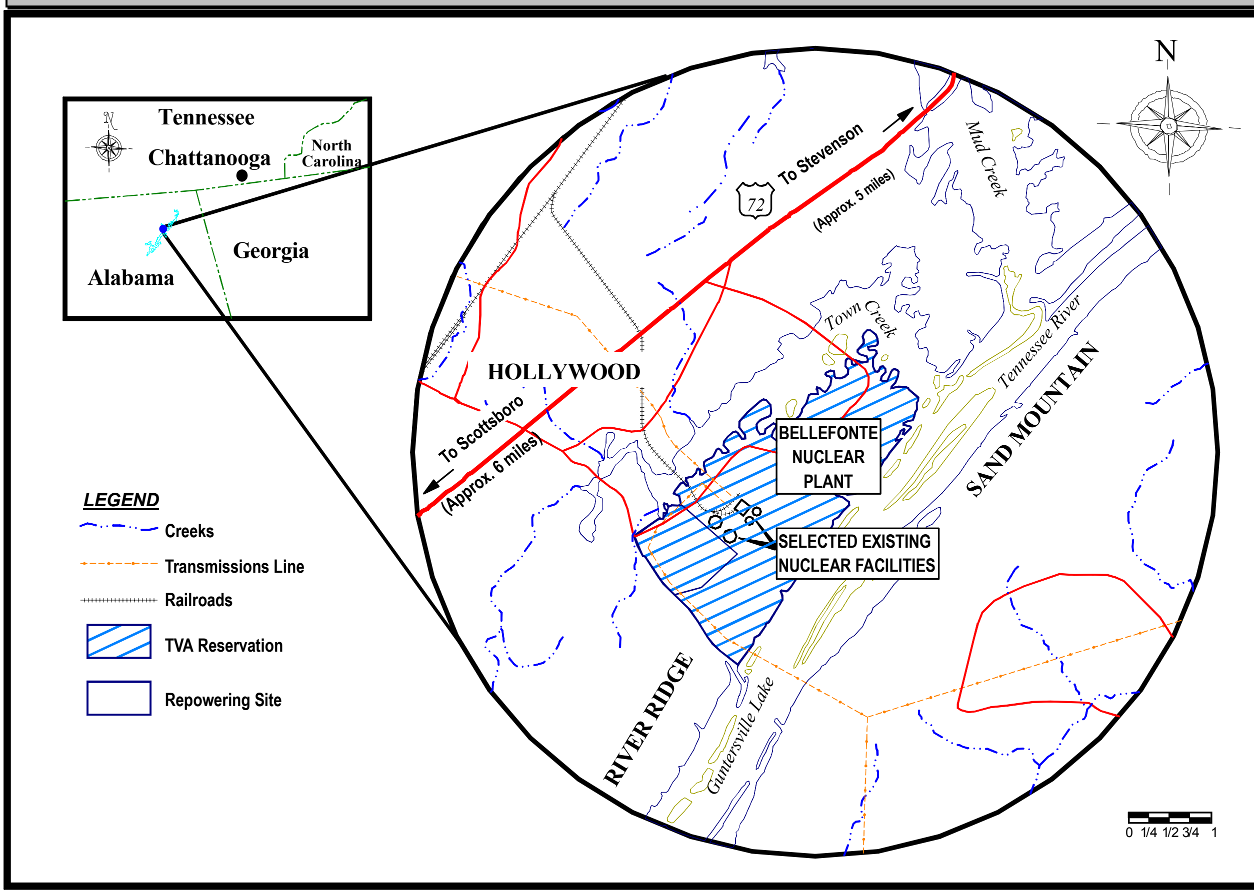
Issue Notice of Intent	April 29, 1996
Public scoping meeting	May 16, 1996
Release Draft EIS	March 13, 1997
Public hearing on Draft EIS	April 8, 1997
Close of public comment period	May 4, 1997
Release Final EIS	October 1997
Issue Record of Decision	November 1997

The proposal to convert Bellefonte is part of a system-wide evaluation of future power needs and a range of options for meeting those needs were discussed in TVA's Integrated Resource Plan and Environmental Impact Statement, Energy Vision 2020, released on December 21, 1995. Energy Vision 2020 was a comprehensive analysis, with extensive public involvement, of long- and short-term actions TVA could take to provide flexible, competitive energy choices for the future.

Recommendations contained in Energy Vision 2020 affecting the use of Bellefonte include the continued deferral of its completion as a nuclear powered facility in the absence of partners who would share the investment risk associated with its construction. Energy Vision 2020's action plan stated TVA's intent to consider other conversion opportunities, namely the conversion of facilities to allow production of electricity from combustion of fossil fuels.

Bellefonte is located on an approximately 1,600-acre site adjacent to the Tennessee River near Hollywood, Alabama (Figure 1). The two-unit nuclear generating plant has a rated capacity of 1,212 megawatts (MW) per unit. The Nuclear Regulatory Commission (NRC) issued the construction permit for Bellefonte in December 1974. By 1988, Unit 1 was 90 percent complete, and Unit 2 was about 58 percent complete. On July 29, 1988, TVA notified NRC that the completion of construction of the Bellefonte Nuclear Plant was being deferred as a result of lower than expected load forecast for the near future. The plant remained in deferred status until March 23, 1993, when TVA notified NRC of plans to complete Bellefonte Units 1 and 2. TVA's decision to complete the Bellefonte plant came after three years of extensive studies that concluded completion of the facility as a nuclear power plant was viable. Subsequently, in December 1994, the TVA Board announced that Bellefonte would not be completed as a nuclear plant without a partner, and put further construction activities on hold until a comprehensive evaluation of TVA's power needs was completed.

Figure 1. Locality Map for Bellefonte



TVA proposes to complete the unfinished Bellefonte Nuclear Plant as a fossil-fueled power plant. The proposed action is conversion, modification, and addition of equipment; the construction of new facilities; and the subsequent operation of the Bellefonte facility as a power plant with an electricity generating capacity of up to 2,895 MW, and chemical production, dependent on the conversion option selected. Among the fossils fuels considered were natural gas, coal, and petroleum coke. The short-term action plan of Energy Vision 2020 recommended several options for converting Bellefonte, including conversion to a combined cycle plant utilizing natural gas or gasified coal as the primary fuel. Recognizing that a degree of uncertainty and market risk were associated with a conversion alternative, an in-depth engineering and financial examination was also initiated to assess and develop the Bellefonte conversion strategy.

PURPOSE AND NEED FOR PROPOSED ACTION

The purpose of the actions proposed in this FEIS is to convert the Bellefonte Nuclear Plant to a fossil-fueled power plant, preferably through the use of natural gas fired combined cycle technology. The need for action to complete Bellefonte stems largely from the past monetary investment in construction activities and facilities at this location. Investment in Bellefonte through December 1995 was about \$4.6 billion. However, a cost estimate, developed for Energy Vision 2020, for completing Unit 1 (as nuclear) is \$1.3 to \$3.5 billion and for Unit 2 is \$0.9 to \$2.4 billion. A more recent study conducted by NUS Corporation in 1996 determined the completion costs of the two Bellefonte units to be \$2.88 billion. The current Bellefonte asset is not producing power. With the TVA Board's decision in 1994 to not complete Bellefonte as a nuclear plant unless a partner is found to share investment and operating risk, the plant could remain in a mothballed condition thereby continuing to be a liability to TVA's financial situation. In addition to making use of an existing asset, the proposed action would also serve the important purpose of meeting future power needs of the region. Energy Vision 2020 concluded that TVA would need 16,500 MW of new capacity between 1998 and 2020 to meet forecasted load growth in the region.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

The objective of the FEIS is to provide environmental data and analyses that will inform the public and TVA decisionmakers of the environmental consequences of proceeding with the conversion of Bellefonte to a fossil fuel power plant. The conversion decision will weigh environmental considerations with economic and technical aspects of the conversion options. This decision will be documented in a Record of Decision which will be prepared after the issuance of this Final EIS.

The alternatives analysis in this FEIS has been designed to meet these objectives. As discussed later in this summary, there are three tiers of decisionmaking. Tier 1 is to decide between the No-Action Alternative, which is to leave Bellefonte as a partially completed nuclear plant into the indefinite future, and the Proposed Action Alternative, which is to proceed with converting Bellefonte to fossil fuel.

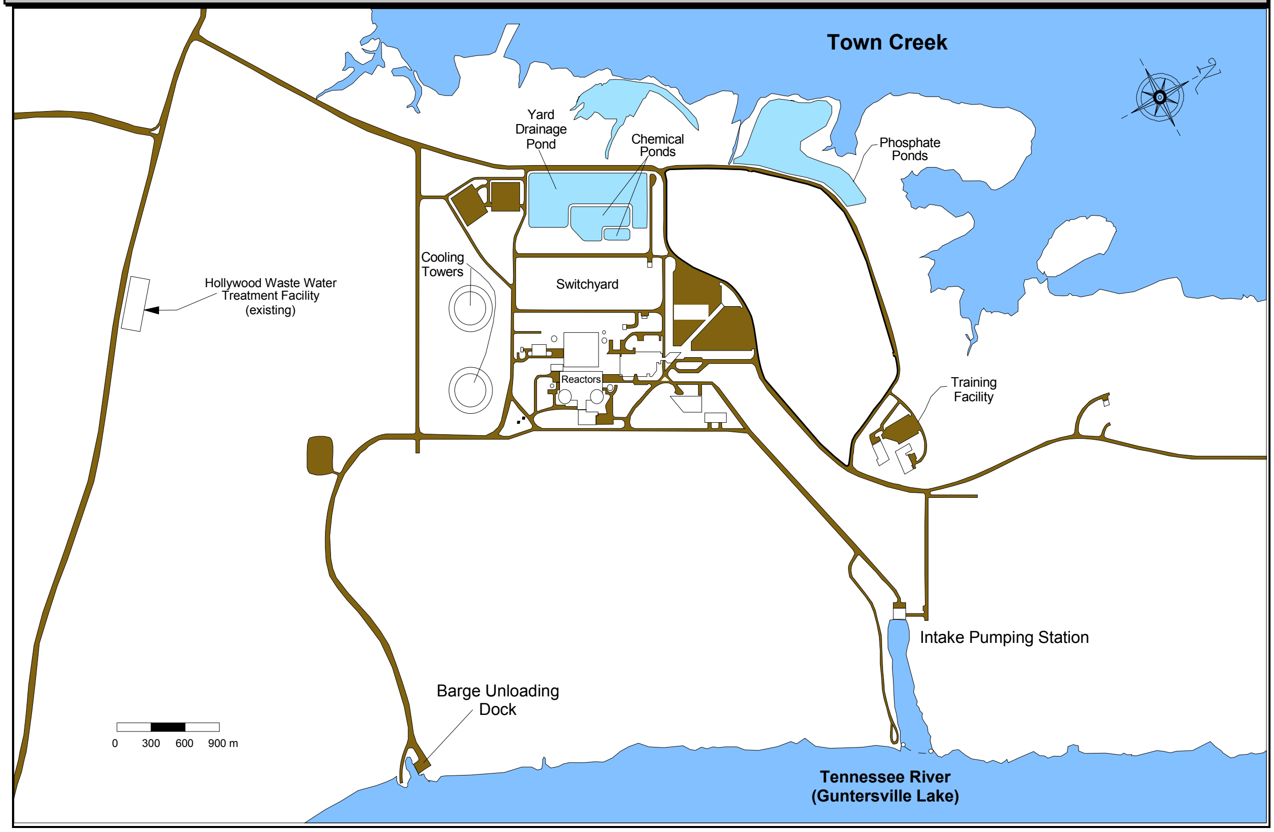
Tier 2 is to select one of five conversion options. The conversion options were derived from information contained in Energy Vision 2020 and data that have become available since the publication of that document.

Tier 3 involves decisions about "suboption choices," basically types of processes, equipment, and modes of operation which cut across several conversion options. An example of a suboption choice would be the type of gasifier that would be used in conversion options involving coal gasification. For most suboptions, it was possible to choose a technology or a mode of operation to represent the suite of likely suboptions, or to establish an envelope that allowed the evaluation of impacts for the "most likely conservative configurations." Conversion option assumptions and configurations reflect these choices.

No-Action Alternative

Continuation of the No-Action Alternative involves the maintenance of the Bellefonte plant as a partially completed nuclear plant. Because of the advanced state of construction (90% for Unit 1 and 58% for Unit 2), deferment involved more than stopping active construction. The lay-up and preservation program has the objective of maintaining the systems, structures, and components for prolonged periods without significant degradation. Approximately 20,000 preventive maintenance activities are performed each year, including verification of the effectiveness of the program, which is accomplished through the use of system engineer walkdowns, corrosion coupon monitoring, and various trend programs. A work force of about 80 personnel are permanently employed at Bellefonte. Figure 2 shows the location of current facilities at Bellefonte. Bellefonte currently holds a minor air source permit and a wastewater discharge permit for maintenance operations. All solid wastes are disposed offsite at permitted landfills, and sanitary wastewater is sent to a treatment plant operated by the City of Hollywood, Alabama.

Figure 2. Current Bellefonte Site Map



Proposed Action Alternative

Drawing from Energy Vision 2020 and information that has become available since its publication, TVA staff compiled a comprehensive list of options for converting Bellefonte, including developing technologies. Each technology option was considered in terms of three criteria.

- Can the technology be used, based on current data, to completely convert Bellefonte?
- Is the technology considered to be at the initial or mature commercial stage of development (i.e., is further demonstration and testing needed to prove the technology)?
- Is the fuel supply adequate for full conversion of Bellefonte?

Options successfully meeting all screening criteria were pulverized coal (PC), natural gas combined cycle (NGCC), integrated gasification combined cycle (IGCC), and IGCC with chemicals coproduction (IGCC/C). Power plants using these technologies would be distinctly different in their emissions, configurations, and operational characteristics and should be addressed as discrete conversion options. However, it is possible that these technologies could be employed together at Bellefonte. Consequently, a combination option was devised to reflect a phased conversion process using elements of each of the three gasification-based options listed above. NGCC is TVA's preferred fossil conversion option.

These five options, along with a consideration of suboption processes, represent a broad, flexible suite of conversion pathways at Bellefonte for future TVA decision making.

- **Option 1:** **Pulverized coal (PC)**
- **Option 2:** **Natural gas combined cycle (NGCC) - Preferred by TVA**
- **Option 3:** **Integrated gasification combined cycle (IGCC)**
- **Option 4:** **IGCC with chemical coproduction (IGCC/C)**
- **Option 5:** **Combination of NGCC and IGCC/C (Combination)**

Pertinent aspects of each of the five conversion options are described in Table 2.

The five conversion options are briefly described in the remainder of this section. The utilization of existing Bellefonte equipment and new facilities are shown in Table 3.

Option 1: Pulverized Coal (PC) Units

The fully completed PC plant would consist of four 600-MW boilers of the subcritical design, for a total generation capacity of 2,400 MW. Boilers would be equipped with particulate and sulfur dioxide removal systems and specially designed burners that produce less quantities of a noxious gas called nitrogen oxide. The steam generated in the PC boilers would be routed to the existing Bellefonte steam turbines, each turbine being served by two boilers. The steam turbines may be modified to optimize operation of the plant. The locations of the PC power block, coal handling, and combustion residue facilities are shown in Figure 3.

Table 2. Major Features of the Conversion Options

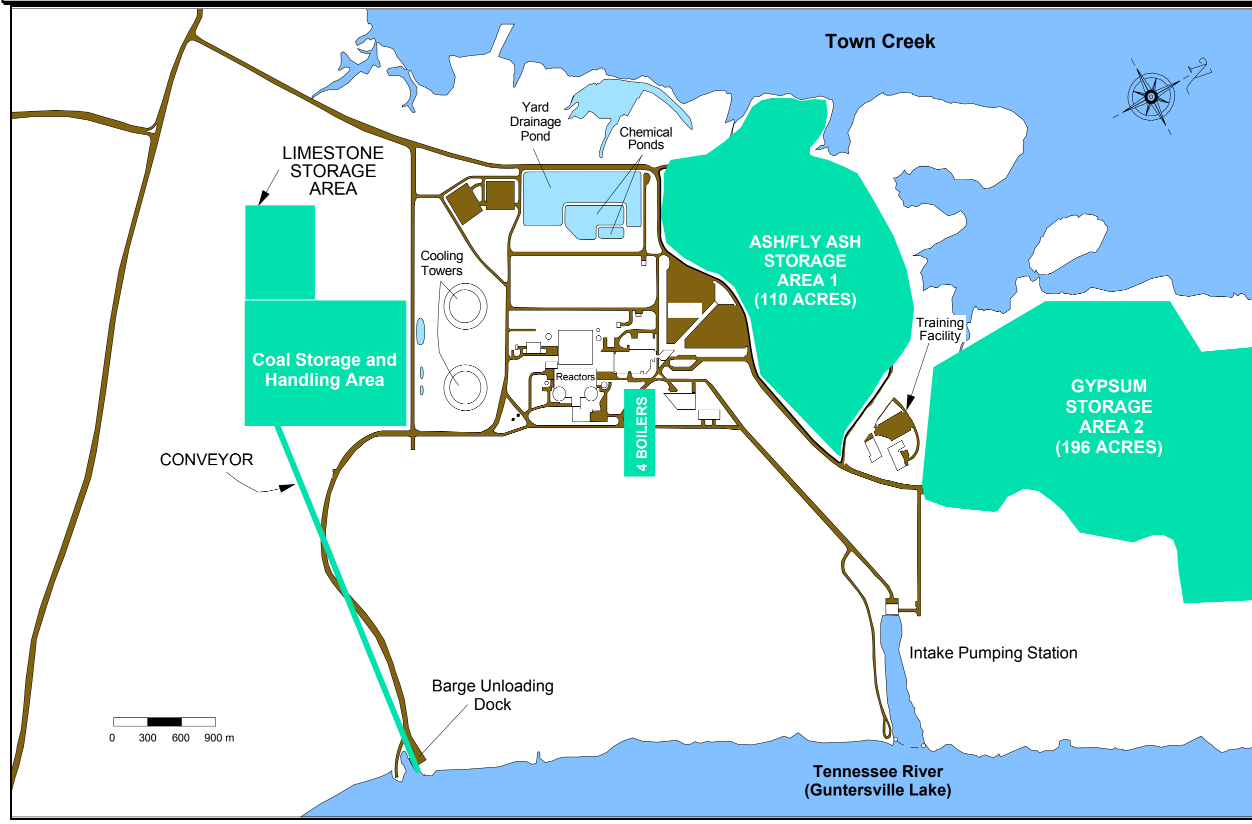
	PC	NGCC (Preferred)	IGCC	IGCC/C	Combination
Total Electricity	2,400	-2,206 - Base Power	2,720	450	-2,565 - Base Power

Production (MW)		-2,406 - Peaking Power			-2,895 - Peaking Power
Fuel(s)	-Coal -Fuel Oil for Startup	-Natural Gas -Fuel Oil as Backup	-Coal -Petroleum Coke -Fuel Oil for startup	-Coal -Petroleum Coke -Fuel Oil for Startup	-Coal -Petroleum Coke -Natural Gas -Fuel Oil as Backup
Fuel Consumed per day	24,974 tons	472 mmscf (with duct burning)	24,000 tons	12,000 tons	12,000 tons 412 mmscf (with duct burning)
Footprint Area (acres)	190	46	190	225	225
By-products	-Gypsum -Ash -Flyash	None	-Sulfur(elemental) -Slag	-Sulfur(elemental) -Slag	-Sulfur (elemental) -Slag
Chemicals Produced	None	None	None	-Acetic Acid -Formaldehyde -MTBE -Urea -Methanol -Ammonia -UAN Solution -Carbon Dioxide	-Acetic Acid -Formaldehyde -MTBE -Urea -Methanol -Ammonia -UAN Solution -Carbon Dioxide
Max. Employees During Construction	1,612	550	2,155	2,898	3,362
Peak Permanent Employment	580	200	200	430	640
Suboptions Considered	-Boilers -Transportation -Solid Fuels -Coal Conveying	-Gas Pipeline -Gas Turbines	-Transportation -Gas Turbines -Solid Fuels -Coal Conveying	-Transportation -Gas Turbines -Solid Fuels -Coal Conveying -Chemicals Production	-Gas Pipeline -Transportation -Gas Turbines -Solid Fuels -Coal Conveying -Chemicals Production

Table 3. Equipment Utilization for Conversion Options

	PC	NGCC (Preferred)	IGCC	IGCC/C	Combination
Existing Bellefonte Equipment					
Unit 1 steam turbine	✓	✓	✓		✓
Unit 2 steam turbine	✓	✓	✓	✓	✓
Unit 1 natural draft cooling tower	✓	✓	✓		✓
Unit 2 natural draft cooling tower	✓	✓	✓	✓	✓
Station auxiliaries (compressed air and service water)	✓	✓	✓	✓	✓
Switchyard and transmission system	✓	✓	✓	✓	✓
Office and service buildings	✓	✓	✓	✓	✓
New Facilities Needed					
PC plant modules	4				
Gasification plants			8	4	4
Natural gas-fired advanced gas turbine and electrical generators		9			6
Synthesis gas-fired combustion turbines			8	1	1
Chemicals plants				1	1
Bottom ash, fly ash, and gypsum handling and storage facilities	✓				
Slag handling and storage facilities			✓	✓	✓
Flare stacks			✓	✓	✓
Heat recovery steam generators (HRSG) and stacks		9	8	1	7
Fuel oil storage tanks	✓	✓	✓	✓	✓
Natural gas pipeline		✓			✓
Coal receiving equipment for coal received by barge	✓		✓	✓	✓
Limestone receiving equipment	✓		✓	✓	✓
Upgraded railroad services			✓	✓	✓
Facilities for shipping chemicals				✓	✓

Figure 3. PC Power Plant



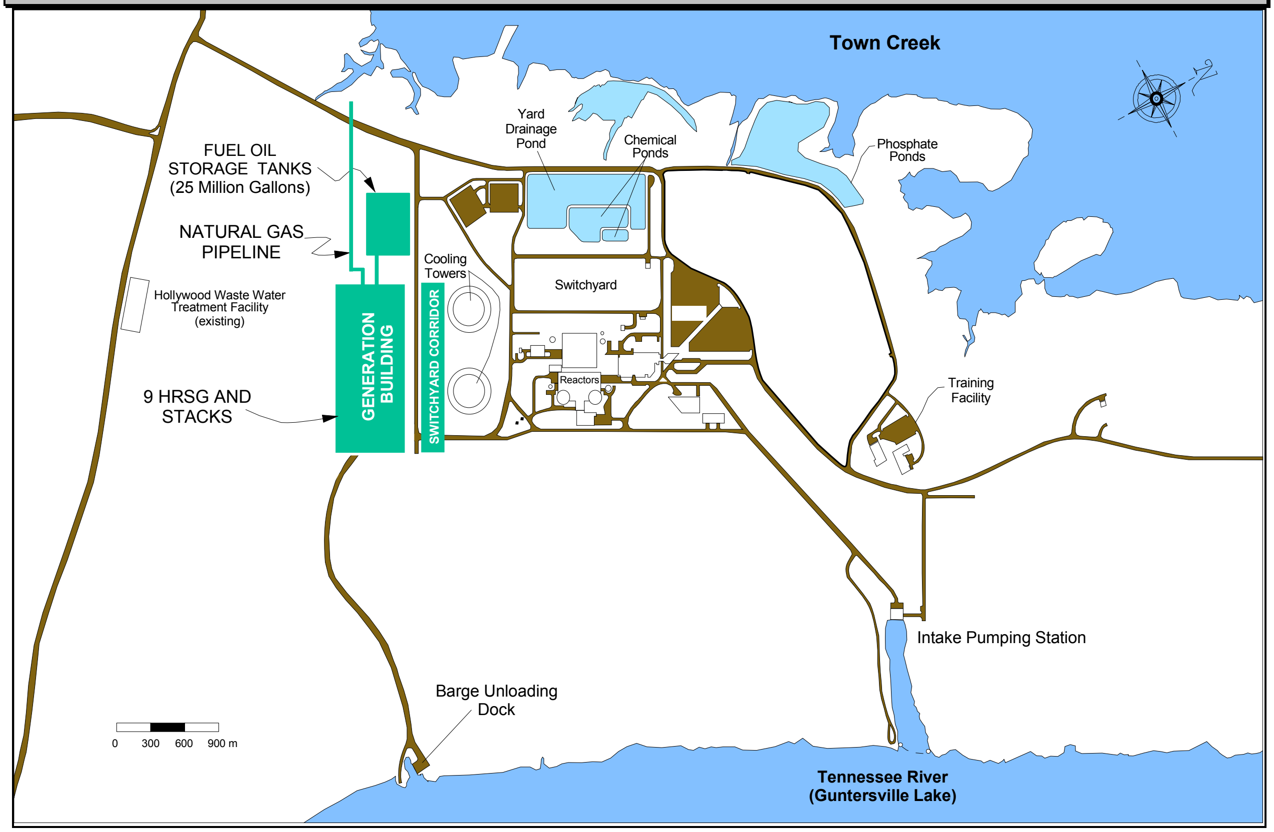
Option 2: Natural Gas Combined Cycle (NGCC) Units - Preferred Option

This option is TVA's preferred conversion option. Natural gas fired combustion turbine combined cycle units, which capture gas turbine exhaust heat to generate steam and drive a steam turbine generator, have been in common use for many years. Advanced combustion turbines are now available to boost simple cycle electrical output by about 50% above older simple cycles and yield plant efficiencies greater than 55%.

The full scale NGCC Option for the conversion of Bellefonte includes nine NGCC modules, each consisting of one gas turbine, one heat recovery steam generator (HRSG), and one stack. The steam generated in the HRSGs would be routed through new high pressure turbines to the existing Bellefonte steam turbine systems. Each one of the two Bellefonte steam turbine systems would be served by four NGCC modules. Optimization of the plant may require replacement or modification of the existing

Bellefonte steam turbines. The power plant's net output would be approximately 2,206 MW with a total natural gas consumption of 434 million standard cubic feet per day. With duct burning, production and natural gas consumption rises to 2,406 MW and 472 million standard cubic feet per day. The locations of the NGCC power block, possible pipeline access, and other features are shown in Figure 4.

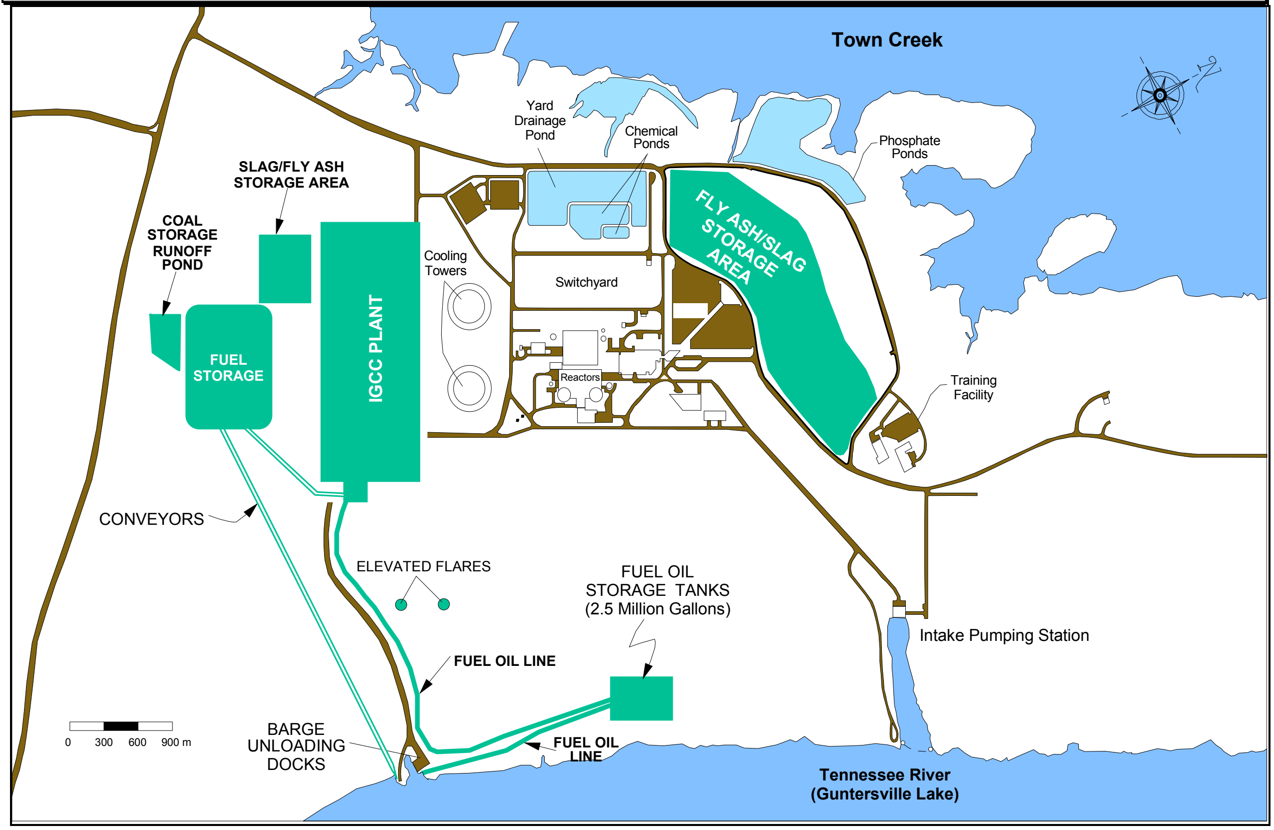
Figure 4. NGCC Power Plant



Option 3: Integrated Gasification Combined Cycle Units

The IGCC Option for Bellefonte consists of eight modules, each consisting of one coal/petroleum coke gasification plant, one combustion turbine, and one HRSG. The steam produced by the eight modules is collected and routed to Bellefonte's two existing steam turbine systems. Each steam system would be served by four modules. Within each steam turbine system, the turbine may require modification. The power plant's net output would be approximately 2,720 MW. The locations of the IGCC power block and associated solids handling and storage areas are shown in Figure 5.

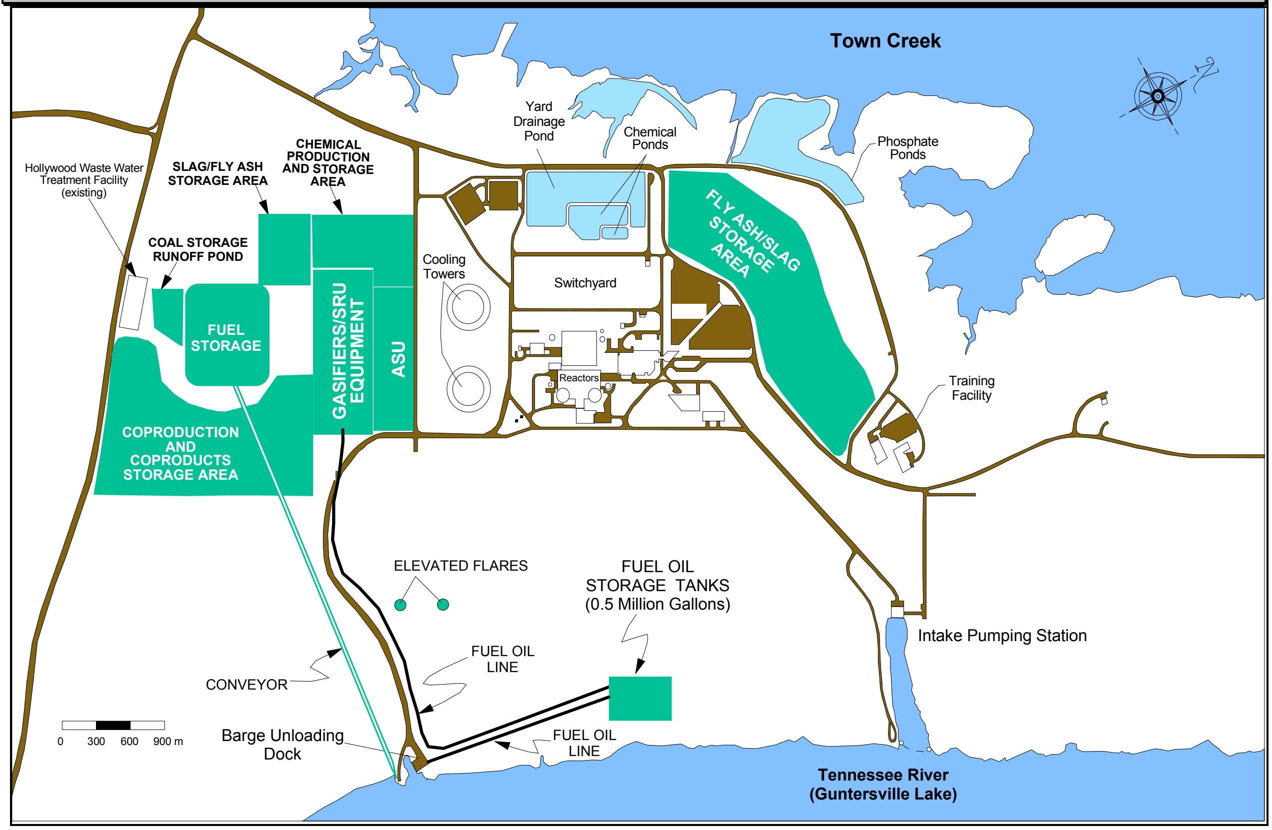
Figure 5. IGCC Power Plant



Option 4: Integrated Gasification Combined Cycle Units With Coproduction

The IGCC/C Option for Bellefonte consists of four modules, one consisting of a coal gasification plant, a combustion turbine, and a HRSG and three consisting of a coal gasification plant each and the related chemical coproduction plants. Approximately 70% of the synthesis gas produced by the four gasification plants would be routed to the chemical plants. The remaining synthesis gas would routed to the combustion turbine combined cycle units. Bellefonte's existing Unit 2 steam turbine system may be modified. The plant's net output would be approximately 450 MW. Total coal and/or petroleum coke consumption would be 12,000 tons/day. The locations of the IGCC/C power block, chemical production, solids handling areas are shown in Figure 6.

Figure 6. IGCC Power Plant with Chemical Coproduction



Several different chemicals and chemical production mixes are being considered for this option. Additional studies are underway by TVA to better assess market opportunities and economic risk associated with the production of various coproducts that can be made from syngas. Study results are not available at this time; however, a production scenario has been selected based on previous economical and technical studies which includes the following chemicals:

- Methanol,
- MTBE,
- Formaldehyde,
- Acetic acid,
- Granular urea,
- Urea ammonium nitrate,
- Ammonia, and
- Carbon dioxide

Option 5: Integrated Gasification Combined Cycle Unit, Natural Gas Combined Cycle Units and Gasification Units with Chemical Coproduction (Combination)

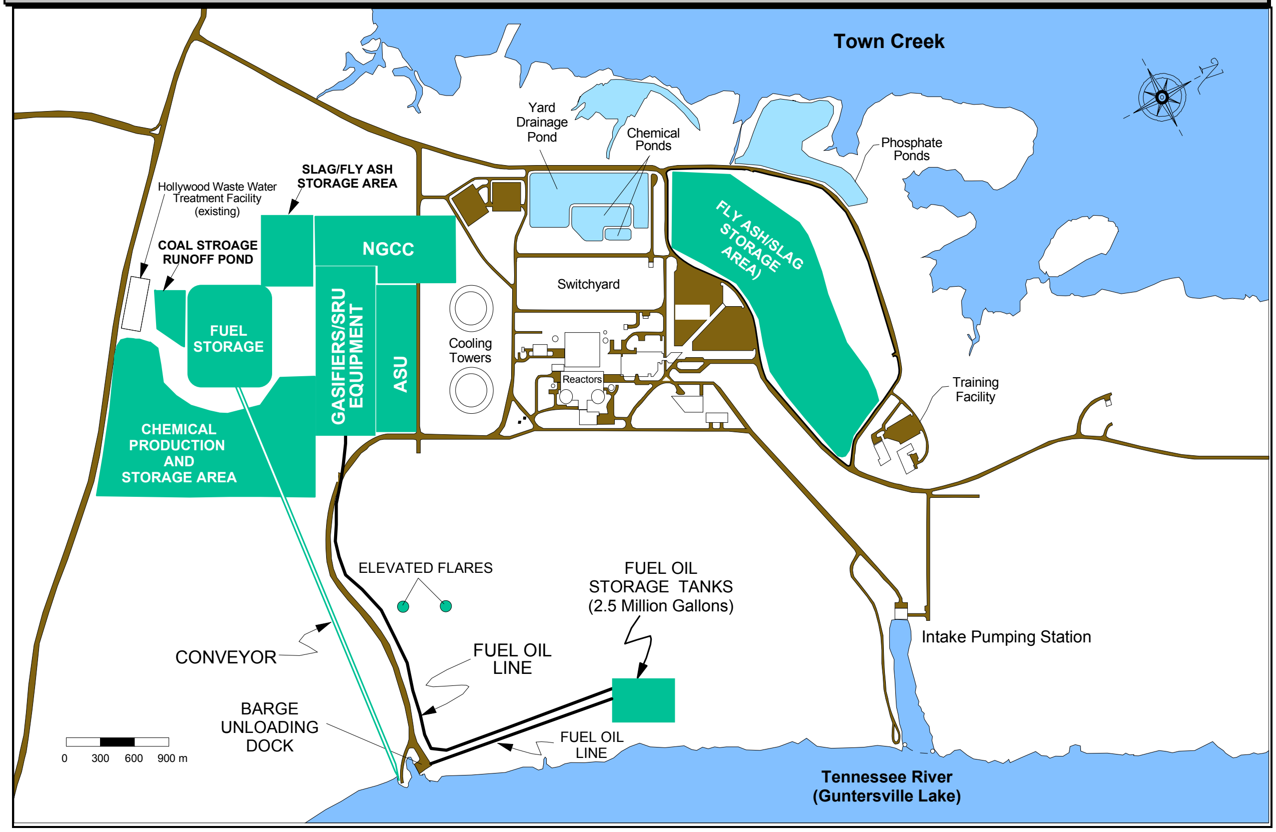
The Combination Option combines the equipment configurations of the NGCC and IGCC/C Options with the concept of phased construction. The first phase for the Combination Option would be the construction of a 335-MW NGCC module. The NGCC module would consist of a natural gas fired combustion turbine, HRSG, and an existing Bellefonte steam turbine system (Unit 2) which may be modified to accept steam from the HRSG.

After construction of the initial NGCC unit is completed, the second phase, an IGCC/C facility, would be constructed. The coproduction phase involves four modules, one consisting of a coal gasification plant, advanced combustion turbine, and HRSG, and three consisting of a coal gasification plant each and related chemical coproduction plants. Excess steam from the gasifiers is routed to the Bellefonte Unit 2 steam system.

In the final phase, a NGCC facility is added. This facility consists of five NGCC units, each with an NGCC unit containing an advanced combustion turbine and HRSG. Duct burners would be included in each HRSG to boost peak power generation. In addition, the Bellefonte Unit 1 steam system may be modified.

The steam produced by four of the NGCC units would be collected and routed to Bellefonte Unit 1 steam system. Steam from the remaining NGCC unit would be routed to Bellefonte Unit 2 steam system. The total power produced from the Combination Option would be 2,565 MW with an additional 300 MW available for peak power requirements. Figure 7 shows the locations of the new facilities required for this option.

Figure 7. Combination of NGCC and IGCC Power Plants with Chemical Coporduction



Description of Suboption Process, Control, and Design Alternatives

The analysis of alternatives in this FEIS involves three tiers. The third tier analysis involves eight suboptions that apply to one or more of the five conversion options. A suboption may be an alternative process, environmental design, or siting configuration. The final decision on many specific technology choices and operational aspects will depend on future market conditions and regulatory constraints. To allow decisionmakers to select a preferred Bellefonte conversion option without the complications of considering an array of process, design, and siting variables, certain simplifying assumptions were made with respect to these suboptions. The selection of these suboptions has important environmental implications.

There are eight suboption choice categories. Each of these is briefly explained below together with the rationale for simplifying assumptions that were made with respect to these choices.

Natural Gas Pipeline Corridor

Sufficient quantities of natural gas do not exist in the Scottsboro area for the conversion options that require use of natural gas. Given the presence of large interstate natural gas pipelines in the region, three potential natural gas pipeline corridors connecting Bellefonte with these interstate corridors were identified. One of these was from a point southeast of Bellefonte, another from a point near Hunstville, Alabama, and a third from near Jasper, Tennessee. The corridor leading northeast to Jasper was determined to be the most likely (at this time) based upon environmental constraints and the presence of parallel right-of-ways that could be available for the new line. Therefore the Conversion Options 2 and 5 assume that gas is transported via this corridor.

Fuels, Feedstocks, And By-Products Transportation Mode

Coal, petroleum coke, limestone, sulfur, slag, and coal ash are several of the high volume solids that will require transport to and from the converted Bellefonte plant. These solid fuels, feed materials, and by-products can be shipped by truck, train, or barge. The selection of the particular transportation mode for each option is dependent upon the transportation economics which relate to source, destination, and quantity of materials.

Gas Turbine

Two generations of combustion turbine technology were considered: “F” technology and advanced “G/H” technology. The use of refurbished gas turbines, modified to run in combined cycle mode, is also possible. The “F” technology was assumed to be the likely turbine selection based on preliminary consideration of electricity output, efficiency, reliability, and installed cost.

Solid Fuel

Solid fuels considered for Options 1, 3, 4, and 5 include coal, biomass, petroleum coke, coal/coke mixtures, refuse derived fuels, and char from coal refining. Biomass and refuse derived fuels were eliminated from detailed consideration because these fuels are not available in sufficient quantities for converting Bellefonte. A 50/50 mix of petroleum coke and coal was assumed to be the most likely fuel selection based upon fuel availability, costs, and process experience.

Boilers

Three types of conventionally fired boilers were considered for use at Bellefonte. In addition to pulverized coal (PC), atmospheric fluidized bed combustion (AFBC) and pressurized fluidized bed combustion (PFBC) are available. PC boiler technology was selected for the options comparison; however, the impact analyses also take into account the more efficient burning PFBC. A detailed analysis was not completed for AFBC because of its low probability of selection.

Gasifiers

Entrained flow technology was selected because it is the most widely demonstrated and commercialized type of gasification. A composite gasifier representing three commercial gasification vendor designs was used for purposes of determining emissions. The three vendors are Destec, Shell, and Texaco.

Chemical Production

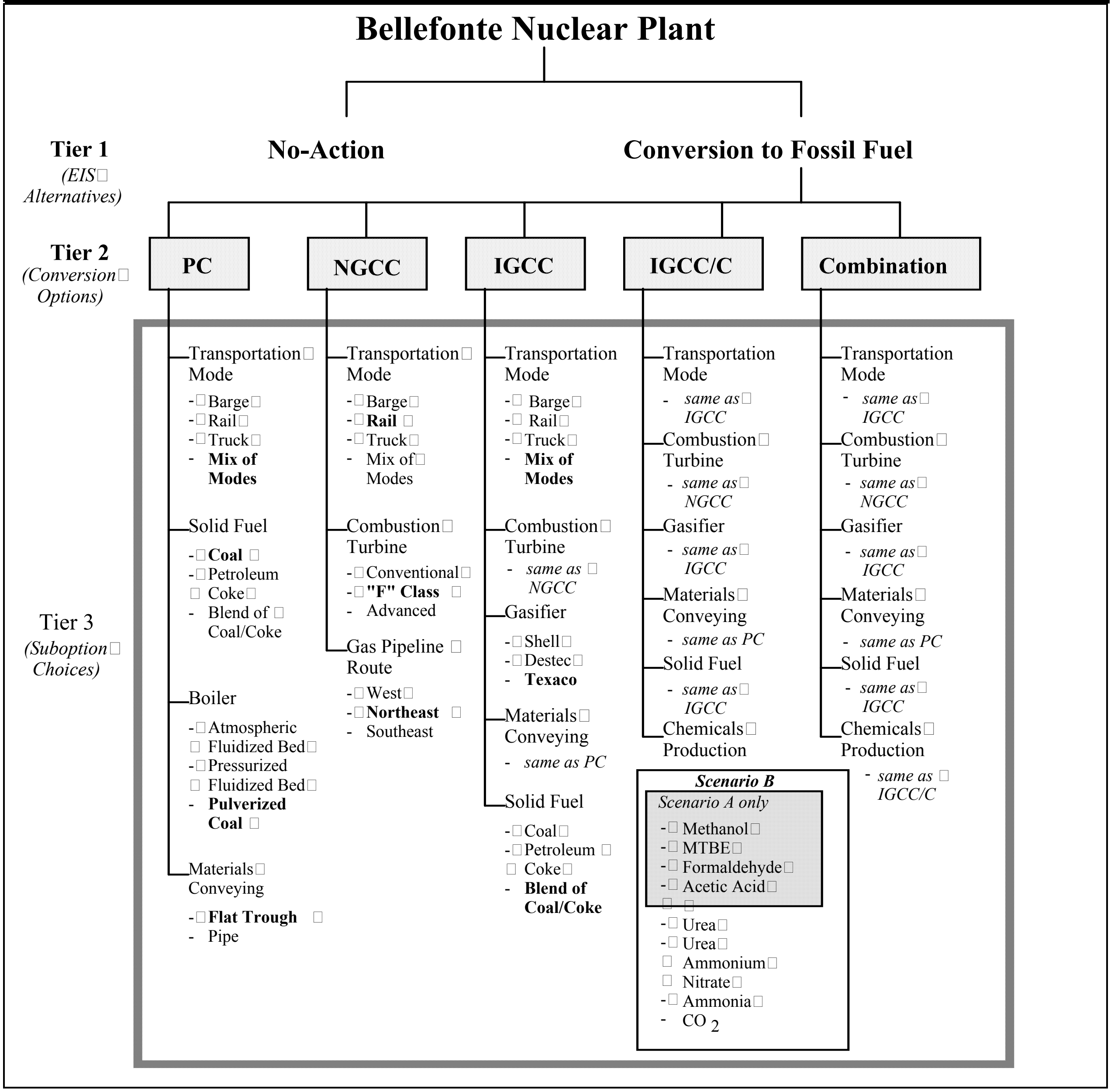
Two chemical production scenarios were considered. One involves methanol derivatives and another involves agricultural chemical production. The suite of chemicals produced from the methanol derivatives was selected for estimating environmental impacts of Options 4 and 5 because the methanol derivatives scenario offers the widest array of coproducts and the most production flexibility.

Coal Conveyance

Coal conveyance options include pipe conveyor and horizontal curve (flat trough). Flat trough conveyance was selected because of economy of operation.

Figure 8 summarizes the technologies, processes, and practices considered in this FEIS and identifies in bold print the choices which are embodied in the evaluated five conversion options.

Figure 8. Summary of Option and Suboption Choices



AFFECTED ENVIRONMENT

Existing Bellefonte Nuclear Plant facilities and structures sit on an approximately 1,600-acre peninsula bordered on three sides by the Town Creek Embayment and Guntersville Lake (Figure 9).

Figure 9. Aerial Photograph of Bellefonte

Pertinent information about environmental resources located in or near the area potentially affected by conversion of the plant to fossil fuel is summarized in Table 4.

Table 4. Affected Environmental Resources

Resource Area	Quality or Condition of Resource	Comments/Specifics
Air Quality	Good	Current air pollutant concentrations below standards, area in attainment for all criteria pollutants, plant holds minor source permit from ADEM, other significant sources located within 50 km, terrain-related site constraints caused by elevated escarpment to the SE
Geologic Setting	Good	Some karst terrain and evidence of sinkholes, low regional seismic hazard, site overburden disturbed by previous construction activities
Soils	Good	A few minor spills need remediation prior to construction, remediation plan in effect, “borrow” soil limited on site
Solid Nonhazardous Waste	Excellent	Waste disposed of in permitted offsite landfills, no active onsite disposal areas
Hazardous Waste	Excellent	Waste disposed of in permitted offsite landfills, no active onsite landfills
Surface Water	Excellent	Nearly unlimited availability from Guntersville Lake, quality parameters are within limits, plant currently holds NPDES permit, temperature of intake water exceeds upper ADEM limit periodically during summer, no discharge points (other than storm water) are allowed into Town Creek Embayment, lake use approved for water contact sports and other recreation uses
Floodplains/ Floodways	Fair	Some areas at risk to flooding which may require special flood proofing or avoidance, no floodways exist
Groundwater	Good	Groundwater level generally increases toward northeast, quality acceptable for consumption, no groundwater constraints exist
Terrestrial Ecology	Fair	Many areas previously disturbed, no substantial or unique areas of habitat exist except in the most northeast portion of the site, a heron rookery is located just upriver of Bellefonte across the inlet to the Town Creek Embayment, no threatened plant species are known to exist at Bellefonte, threatened animal species may occasionally use the site, but the habitat does not attract such species from nearby more desirable areas
Aquatic Ecology	Good	Guntersville Lake supports high quality and diverse fisheries and benthic (such as mussels) life, no aquatic species of threatened wildlife have been found in recent years near Bellefonte
Wetlands	Good	Wetlands exist along nearly the entire shoreline of Bellefonte, wetlands along the river front are fringe type and not generally of high quality, similar wetlands are widespread in Guntersville Lake
Socioeconomic	Excellent	Population is diverse and evenly distributed, diverse industry with a third of the jobs in manufacturing, good community/municipal services and housing availability, existing Bellefonte staff is about 80 people
Transportation	Good	Well served by highway, rail, and river transport systems
Land Uses	Good	1600-acre site contains partially constructed nuclear plant, land use in surrounding area is mix of residential, commercial, and agricultural
Aesthetic and Recreation	Excellent	Except for cooling towers and reactor buildings, site facilities are not visible from the river and visible only for short distances along major roadways, site is most visible to residents along Town Creek Embayment, the embayment and lake supports recreational fishing, hunting is allowed on TVA lands outside the restricted plant areas
Cultural Resources	Good	Contains three protected sites of archaeological significance. No structures of historical significance are present.
Noise Conditions	Excellent	Levels typical of a quiet rural community, no local sources of noise

The quality of the affected environment at Bellefonte is good to excellent for most resource areas. No resource area poses a significant obstacle for conversion of Bellefonte. This is because the affected area has been disturbed previously as a result of nuclear plant construction activities and because no unique terrestrial or aquatic habitat nor protected species are found on site. The site is well served by transportation and municipal services.

ENVIRONMENTAL CONSEQUENCES

Environmental resources and values were evaluated for impacts construction and operation of each proposed conversion option. Tables 5 and 6 compare impacts for each conversion option for construction and operation, respectively. Impacts are assigned a relative impact severity, using a range of pluses and minuses, as compared with the No-Action Alternative. Impact duration is described as either temporary (lasting only a few months or the period of construction) or permanent (life of the plant). Impacts are described as being positive or negative at three levels: light, moderate, or important.

This format is designed to allow the direct comparison of options but suffers from a subjective bias introduced by the consolidation of evaluation results in an unweighted framework. An example of this is the air quality impact category which forces the derivation of a single category assignment from considerations of the impacts from criteria air pollutants, hazardous air pollutants, acid rain, global warming, visibility and odors. Chapter 4 presents detailed results for a more thorough understanding of the scientific basis for impacts and ratings.

Note that impacts are presented for each of the five conversion options AND for the incremental impacts associated with a possible connected action: the construction and operation of a natural gas pipeline. Since pipeline construction would not be undertaken if supplies are brought to the Bellefonte area for reasons unrelated to Bellefonte, it was believed unfair to group these impacts with the two affected options, NGCC and Combination. By presenting pipeline impacts in this way, the reader can either consider these incremental effects or not, depending on the gas supply situation at the time a decision is made regarding a conversion option.

Table 5. Summary of Construction-Related Impacts for Each of the Five Bellefonte Conversion Options Compared to the No-Action Alternative

	CONVERSION OPTION					
IMPACT CATEGORY	1 PC	2 NGCC	Natural Gas Pipeline	3 IGCC	4 IGCC/C	5 Combination
Physical Resources						
Air Quality	T –	T –	T –	T –	T –	T –
Geologic Setting	P –	N	P –	P –	P –	P –
Soils	P –	N	T – –	P –	P –	P –
Solid Nonhazardous Wastes	T –	T –	T –	T –	T –	T –
Hazardous Wastes	T –	T –	T –	T –	T –	T –
Surface Water						
Availability	N	N	T –	N	N	N
Quality	T – – –	T –	T – –	T –	T –	T –
Floodplains/Floodways	N	N	N	N	N	N
Groundwater						
Availability	N	N	N	N	N	N
Quality	N	N	T –	N	N	N
Biological Resources						
Terrestrial Ecology	P –	P –	T –	P –	P –	P –
Aquatic Ecology	T –	N	N	T –	T – –	T – –
Wetlands	P –	N	T –	P –	P –	P –
Man-Made Environment						
Socioeconomics	T ++	T +	T +	T ++	T ++	T +++
Transportation	T – –	T –	T –	T – –	T – –	T – –
Land Use	P –	N	P –	P –	P –	P –
Aesthetics & Recreation	P – –	P –	T –	P – – –	P – – –	P – – –
Cultural Resources	N	N	N	N	N	N
Noise Impacts	T –	T –	T –	T –	T –	T –
Safety and Health	T	T	T	T	T	T

Key to impact description symbols:

N means no change or negligible impacts
+ or - means light positive or negative
++ or -- means moderate positive or negative
+++ or --- means important positive or negative
T means temporary (short-term)
P means permanent (lifetime of plant)

Note: For a particular impact area (i.e. air quality, socioeconomic, etc.), the degree of impacts are expressed only relative to the No-Action Alternative. No measure of the importance between impact areas has been applied.

Table 6. Summary of Operation-Related Impacts for Each of the Five Bellefonte Conversion Options Compared to the No-Action Alternative

	CONVERSION OPTION					
IMPACT CATEGORY	1 PC	2 NGCC	Natural Gas Pipeline	3 IGCC	4 IGCC/C	5 Combination
Physical Resources						
Air Quality	P – –	P –	N	P – –	P – – –	P – – –
Geologic Setting	N	N	N	N	N	N
Soils	N	N	N	N	N	N
Solid Nonhazardous Wastes	P –	N	N	P –	P –	P –
Hazardous Wastes	P –	P –	N	P –	P –	P –
Surface Water						
Availability	N	N	N	N	N	N
Quality	P – – –	P –	N	P – –	P – –	P – –
Floodplains/Floodways	N	N	N	N	N	N
Groundwater						
Availability	N	N	N	N	N	N
Quality	P –	N	N	P –	P –	P –
Biological Resources						
Terrestrial Ecology	N	N	P –	N	N	N
Aquatic Ecology	P – –	N	N	P – –	P –	P –
Wetlands	N	N	N	N	N	N
Man-Made Environment						
Socioeconomics	P +	P +	N	P ++	P ++	P +++
Transportation	P – –	P –	N	P – –	P – –	P – –
Land Use	N	N	P –	N	N	N
Aesthetics & Recreation	P – –	P –	P –	P – – –	P – – –	P – – –
Cultural Resources	N	N	N	N	N	N
Noise Impacts	P –	P –	N	P – –	P – –	P – –
Safety & Health	T –	T –	T –	T –	T –	T –

Key to impact description symbols:

N means no change or negligible impacts
+ or - means light positive or negative
++ or -- means moderate positive or negative
+++ or --- means important positive or negative
T means temporary (short-term)
P means permanent (lifetime of plant)

Note: For a particular impact area (i.e. air quality, socioeconomic, etc.), the degree of impacts are expressed only relative to the No-Action Alternative. No measure of the importance between impact areas has been applied.

Air Quality

Transient emissions of gaseous and particulate air pollutants will occur throughout the construction phase of any Bellefonte conversion option or variant. The impacts of these emissions on local and regional air quality will be minimal and directly dependent upon the amount of necessary new construction. Since the Bellefonte site was previously prepared for the construction of a 2,400 MW nuclear generation facility, anticipated construction-related air quality impacts will be less than for a new site. Accordingly, the overall air quality impact of construction activities for any of the proposed conversion options or variants will not be significant.

The power generation phase of all proposed options or variants will result in the emission of regulatorily significant quantities of a number of air pollutants including, most importantly, sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM10), and carbon monoxide (CO). The FEIS addresses a number of specific air quality issues in detail including potential impacts on ambient air quality standards, prevention of significant deterioration, plume blight, hazardous air pollutants, odors, cooling tower drift, cumulative impacts, air quality related values, regional haze, acidic deposition, and climate change. Where appropriate, EPA-approved dispersion models are used to assist in the assessment of these issues.

Although no ambient air quality standards would be exceeded by any option or variant, some, such as the as-configured PC Option and PFBC variant, for example, will have difficulty demonstrating compliance with short-term Prevention of Significant Deterioration (PSD) Class I and Class II increments for SO_2. In contrast, the lower overall emissions rates from the NGCC and IGCC/C Options appear substantially more innocuous from an air quality perspective.

Important issues identified in this document that will be further addressed upon selection of a conversion option or variant (during permitting) include operational contributions to:

- Class I and/or Class II PSD increments for SO_2 and PM10,
- Plume blight and regional haze in Class I areas, and
- Local and regional production of secondary air pollutants (particularly with respect to recently promulgated standards for ozone and PM2.5).

Notwithstanding the continuing importance of these issues, it should be recognized that a range of additional design and emissions control options are available to bring any of these options or variants into environmental compliance and that the construction and operating permitting process requires substantive demonstration of compliance with both source-related requirements and ambient air quality standard and increment regulations. Finally, to the extent that the operation of the constructed facility allows the less frequent use or retirement of older, less well controlled generating resources, there would be a net decline in regional pollution emissions and a corresponding improvement in regional air quality and air quality related values.

The air quality impact of the chemical operation phase for the IGCC/C and Combination Options and their variants will also be of environmental significance. However, since the preliminary design of the chemical operations calls for the combustion of purge/off-gas streams with the syngas or duct firing prior to the HRSG, emissions from chemical production will be negligible. As for generation, chemical operations will be required to demonstrate compliance with environmental laws and regulations and, if needed, additional design and emissions control options may be applied.

The impact ratings reflect the expectation that technology configurations actually constructed would include emission controls sufficient to ensure compliance with regulations and PSD increments. The important negative permanent ratings assigned to Options 4 and 5 are related to the potential air quality issues inherent in the operation of a chemical plant.

Geologic Setting

The lightly negative impacts for construction of all five options are based on the need to provide bedrock testing and grouting to reflect the typically karst terrain in this area of North Alabama.

Operation results in no negative impacts to geologic stability.

Soils

Soils of agricultural value within the footprint of each conversion option will be unavailable for future use. The lost agricultural productivity of each option is variable, depending on how much of the affected land was disturbed by previous construction/industrial activity, and how much land will be impacted by new construction/industrial activity. The preferred NGCC Option was assigned a negligible impact because of its relatively small footprint, which occurs on land already permanently impacted by present industrial facilities. The other options were assigned a lightly negative permanent impact rating because of proposed additional construction and industrial needs, such as for fuel, by-product, and waste storage/disposal. All conversion options, however, will have a negligible impact on county agricultural productivity. Soils impacts for construction of the natural gas pipeline, an effect incremental to the NGCC and Combination Options, were classified as moderate because of the disturbance to the topsoil along its route.

Operation would result in no additional land use, and no impacts would occur after construction is complete.

Solid Nonhazardous Wastes

Solid nonhazardous wastes generated during construction would be disposed off site at state-permitted landfills. The light temporary impacts shown for each conversion option are indicative of the small pressure that might be placed on off site landfill capacities during construction only.

The combustion by-product materials generated by coal utilization, Options 1, 3, 4, and 5, would be marketed to the highest extent possible. The materials that cannot be marketed, which include off-specification ash, slag, and gypsum generated during unit startups, etc., would have to be disposed in an acceptable way. For this FEIS, it has been assumed that all waste would be disposed in appropriately designed areas on the Bellefonte property. The disposal of these materials is not regulated by ADEM; however, any disposal area will conform to good engineering practice which requires that a buffer zone of low permeability soil or a liner separate the disposed solids from groundwater. The lightly negative permanent ratings for the operation of the coal-consuming options (Options 1, 3, 4, and 5) are associated with the expected generation of some off-specification solids which cannot find a market and thus requires disposal for the life of the plant. Noncombustion wastes generated during operation of all five conversion options will be taken to nearby state-permitted municipal landfills.

Hazardous Waste

The lightly negative temporary impacts during construction assigned to all options reflect the expected generation of some low-volume wastes which prove to be characteristically hazardous, thus requiring special handling, reporting, and disposal at appropriately permitted disposal facilities. These wastes would be transported to the TVA Hazardous Waste Management Facility in Muscle Shoals, Alabama, for disposal elsewhere.

Larger quantities of hazardous wastes may be produced during operation also. These wastes will be handled like the hazardous wastes from the construction phase. This resulted in the assignment of lightly permanent negative ratings to all options to reflect this minimal impact extending for the life of the plant.

Surface Water

Neither construction nor operation of the five conversion options will pose any problems from a surface water availability standpoint. The proximity and volume flow of the Tennessee River provides a ready source of raw water of sufficient quantity to meet foreseeable needs, including the operation of both natural draft cooling towers. No environmental impacts are expected.

Construction activities for the five conversion options, considering the Best Management Practices (BMPs) required for TVA construction projects, are not expected to result in any surface water quality problems. All construction activities which disturb more than five acres will require a special construction activities runoff permit. The construction storm water runoff for the PC Option will result in increased monitoring and controlling to prevent soil erosion into surface streams, thus the assignment of a higher negative temporary impact.

The impacts during operations are related to the handling, storing, and hauling activities of all materials around the site. The PC Option is highly negative mainly due to the storing of coal in the coal pile; the additional hauling of fly ash and bottom ash; and the increased acreage needed on site for storing the fly ash and bottom ash, and the wet stacking of gypsum. Erosion control structures and measures will be used by TVA to limit the impact from all five options.

Several types of limitations are typically placed on point-source waste water discharges to surface waters at the Bellefonte site, including water quality-based limits and technology-based limits for various types of sources. Typically, waste water generated as a result of power production and industrial/manufacturing operations is treated to the level needed to meet these limits before discharge. No problems are expected in the removal of pollutants to the levels required to comply with regulations, although treatability studies have not yet been completed for comingled streams, especially those for the options with chemical production (Options 4 and 5). The use of the existing cooling towers, assumed for all conversion options, may raise an issue related to the discharge of heated blowdown discharge. For several days during the course of a typical summer, the instream ambient temperature of the Tennessee River exceeds the maximum temperature allowed for discharged effluent. This situation creates an anomaly since the temperature of the extracted water would be higher than that allowed for any discharge. The approach planned for Bellefonte is to obtain a 316(a) variance for temporary releases of heated effluent during such periods. This potential problem is the reason for the moderately negative overall ratings. If a variance cannot be obtained, TVA may be required to lower the temperature of discharge water before its release to the Tennessee River, which would increase costs.

Floodplains/Floodways

For all of the conversion options, facilities would be sited to provide a reasonable level of protection from flooding. All facilities related to the production of power would be located outside the limits of the 500-year floodplain, elevation 603.1 feet above mean sea level. The only facilities located within the limits of the floodplain would be repetitive actions: the flyash and bottom ash storage area, and the gypsum storage area. Alternatives to locating the flyash and bottom ash, and gypsum storage areas within the floodplain were evaluated and documented to support a determination of “no practicable alternative” to the proposed floodplain siting. Construction of the storage areas would not adversely impact flood elevations and containment dikes would be constructed with top elevations above the 500-year flood to reduce the possibility of flooding of these areas. The project would comply with the requirements of Executive Order 11988 (Floodplain Management).

There would be no negative impacts associated with this resource area for any conversion option after construction.

Groundwater

No groundwater would be used during either construction or operation of the five conversion options; therefore, there would be no impacts to groundwater availability.

Construction of conversion facilities is expected to have no detectable impact on the quality of groundwater. For operation, a small risk of contamination is associated with each conversion option except NGCC because of the increased array of feedstocks, products, by-products, wastes, etc., to be handled, processed, and/or stored on site. Under normal circumstances, groundwater quality would be protected by use of BMPs, liners, containment vessels, and other measures. Spills and accidental releases would be decontaminated and mitigated in accordance with TVA procedures (Spill Prevention Control and Countermeasure Plan) and ADEM regulations. However, a remote possibility exists for the failure of a storage area liner or containment system during a catastrophic event or an earthquake. For these reasons, a lightly negative permanent effect has been assigned to all conversion options except NGCC, the preferred option, which involves little or no risk of groundwater contamination.

Terrestrial Ecology

Because of the small footprints and quality of the terrestrial habitat that would be disturbed by conversion of Bellefonte, impacts for this category would be insignificant. No rare plants or unique or uncommon plant communities will be affected. Much of the affected area has been previously disturbed by construction activities, therefore, no important woodlands or grasslands would be affected by construction. Animal species found in the affected area are regionally abundant. No protected species are found on the Bellefonte site. The lightly negative, but permanent, impacts of construction are related to the small habitat losses expected.

Operation will have no additional impacts on terrestrial biological resources.

Aquatic Ecology

Effects to aquatic resources are temporary during construction. Most effects would be the result of stormwater runoff and leaching from disturbed or contaminated areas, construction of a barge terminal, coal unloader facility and the lowering of the existing cooling tower blowdown diffuser pipes five feet to allow barge movement. The dredging and barge terminal construction activities would result in near field impacts on resident aquatic communities as a result of increased turbidity dislocation of mussels, fish, and other water life. Protected species have not been found in the affected portion of the Tennessee River. BMPs will be developed to avoid primary spawning seasons and to otherwise minimize impacts. The assignment of moderately negative ratings for Options 4 and 5 are related to the construction of an expanded barge terminal and loading facility for coproducts. Light temporary impacts are expected for the PFBC and IGCC Options, while no impact is expected for NGCC, the preferred option, which avoids the construction of a barge terminal.

Impacts during operation are related to the intake of raw water (entrainment and impingement of aquatic life), possible spills of raw material and products during barge loading/unloading, possible accidental introduction of fuels and products into surface water, and permitted waste water discharges. Although no significant long-term, irreversible impacts are expected to aquatic communities in this stretch of the Tennessee River, small impacts will occur for Options 1, 3, 4, and 5 (no aquatic effects are expected for the NGCC Option, the preferred option), during the course of normal operation and during spills or upsets. The ratings are related to the degree of impacts associated with the amount of water used, extent of barge loading/unloading activities, the number of fuels, chemicals and by-products involved in each option, and the relative impacts of toxic and thermal pollutants. The PC and IGCC Options were assigned a moderately negative permanent impact, whereas the IGCC/C and Combination Options were assigned lightly negative impacts, primarily on the basis of reduced coal use.

Wetlands

Options 1, 3, 4, and 5 will require the elimination of 24 acres (9.8 hectares) of aquatic bed and forested wetland islands for the construction of barge handling facilities to handle coal. This negative impact will be permanent for the life of the facility, and can be compensated through the Section 404 of the Clean Water Act mitigation process. The NGCC Option, the preferred option, will not impact any wetlands. The associated gas pipeline corridor may impact limited areas of wetlands, but those impacts will be temporary and insignificant. The lightly negative permanent impact ratings for Options 1, 3, 4, and 5 are associated with the loss of the 20 acres of wetlands.

No additional loss of wetlands would occur during operation of the converted Bellefonte.

Socioeconomics

The socioeconomic impacts for construction are primarily positive because of jobs creation and the multiplying benefit to the local economy. Ratings are directly proportional to the number of workers needed during construction for each of the five conversion options. Some negative impacts were noted for demands on housing and social services, but these were more than overcome by the increased taxes available to local governments and the influx of construction-related dollars. The rating for the Combination Option was judged to be important with an estimated peak employment of 3,447 and with 15,759 person years of employment over ten years, as compared with peak employment of 550 and with 3,008 person years over eight years associated with NGCC, the preferred option, which received a lightly positive rating.

Impacts during operation were similarly treated, except they were long term. It is expected that of the permanent work force who would move into the area (about half the work force), close to 90% would buy or rent houses and 90% would bring their families. Employment at the plant, depending on the conversion option, would result in annual wages ranging from $8.8 to over $28 million dollars annually. Impacts on social services, such as fire departments and schools are expected to be small.

Transportation

Additional traffic will be generated during the construction phase of the project. This additional traffic will be most noticed during shift changes. The capacity levels of the local highways will be negatively affected. Impacts would be most acute on Bellefonte Road and Jackson State Route 33 which lead to U.S. Highway 72. Traffic on U.S. Highway 72 would be minimally affected, but some loss of service capability, i.e., lower operating speeds and momentary stoppages, would occur on the roads leading to U.S. Highway 72. Highway impacts can be cost effectively mitigated through staggered work hours and carpooling. Impacts on railroads and river transport systems are expected to be minimal during construction. Construction of new rail access and layby tracks and upgrading of existing tracks leading to Bellefonte would be needed to support the non-NGCC Options. Moderately negative impact ratings were assigned all to conversion options except NGCC, which was lightly negative.

The impact on the local road network during operation of the converted plant would be reduced since the daily permanent work force is somewhat lower. Use of rail and river transport is expected to increase significantly, except for NGCC, because of the need to transport feedstock and products to and from the site. An increase of about 10,600 rail car units per year was projected to serve the IGCC/C and Combination Options. The existing rail system in North Alabama is not expected to experience any congestion from this additional demand. The design coal for all coal-consuming options involves the import of Illinois No. 6 coal by barge. For the IGCC-based options, a coal blend with petroleum coke is the design basis which may involve transport of supplies from the Gulf Coast area, also by barge. Additional barge traffic is estimated to be 6,073 barges annually for the PC Option. This activity places additional demand on lockages through the four dams on the Tennessee River downstream of Bellefonte. Using existing lock capacities, it was projected that the additional barges could be easily accommodated except at Kentucky Dam which currently experiences large delays. Alternatives for importing fuel include rail and barge combinations using various coal transfer terminals located on the Tennessee River but these alternatives were not evaluated in detail. The NGCC Option, the preferred option, received a lightly negative impact for this category primarily for its impacts to roadway use due to workforce commuting. Moderately negative impact ratings were assigned to other options. These impact ratings are predominately related to impacts to road, rail and barge impacts. All impacts are considered to be permanent.

Land Use

Construction would result in the consumption of a small amount of acreage currently used or available for hay production. Land requirements range from 46 acres for the NGCC Option to 225 acres for the Combination Option. However, land use impacts would on the whole be insignificant for all conversion options.

Additional impacts on land use are expected for operation under current plant operating assumptions. These include the disposal of unmarketable combustion residue. The largest impact on land use is for the PC Option, which is projected (assuming zero marketing success) to require approximately 300 acres for 20 years of full operation.

Aesthetic and Recreation

Construction activities are typically viewed as transient disturbance of the environment from an aesthetic and recreation standpoint. However, several aspects of each of the conversion options will involve a lasting visual reminder of changes at the Bellefonte site. These include the new mooring cells, barge terminals, and coal transfer facilities along a 4,500-foot stretch of the Tennessee River constructed to serve the non-NGCC Options and construction of combustion flue gas stacks ranging in number from two to twelve and in height from 200 to 580 feet. A fuel oil storage tank is associated with two of the five options. These facilities will be noticeable to the casual observer from long distances in any direction and from a considerable stretch of U. S. Highway 72. Lightly negative permanent ratings were assigned to NGCC, TVA's preferred option, because of the avoidance of barge facilities and fuel tanks. Permanent moderately negative ratings were assigned to PC, while the options involving IGCC were given important negative ratings, partly because of the additional structures involved.

Operation of all conversion options would result in the emission of air pollutants and noise from combustion turbines (except for PC) and the cooling tower. The flare stack (not used for NGCC or PC) would probably be easily heard at the plant boundary. Depending on conditions, the flame from the flare stack would be visible for large distances, especially at night. Plumes from combustion stacks could be visible on some occasions, but opacity is expected to be minimal because of the advanced air pollutant control technologies to be used. Also, a negative impact along Jackson County Road 33 would be realized from the resultant truck traffic associated with the transportation of some raw materials to the plant and by-products to markets. Important negative permanent impacts are expected from Conversion Options 3, 4, and 5, while the PC Option impacts were rated as moderate. The NGCC Option was given a rating of lightly negative.

Cultural Resources

Previous surveys of the Bellefonte site identified five archaeological sites. However, none of these sites are within the area affected by the construction of any of the five conversion options and therefore there should be no impacts. All structures associated with the original town site of Bellefonte eligible for placement on the National Register of Historic Places were removed prior to the conversion project. Consequently, there are no impacts to structures with potential historical significance for construction.

Operation of a converted Bellefonte plant will not impact cultural resources.

Noise Impacts

Routine construction activities associated with all five conversion options will generate noise that is predicted to have no impact except a minor increase in background sound levels for Options 2 through 5 at the nearest fence line. For all options, there will be short periods in which steam lines are cleaned out prior to plant operation in which noise levels would be very loud at the nearest fence line and nearest residence. These are unavoidable, short-term, temporary impacts that will be mitigated through notification of employees and nearby residents to avoid the "startle effect" on residents and hearing damage to employees near the power block.

Routine operating conditions, even at full capacity, would not result in important adverse impacts to sensitive off-site receptors from any of the five conversion options. Noise modeling of sources in the power block, at the barge dock, and at the coal pile indicates that during routine operating conditions there will be substantial increases in noise levels at the nearest fence line for all but TVA's preferred option, (NGCC); however, none of the options result in levels greater than the 65 Ldn threshold of significant adverse impacts. The PC Option was predicted to result in the greatest increase in noise levels.

Three of the five conversion options—IGCC, IGCC/C, and Combination—involve the use of flares. During the times when flaring is occurring (estimated to be no more than one hour per event and no more than 90 events per year) no significant adverse impacts are expected although the flaring would result in a substantial increase in sound levels at all receptors. By scheduling gasification start ups and shut downs for daylight hours, TVA can mitigate the unavoidable impacts of flaring. Finally, there will be noise impacts from truck traffic hauling combustion by-products from the plant. These impacts are greatest for the PC conversion option and are absent from the NGCC Option.

For these reasons, the NGCC Conversion Option is the least impactive overall with the other four options resulting in minor impacts with occasional moderately high levels from flaring and/or truck traffic.

Safety and Health

Construction and operation of any large and complex facility involving a wide array of crafts and personnel interaction poses some risk to the safety of workers. Impacts to safety of workers would be minimized by TVA's safety program which requires workplace standards, workplace accident investigation, emergency response programs, individualized training, job safety planning, training, employee involvement, and workplace inspections, monitoring, and audits. Lightly negative temporary impacts were assigned to each conversion option.

Electromagnetic Fields (EMF)

TVA's standard location practice has the effect of minimizing public exposures to transmission line EMF. The transmission line route selection team used a constraint model that placed a 300-foot radius (91.4 meter) buffer around occupied buildings. For schools, a 1200-foot (366-m) buffer was used. The purpose of these buffers was to reduce potential land use conflicts with yard trees, outbuildings and ancillary facilities, and to reduce potential visual impacts and possible EMF-related controversy. Though not absolute location constraints, these buffers weigh heavily in location decisions, influencing selection of route options and alignments. Because EMF diminishes so quickly with distance, the routing of transmission lines using constraint buffers effectively reduces potential public exposure to EMF.

Health Effects from the Fuel Cycle

For the PC, IGCC, and IGCC/C Options, coal would be the primary fuel source. For the acquisition of coal, significant reductions in rates of mining deaths per number of employee hours worked have been achieved over the last few years in the mining industry. A combination of factors has been responsible for the dramatic safety gains in the U. S. mining industry since the turn of the century. The rate of coal mining deaths decreased from about 0.20 fatalities per 200,000 hours worked by miners (or one death per million production hours) in 1970 to about 0.07 fatalities in 1977 and an average of 0.04 fatalities for the 1990-94 period.

Natural gas would be the primary fuel for the NGCC and Combination Options. Natural gas extraction is technologically simpler and less labor intensive than coal mining, consequently, health effects are fewer and less pronounced.

Impacts Due to Accidents

The accident scenarios evaluated in Section 4.2.18.3 are considered to be rare occurrences. The approach used in this section is to identify reasonably foreseeable accident scenarios and, using guidance provided by pertinent regulations which affect the operation of facilities like those described herein, develop information which would provide residents living near Bellefonte a better understanding of possible health risks. As a federal agency, TVA is not subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) or the Occupational Safety and Health Act. However, TVA is committed to complying with regulations to protect public health and worker safety. As a matter of policy and consistent with Executive Order 12856, TVA complies with EPCRA to the extent other utilities do. TVA must internally comply with Occupational Safety and Health Administration substantive requirements as these are incorporated in its occupational health and safety manual. All facilities would be designed and constructed to prevent hazards from impacting the environment and public health. In addition, TVA would develop and implement safety programs with the primary goals of minimizing potential for accidents and protection of the public and environment.

VOLUME I

GLOSSARY

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VOLUME II

List of Figures

°C ....Degrees Celsius
°F..................................Degrees Fahrenheit
μg/g ....Micrograms Per Gram
μg/kg ....Micrograms Per Kilogram
μg/L..............................Micrograms Per Liter
$\mu g/m^2/yr$ ....Micrograms Per Square Meter Per Year
$\mu g/m^3$ ....Micrograms Per Cubic Meter
μm ....Micrometer (micron)
μmhos...........................Micromhms
μmhos/cm.....................Micromhos Per Centimeter
AADT ....Average Annual Daily Trips
AAQS............................Ambient Air Quality Standard
ACGIH..........................American Conference of Governmental Industrial Hygienists
ADEM...........................Alabama Department of Environmental Management
ADT ....Average Daily Traffic
AFBC............................Atmospheric Pressure Circulating Fluidized Bed Coal Combustion
AGL ....Above Ground Level
AMSL ....Above Mean Sea Level
ANSI ....American National Standards Institute
AQRV ....Air-Quality Related Value
ASTM ....American Society for Testing and Materials
BACT............................Best Available Control Technology
BAT ....Best Available Technology
BLIS..............................BACT/LAER Information System
BMP ....Best Management Practices
BOD ....Biochemical Oxygen Demand
BOD_5.............................5-Day Biochemical Oxygen Demand
Btu.................................British Thermal Unit
Btu/gal...........................British Thermal Units Per Gallon
Btu/lb ....British Thermal Units Per Pound
Btu/scf...........................British Thermal Units Per Standard Cubic Foot
CAA ....Clean Air Act
$CaCO_3$ ....Calcium Carbonate
$CaSO_4$............................Calcium Sulfate - Gypsum
CaS ....Calcium Sulfide
Ca/S Ratio ....Calcium to Sulfur ratio
CC ....Combined Cycle
CCT..............................Clean Coal Technology
CDBG ....Community Development Block Grant
CE ....Combustion Engineering
CEQ ....Council on Environmental Quality
CERCLA.......................Comprehensive Environmental Response, Compensation, and Liability Act, 1980
CFC ....Chlorofluorocarbons
CFR...............................Code of Federal Regulations
cfs.................................Cubic Feet Per Second
CG ....Coal Gasification
CH_4...............................Methane
cm/sec ....Centimeters Per Second
CO ....Carbon Monoxide

CO_2................................Carbon Dioxide
COD..............................Chemical Oxygen Demand
Combination..................Combination of NGCC and IGCC/C
CORMIX.......................Cornell Mixing Zone Expert System
COS...............................Carbonyl Sulfide
CSM..............................Cubic Feet Per Second Per Square Mile
CT.................................Combustion Turbine
CTC...............................Control Technology Center
CTCC............................Combustion Turbine Combined Cycle
CWA.............................Clean Water Act
CWM............................Clean Waste Management
DASHO.........................Designated Agency Safety and Health Offical
dB..................................Decibel
DEIS..............................Draft Environmental Impact Statement
DEM..............................Digital Elevation Model
DLN..............................Dry Low NO_x
DNL..............................Day-Night Average Sound Levels
DO.................................Dissolved Oxygen
DOT..............................Department of Transportation
DSN..............................Discharge Source Number
EA.................................Environmental Assessment
*E*Hg...............................Expected Mercury Concentrations
EIS................................Environmental Impact Statement
EMF..............................Electromagnetic Fields
EMP..............................Environmental Monitoring Plan
EMPO...........................Environmental Monitoring Plan Outline
EMS..............................Emergency Medical Services
EO.................................Executive Order
EPA...............................U.S. Environmental Protection Agency
EPRCA..........................Emergency Planning and Community Right-to Know Act
EPRI..............................Electric Power Research Institute
ESA...............................Endangered Species Act
ESP................................Electrostatic Precipitator
FAA..............................Federal Aviation Administration
FEIS..............................Final Environmental Impact Statement
FEMA...........................Federal Emergency Management Agency
FERC............................Federal Energy Regulatory Commission
FGD..............................Flue Gas Desulfurization
FHWA...........................Federal Highway Administration
FICON..........................Federal Interagency Committee on Noise
FICUN..........................Federal Interagency Committee on Urban Noise
FIPR..............................Florida Institute for Phosphate Research
FLM..............................Federal Land Manager
FONSI...........................Finding Of No Significant Impact
fps..................................Feet Per Second
FR..................................Federal Register
FRP...............................Flood Risk Profile
ft....................................Foot
ft-bls..............................Feet Below Land Surface

ft/day ....Feet Per Day
ft/ft ....Feet Per Foot
ft-msl ....Feet Above Mean Sea Level
ft-NGVD ....Feet Above National Geodetic Vertical Datum of 1928
ft^2/day ....Square Feet Per Day
ft^3/day ....Cubic Feet Per Day
ft^3/day/ft^3 ....Cubic Feet Per Day Per Cubic Foot
ft^3/hr ....Cubic Feet Per Hour
FTE ....Full-Time Equivalent
g ....Gram
g/m^2 ....Grams Per Square Meter
g/m^2/yr...........................Grams Per Square Meter Per Year
g/sec ....Grams Per Second
GATX ....General American Transportation Corporation
GC-MS..........................Gas Chromatograph-Mass Spectrometer
GEP ....Good Engineering Practice
gpd ....Gallons Per Day
gpm ....Gallons Per Minute
gpm/ft............................Gallons Per Minute Per Foot
gpm/ft^2...........................Gallons Per Minute Per Square Foot
gr ....Grain
gr/scf ....Grains Per Standard Cubic Foot
GWH ....Gigawatt Hours
H_2 ....Hydrogen
H_2S ....Hydrogen Sulfide
H_2SO_4 ....Sulfuric Acid
HCN/COS ....Hydrogen Cyanide/Carbonyl Sulfide
HEAST..........................Health Effects Assessment Summary Tables
HEP ....Habitat Evaluation Procedure
HGCU ....Hot Gas Cleanup
HHV ....Higher Heating Value
HRS..............................Health and Rehabilitative Services
HRSG ....Heat Recovery Steam Generator
HSH ....Highest-Second Highest
HUD .............................U.S. Department of Housing and Urban Development
HWSF ....Hazardous Waste Storage Facility
Hz.................................Hertz (cycles per second)
IAF ....Induced Air Floatation
ICC ....Interstate Commerce Commission
IDLH ....Immediately Dangerous to Life and Health
IGCC ....Integrated Gasification Combined Cycle
IGCC/C ....Integrated Gasification Combined Cycle w/Chemical Coproduction
IRIS ....Integrated Risk Information System
ISC ....Industrial Source Complex Model
ISC2 ....Industrial Source Complex Model 2
ISC3 ....Industrial Source Complex Model 3
ISCLT2 ....Industrial Source Complex Long-Term Model
ISCST2..........................Industrial Source Complex Short-Term Model
IWT ....Industrial Wastewater Treatment

kg ....Kilogram
kg/km^2 ....Kilograms Per Square Kilometer
km ....Kilometer
km^2 ....Square Kilometer
kV/m ....Kilovolts Per Meter
kV..................................Kilovolt
KW, kW ....Kilowatt
kWh...............................Kilowatt-hour
LAER ....Lowest Achievable Emission Rate
lb ....Pound
lb/ft^3 ....Pounds Per Cubic Foot
lb/gal ....Pounds Per Gallon
lb/hr ....Pounds Per Hour
lb/mmBtu ....Pounds Per Million British Thermal Unit
lb/MWh ....Pounds Per Megawatt Hour
lbs ....Pounds
lb/yr ....Pounds Per Year
L_{eq}..................................Equivalent Sound Level
$L_{eq(l)}$ ....Equivalent Sound Level for a l-hour Period
$L_{eq(24)}$ ....Equivalent Sound Level for a 24-hour Period
LHV ....Lower Heating Value
L_{max}................................Maximum Level (of Noise)
LOC ....Level of Concern
LOLP ....Loss of Load Probability
LOS ....Level of Service
LSFO.............................Limestone Forced Oxidation
m ....Meter
m^2 ....Square Meter
m^3/yr.............................Cubic Meters Per Year
mm ....Million
M-l ....Code for Industrial Land Use
MCL..............................Maximum Contaminant Level
MCR..............................Maximum Current Rating
MDEA...........................Methyl Diethanolomine
MDL..............................Method Detection Limit
mG ....Milligauss
mg ....Milligram
mgd ....Million Gallons Per Day
mg/kg ....Milligrams Per Kilogram
mg/L..............................Milligrams Per Liter
mg/m^2 ....Milligrams Per Square Meter
$mg/m^2/yr$ ....Milligrams Per Square Meter Per Year
mi^2 ....Square Mile
MIR ....Maximum Individual Risk
MIT ....Mechanical Integrity Test
mL ....Milliliter
mmBtu...........................Million British Thermal Units
mmBtu/hr ....Million British Thermal Unit per hour
mmcf ....Million Cubic Feet

mmscf............................Million Standard Cubic Feet
MODFLOW..................Modular Three-Dimensional Finite Difference Groundwater Flow Model
mph ....Miles Per Hour
MPN..............................Most Probable Number
MSDS............................Material Safety Data Sheets
MSA..............................Metropolitan Statistical Area
msl.................................Mean Sea level
MSW.............................Municipal Solid Waste
MTBE ....Methyl Tertiary Butyl Ether
Mton..............................Thousand Tons
MW ....Megawatts, electrical
N_2O ....Nitrous Oxide
NAAQS.........................National Ambient Air Quality Standards
$NaHCO_3$ ....Sodium Bicarbonate
NAS ....National Audubon Society
NCA ....Noise Control Act
NEC ....National Electric Code
NEHRP ....National Earthquake Hazards Reduction Program
NEPA ....National Environmental Policy Act
NESC ....National Electrical Safety Code
NESHAPS.....................National Emission Standards for Hazardous Air Pollutants
NFPA ....National Fire Protection Association
ng ....Nanogram
NGCC ....Natural Gas Combined Cycle
NH_3 ....Ammonia
NOA..............................Notice of Availability
NOI ....Notice of Intent
NO_x ....Nitrogen Oxides
NPDES..........................National Pollutant Discharge Elimination System
NPS ....National Park Service
NPV ....Net Present Value
NRC ....Nuclear Regulatory Commission
NSPS.............................New Source Performance Standards
NSR...............................New Source Review
NTU ....Nephelometric Turbidity Units
NWA.............................National Wilderness Area
NWI ....National Wetlands Inventory
NWS..............................National Weather Service
O_2 ....Oxygen
O_3 ....Ozone
OFA ....Overfire Air
OSHA............................Occupational Safety and Health Administration
OTAG ....Ozone Transport Assessment Group
PAH ....Polynuclear Aromatic Hydrocarbon
PC..................................Pulverized Coal
PCB...............................Polychlorinated Biphenyls
pCi/L ....Pico Curies Per Liter
PFBC.............................Pressurized Fluidized Bed Coal Combustion
PhM...............................Phosphate Mining

PHX ....Primary Heat Exchanger
PM2.5............................Particulate Matter
PM10.............................Particulate Matter less than or equal to 10 micrometers in diameter
POM..............................Polycyclic Organic Matter
PON ....Program Opportunity Notice
POTW ....Publicly-Owned Treatment Works
PPA ....Pollution Prevention Act
ppb ....Parts Per Billion, volume
ppm ....Parts Per Million, volume
PPP................................Pollution Prevention Plan
ppt ....Parts Per Trillion, volume
PSD ....Prevention of Significant Deterioration
PSES ....Point-Source Evaluation Section
psig................................Pounds Per Square Inch Gauge
Pt-Co ....Platinum Cobalt
PVC...............................Polyvinyl Chloride
PWRR ....Present Worth Revenue Requirements
PWS ....Public Water Supply
QUAL2E ....Enhanced Stream Water Quality Model
R-l ....Code for Residential Land Use
Ra ....Radium
RAL ....Restricted Awards List
RC ....Rural Conservation
RCC ....Rural-Cluster Center
RCRA............................Resource Conservation and Recovery Act
RDF...............................Refuse Derived Fuel
RH ....Relative Humidity
RMS ....Root Mean Square
RO ....Reverse Osmosis
ROD ....Record of Decision
ROW ....Right-of-Way
RSC ....Radiant Syngas Cooler
RTDM ....Rough Terrain Diffusion Model
SAR...............................Staff Analysis Report
SARA ....Superfund Amendments and Reauthorization Act
SCA...............................Site Certification Application
scf..................................Standard Cubic Foot
SCGP-1 ....Shell Coal Gasification Process Pilot Plant
SCR ....Selective Catalytic Reduction
SCS ....Soil Conservation Service
SEL ....Sound Exposure Level
SHPO ....State Historic Preservation Officer
SIA ....Significant Impact Areas
SIC ....Standard Industrial Classification
SMSA............................Standard Metropolitan Statistical Area
SNCR ....Selective Noncatalytic Reduction
SO_2 ....Sulfur Dioxide
SO_3 ....Sulfur Trioxide
SO_X................................Sulfur Oxides

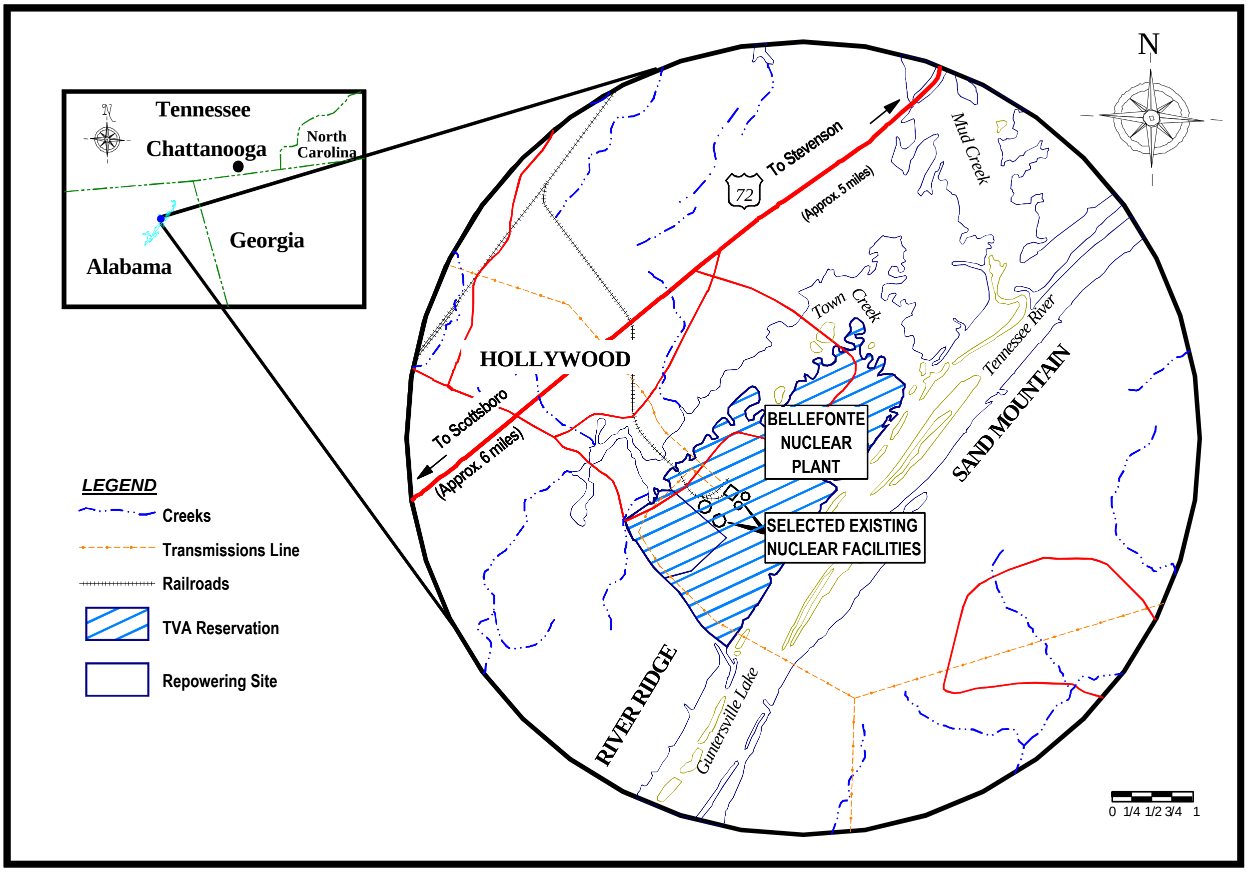
SPCC.............................Spill Prevention Control and Countermeasure Plan
SPOC ....Single Point Of Contact
SSFI ....Shell Synthetic Fuels, Inc.
ST..................................Steam Turbine
STORET ....Storage and Retrieval of Parametric Data
stpd................................Short Tons Per Day
SU ....Standard Units
TCLP.............................Toxicity Characteristic Leaching Procedure
TDS...............................Total Dissolved Solids
TLV-TWA ....Threshold Limit Value-Time Weighted Averages
TN ....Total Nitrogen
TP..................................Total Phosphorus
tpd ....Tons Per Day
TPR ....Total Population Risk
tpy ....Tons Per Year
TRM..............................Tennessee River Mile
TSP ....Total Suspended Particulates
TSS ....Total Suspended Solids
TVA ....Tennessee Valley Authority
UAMV-PIG..................Urban Airshed Model V-Plume-in-Grid
UAN..............................Urea Ammonium Nitrate
UIC................................Underground Injection Control
URF...............................Unit Risk Factor
U.S. ....United States
USACE .........................U.S. Army Corps of Engineers
USC...............................U.S. Code
USGS ............................U.S. Geological Survey
VISCREEN...................Visual Impact Screening
VMT..............................Vehicle Miles Traveled
VOC ....Volatile Organic Compound
WET..............................Whole Effluent Toxicity
WQ................................Water Quality
WUCA ....Water Use Caution Area
WUP ....Water Use Permit
WWF.............................World Wildlife Fund
Yrs.................................Years

1.0 PURPOSE AND NEED FOR PROPOSED ACTION

1.1 Project Overview

The Tennessee Valley Authority (TVA) proposes to complete the unfinished TVA Bellefonte Nuclear Plant as a fossil-fueled power plant. Bellefonte Nuclear Plant is located near the cities of Hollywood and Scottsboro in northeast Alabama (see Figure 1.1-1). The proposed action is conversion, modification, and addition of equipment; the construction of new facilities; and the subsequent operation of the Bellefonte facility as a power plant with an electricity generating capacity of up to 2,895 megawatts (MW), depending on the conversion option selected. Among the fossil fuels considered were natural gas, coal and petroleum coke. Plant conversion technologies considered in this Final Environmental Impact Statement (FEIS) included coal gasification, combustion turbine combined cycle, fluidized bed combustion, pulverized coal, and chemicals coproduction.

Figure 1.1-1 Location of Bellefonte Nuclear Plant



Bellefonte is located on an approximately 1,600-acre site adjacent to the Tennessee River near Hollywood, Alabama. The two-unit nuclear generating plant has a rated capacity of 1,212 MW per unit. Major components of the nuclear steam supply system were supplied by Babcock & Wilcox, and the turbine generators, by Brown Boveri. Bellefonte is a third generation design TVA nuclear plant that takes full advantage of lessons learned from construction, operation, and maintenance of other TVA plants.

The Nuclear Regulatory Commission (NRC) issued the construction permit for Bellefonte in December 1974. By 1988, Unit 1 was 90 percent complete, and Unit 2 was about 58 percent complete. On July 29, 1988, TVA notified NRC that Bellefonte was being deferred as a result of a lower load forecast for the near future. The plant remained in deferred status until March 23, 1993, when TVA notified NRC of plans to complete Bellefonte Units 1 and 2. TVA's decision to complete the Bellefonte plant came after three years of extensive studies that concluded completion of the facility as a nuclear power plant was viable. Subsequently, in December 1994, the TVA Board announced that Bellefonte would not be completed as a nuclear plant without a partner, and put further construction activities on hold until a comprehensive evaluation of TVA's power needs was completed.

TVA evaluated its system-wide power needs and a range of demand-side and supply-side options for meeting those needs in a Programmatic Environmental Impact Statement, Energy Vision 2020, published December 21, 1995.[1] Energy Vision 2020 was a comprehensive analysis, with extensive public involvement, of long-term and short-term actions TVA could take to provide flexible and competitive energy choices for the future.

Recommendations contained in Energy Vision 2020 affecting Bellefonte include the continued deferral of its completion as a nuclear powered facility in the absence of partners who would share the investment risk associated with its construction. Energy Vision 2020's short-term action plan stated TVA's intent to consider opportunities for the conversion of facilities at Bellefonte to allow production of electricity from combustion of fossil fuels.

The actions being contemplated for Bellefonte will be considered along with two other projects which could lead to increasing TVA's electrical generating capacity before the Bellefonte conversion would be completed: the Red Hills Power Project in Choctaw County, Mississippi, and the option purchase agreement for Batesville Generating Facility, near Batesville, Mississippi.

The Red Hills Power Project, originally proposed to TVA in 1993, involves the cooperative efforts by the State of Mississippi, Phillips Coal Company, and Tractebel Power Incorporated, to develop and construct a 450-MW lignite coal-fueled power plant and adjacent lignite mine. Among the supply-side options evaluated in Energy Vision 2020 were two lignite coal-fueled configurations, one a TVA-sponsored plant and one that would be built and operated by an independent power producer. In February 1996, TVA agreed to support this project through the signing of five-year contract extensions with local distributors and cooperatives. TVA has signed a power purchase agreement contingent on environmental review.

A second project is underway that may provide some of the power needed in the short term by TVA. In June 1996, TVA entered into an Option Purchase Agreement with LSP Energy Limited Partnership for the right to purchase 750 MW of power produced by a natural gas fueled power plant near the City of Batesville, Mississippi. LSP Energy may construct as much as 1,110 MW of capacity, but output exceeding 750 MW would be offered to TVA or other utilities for distribution on the open market since this increment is not covered in the agreement. The Draft EIS for this project has been issued. Commercial operation of the plant is proposed in early 2000.

This EIS is being prepared to help TVA decisionmakers and the public understand the environmental consequences of converting Bellefonte. The FEIS addresses the conversion options listed in Energy Vision 2020 and presents the results of environmental evaluations of options and alternatives offering the best economic return and acceptable technical difficulty for implementation at Bellefonte. Table 1.1-1 shows key milestones for the preparation of the EIS.

Table 1.1-1 Milestones for Bellefonte Conversion EIS

Issue Notice of Intent	April 29, 1996
Public scoping meeting	May 16, 1996
Release Draft EIS	March 13, 1997
Public hearing on Draft EIS	April 8, 1997
Close of public comment period	May 5, 1997
Release Final EIS	October 1997
Issue Record of Decision	November 1997

1.2 EIS Overview

This FEIS has been prepared by TVA in accordance with the National Environmental Policy Act (NEPA) of 1969 and is consistent with subsequent regulations published by the Council of Environmental Quality.[2] TVA's NEPA procedures are described in TVA Instruction IX (Environmental Review), entitled "Procedures for Compliance with the National Environmental Policy Act," dated April 12, 1983.[3] Instruction IX indicates that construction of major power generating facilities would normally require preparation of an EIS.

The EIS relies on and tiers from information contained in two other documents prepared by TVA. First, it has been determined that the FEIS published in 1974 for the completion of Bellefonte as a nuclear plant remains adequate to support the completion of Bellefonte as a nuclear plant.[4] Given the passage of time and possible changes in environmental conditions at Bellefonte, the 1974 FEIS was reviewed in 1993 by TVA staff.[5]

Second, the completion and publication of Energy Vision 2020 provides a programmatic EIS umbrella for this FEIS. Incorporating Energy Vision 2020 by reference allows treatment of strategies and programmatic issues involving the use of Bellefonte to be brief. Adequate information was presented in Energy Vision 2020 to support the initiation of conversion activities at Bellefonte. The discussion of the purpose and need for Bellefonte conversion in the following section relies heavily upon information contained in Energy Vision 2020. Frequent references are made to Energy Vision 2020 to avoid the presentation of lengthy and repetitive information in this FEIS. This FEIS is a site specific analysis of possible actions recommended in Energy Vision 2020 for conversion of Bellefonte.

TVA has embarked on a study of conversion options to identify which options offer the best investment opportunities and least financial risk. The results of that study will become available at about the same time that the FEIS is finalized. The completion of these two efforts will allow TVA to make an investment decision based on the best and most timely economic, technical, and environmental information.

TVA formally began the NEPA process with the publication of a Notice of Intent (NOI) to prepare an EIS and to conduct a public scoping meeting. The NOI was published in the *Federal Register* on April 29, 1996, (61 FR 18767). Public notices announcing the public scoping meeting were published in the Chattanooga Times on May 6, 1996, the Florence Times Daily on May 7, 1996, the Huntsville Times on May 3, 1996, and the Knoxville News Sentinel on May 3, 1996. An orientation of TVA plans and activities associated with the completion of Bellefonte was provided to invited community leaders and elected officials on May 9, 1996. A public scoping meeting was held on May 16, 1996, at the Scottsboro High School, Scottsboro, Alabama. At the public scoping meeting, members of the public were invited to attend an overview of possible Bellefonte completion activities and invited to provide oral comments and/or to submit written comments by the close of the scoping period, May 29, 1996. The meeting was attended by 31 individuals, nearly all of whom participated in informal breakout sessions designed to elicit input to the preparation of the FEIS. Additionally, three individuals and organizations submitted written comments for inclusion in the public record. A Public Scoping Document was prepared.[6]

A courtesy briefing describing the impending release of the DEIS, the review and comment period, and public meeting plans to obtain public inputs was provided on March 6, 1997, by TVA staff to local elected officials, congressional staff, members of the print media, and community leaders from Jackson County. On March 6, 1997, the DEIS was sent to federal, state, and local government agencies and to members of the media, public interest groups, citizens groups, and private citizens. Copies were provided to each person, who indicated a desire to receive the document, that attended the public scoping meeting held May 16, 1996, at Scottsboro, Alabama. TVA issued an announcement March 7, 1997, to local, regional, and national news media that a Draft EIS had been completed and was available for review and comment. On March 14, 1997, EPA published a Notice of Availability (NOA) of the DEIS in the *Federal Register* (62 FR 12181). In the days following the DEIS's release, news articles were published in several local and regional newspapers and trade journals. On the last publication date before April 8, 1997, paid advertisements were printed in four local newspapers with information about the public hearing to be held on April 8, 1997.

- Chattanooga Times, Chattanooga, Tennessee
- Huntsville Times, Huntsville, Alabama
- The Daily Sentinel, Scottsboro, Alabama
- The North Jackson Progress, Stevenson, Alabama

The Bellefonte DEIS public meeting was held on Tuesday, April 8, 1997, at the Scottsboro High School Main Auditorium at 6:30 p.m. During the meeting, 31 people filled out registration cards. Participants at the meeting had the opportunity to look at a variety of exhibits and pick up several handouts. A transcript of meeting proceedings was prepared. Availability of EPA Comments for the Bellefonte DEIS appeared in the *Federal Register* (62 FR 28470) on May 23, 1997.

The FEIS is contained in two volumes. Volume I consists of what was in the DEIS as modified and updated following public review of that document (The DEIS consisted of a single volume). Volume II consists of two appendices which contain a list of commentors, and the comments provided by reviewers and TVA's responses to those comments.

Chapter 2 of this FEIS describes options for completion of Bellefonte as a fossil plant. Construction as well as operational aspects of each option are discussed. This section describes screening efforts which narrowed the list of options to those addressed in detail in the FEIS. Options eliminated from the detailed study are briefly discussed. In addition, several process and facility suboptions are described which involve decisions to be made once a conversion option is selected. Examples of suboptions are various combustion turbine designs and fuels for firing the gasifiers.

The existing condition of environmental resources in the vicinity of Bellefonte Nuclear Plant is described in Chapter 3. Chapter 4 describes the environmental consequences of conversion options. The potential adverse impacts associated with these options are summarized at the end of Chapter 2. Permits and approvals required for completion of Bellefonte as a fossil plant are listed in Chapter 5. Chapter 6 describes the involvement of the public in the preparation of the EIS, including the public scoping and review processes. Individuals involved in preparing the FEIS are identified in Chapter 7. The individuals, organizations, and agencies to whom copies of the FEIS were provided are listed in Chapter 8. The Appendices contain several technical documents, figures, and data that support the impacts evaluations but were too detailed for inclusion in the text.

1.3 Purpose of Proposed Action

The purpose of the actions proposed in this FEIS is to convert Bellefonte Nuclear Plant to a fossil-fueled power plant, preferably through the use of natural gas fired combined cycle technology. TVA's integrated resource plan and programmatic environmental impact statement, Energy Vision 2020, was completed in December 1995. Energy Vision 2020 contains recommendations for meeting future TVA power system capacity requirements. The short-term action plan of Energy Vision 2020 recommended the following concerning the unfinished Bellefonte Nuclear Plant:

> "Converting the Bellefonte Nuclear Plant to a combined cycle plant utilizing natural gas or gasified coal as the primary fuel has been identified as one of the most viable options. Such an alternative provides the opportunity to utilize a substantial portion of the Bellefonte non-nuclear plant equipment. However, there is a degree of uncertainty and market risk associated with this alternative which requires further in-depth engineering and financial examination. Accordingly, TVA will use an outside, independent team of technical and financial experts to assess and develop the Bellefonte conversion strategy more fully over the next 18 to 24 months. During the course of this study, TVA will also pursue the evaluation and development of a demonstration gasification plant with the Department of Energy. In the meantime, the Bellefonte plant and Watts Bar Nuclear Plant Unit 2 will continue in a deferred status. TVA will continue to be receptive should outside entities propose an acceptable financial arrangement to complete these units as nuclear facilities in partnership with TVA."[1]

Energy Vision 2020 presents TVA's strategies and plans for meeting power needs for the 1995-2020 period. Various technologies and strategies were evaluated at the programmatic or strategy level for their environmental impacts in Energy Vision 2020 but site specific environmental impacts were generally not assessed. Consequently, Energy Vision 2020 stated that "prior to deployment of any option, TVA will conduct an appropriate site-level environmental review."

1.4 Need for the Proposed Action

1.4.1 Meet Future Power Demands

The conversion of Bellefonte Nuclear Plant to a fossil-fueled power plant would meet a TVA need to provide affordable electric power to TVA's customers. Energy Vision 2020 concluded that TVA would need an additional 800 MW of generating capacity by 1998 and an additional 16,500 MW by 2020. These estimates are based on the medium load forecast.[1] The range of estimates was from a low forecast of no growth to a high forecast of more than 20,000 MW through the same period. To determine the best way to meet this need, TVA examined a broad range of supply-side and demand-side options. The strategy presented in Energy Vision 2020 is flexible and allows the consideration of a broad range of options for meeting customer needs while avoiding a costly surplus of capacity or a shortage of capacity. The reader is referred to Energy Vision 2020 for a more detailed discussion of TVA's long-term and short-term strategies for meeting future power needs and an assessment of the risks associated with various options.[1]

1.4.2 Utilize TVA Assets

The need for action to complete Bellefonte stems from the previous monetary investment in construction activities and facilities at this location. Investment in Bellefonte through December 1995 was about $4.6 billion. However, the cost estimate as developed for TVA's Integrated Resource Plan for completing Unit 1 (as nuclear) is $1.3 to $3.5 billion and for Unit 2 is $0.9 and $2.4 billion. A more recent study conducted by NUS Corporation in 1996 determined the completion cost for the two Bellefonte units to be $2.88 billion. The current Bellefonte asset is not producing power. With the TVA Board's decision in 1994 to not complete Bellefonte as a nuclear plant unless a partner is found to share investment and operating risk, the plant could continue to be a liability to TVA.

1.5 References

1. Tennessee Valley Authority, Energy Vision 2020, Integrated Resource Plan Environmental Impact Statement, Volumes 1-3, TVA, December 21, 1995
2. 40 CFR Parts 1500-1508, "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act."
3. Tennessee Valley Authority, TVA Instruction IX, Environmental Review, "Procedure for Compliance with the National Environmental Policy Act," April 12, 1983.
4. Tennessee Valley Authority, Final Environmental Impact Statement, Bellefonte Nuclear Plant, Units 1 and 2, Volumes 1 and 2, May 24, 1974.
5. Tennessee Valley Authority, "Review of Final Environmental Statement, Bellefonte Nuclear Plant Units 1 and 2," March 1993.
6. Tennessee Valley Authority, "Environmental Impact Statement: Bellefonte Nuclear Plant Conversion Project, Public Scoping Document," July 1996.

2 .0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

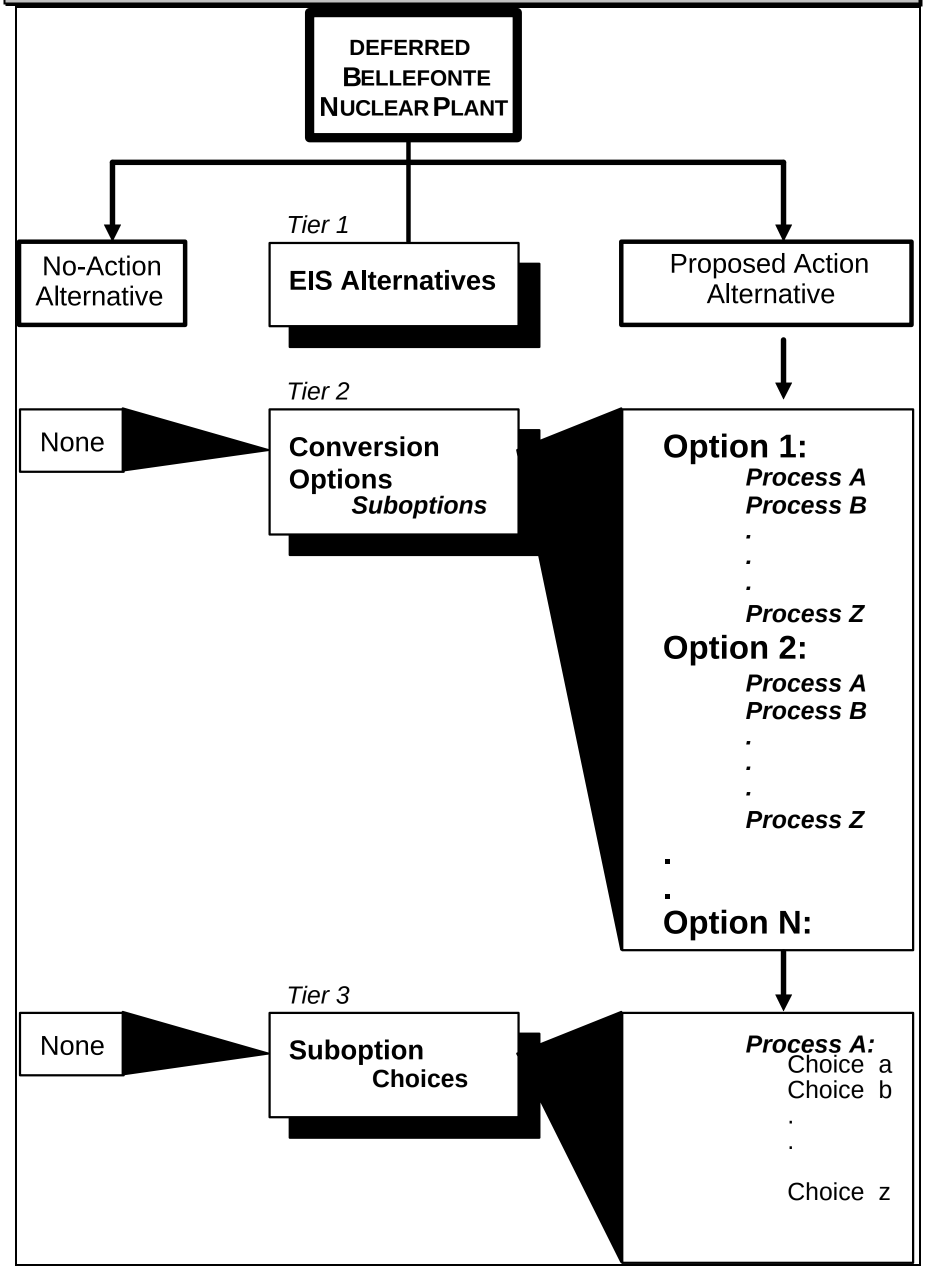
The objective of the EIS is to provide environmental data and analyses that will inform the public and Tennessee Valley Authority (TVA) decisionmakers of the environmental consequences of proceeding with the conversion of Bellefonte to a fossil fuel power plant. The conversion decision will weigh environmental considerations with economic and technical aspects of conversion options. This decision will be documented in a Record of Decision (ROD) which will be prepared after the issuance of this Final Environmental Impact Statement (FEIS).

The alternatives analyses in this FEIS was designed to meet these objectives. As shown in Figure 2.0-1, there are three tiers of decisionmaking. Tier 1 is to decide between the No-Action Alternative, which is to leave Bellefonte as a partially completed nuclear plant into the indefinite future, and the Proposed Action Alternative, which is to proceed with converting Bellefonte to fossil fuel.

Tier 2 is to select one of five conversion options. TVA's preference among the five conversion options is natural gas combined cycle (NGCC). The conversion options were derived from information contained in Energy Vision 2020 and data that have become available since the publication of that document. [1]

Tier 3 involves decisions about "suboption choices," basically types of processes, equipment, and modes of operation which cut across several conversion options. An example of a suboption choice would be the type of gasifier that would be used in conversion options involving coal gasification. For most suboptions, it was possible to choose a technology or a mode of operation to represent the suite of likely suboptions or to establish an envelope of emissions that allowed the evaluation of impacts for the "most likely conservative configurations." Conversion option descriptions presented in Section 2.2 reflect these choices.

Figure 2.0-1 Decision Matrix for Bellefonte Nuclear Plant Conversion



The No-Action Alternative is described in Section 2.1 and the Proposed Action Alternative and its array of reasonable conversion options are described in Section 2.2. The process used to identify conversion options is presented early in Section 2.2. Section 2.3 presents information about suboption process, control, and design choices. A summary of the environmental consequences of each of the five conversion options is presented in Section 2.4.

2.1 Description of the No-Action Alternative

This section describes the No-Action Alternative, in which no conversion of Bellefonte Nuclear Plant occurs. The No-Action Alternative involves the continued deferral of the unfinished Bellefonte nuclear units while TVA explores arrangements with outside entities to complete the units as nuclear facilities.

2.1.1 Current Status of Bellefonte Nuclear Plant

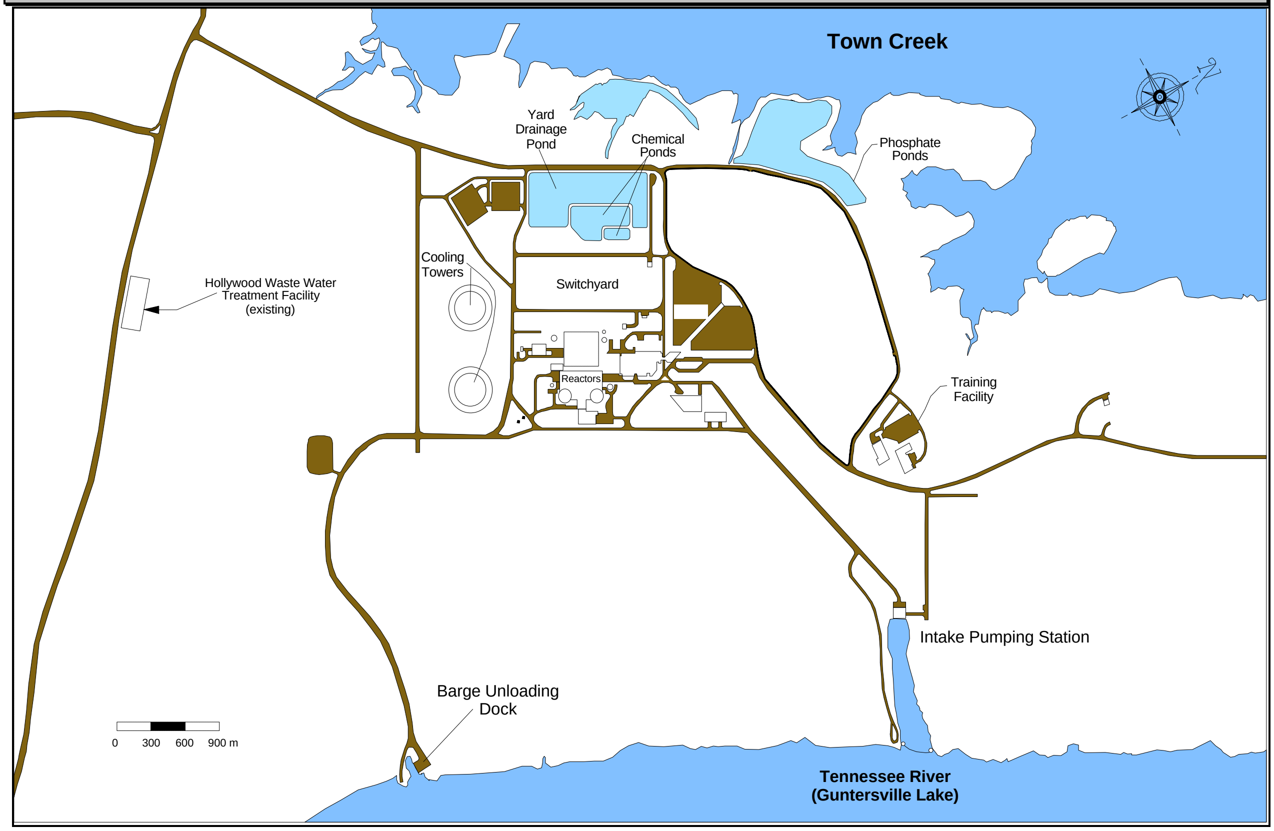
Figure 2.1-1 reflects the current site and facilities. All major structures have been constructed. Since December 1994, engineering and construction activities have been suspended. The plant systems and structures are maintained through an active layup and preservation program initiated in 1988. Pending the outcome of nuclear partnering efforts or the conversion studies, the plant will continue in the layup and preservation mode.

2.1.2 Description of Layup & Preservation of Bellefonte

Pumps, valves, and piping have been installed, and most of the systems have been flushed and readied for preoperational testing. The layup and preservation program was developed with the objective of maintaining the systems, structures, and components for a prolonged period without significant degradation.

The Plant Preventive Maintenance Database Program is utilized to track and implement accepted preservation practices such as motor and pump shaft rotation, meggar testing, bearing lubrication, lubrication levels, motor/valve motor heat, changing corrosion inhibitors and desiccant bags, sample/oil changes, instrumentation inspections, etc. Approximately 20,000 preventive maintenance activities are performed each year. Protective covers, caps, tape, enclosures, etc., are used throughout the plant.

Figure 2.1-1 Current Bellefonte Site Map



Verification of the effectiveness of the program is accomplished through the use of system engineer walkdowns, corrosion coupon monitoring, and various trending programs. In addition, various internal and external audits and assessments provide assurance of the adequacy of the program.

Mechanical Preservation

Piping systems which had been previously wetted were drained and dried to an internal relative humidity (RH) less than 40%. The internal RH of carbon steel systems is monitored to ensure that the 40% RH limit is not exceeded, and drain valves of piping systems are periodically checked to ensure the piping systems remain dry.

Because of the advanced state of completion of the plant, special preventive maintenance is performed:

- The Unit 1 emergency diesel generators are “barred” over monthly,
- The main turbogenerators for each unit are placed on turning gear and the shafts rotated every other week,
- The diesel fire pumps are maintained in an operational status and are run monthly,
- Both the shell and tube side of the main condensers are dry with the tube side being maintained with a flow of warm dehumidified air, and
- The reactor coolant system is being maintained dry using a flow of warm dehumidified air.

Electrical Preservation

Since the electrical symptoms were essentially complete at the time of deferral, the principal method for electrical preservation for the electrical distribution systems is to energize the system. Periodic inspections are performed with particular attention focused on those components supporting energized and operating equipment. Switch gear and electrical/electronic panels are maintained energized.

Operating Systems

Because of their advanced state of completion, some systems are required to be in operation. These systems are maintained in accordance with the plant preventative maintenance program which implements recognized operational maintenance practices.

Systems that are operational/energized to support the current stage of completion are noted below:

- Systems required to support placing the main turbine on turning gear,
- High pressure fire protection and detection systems are operational to detect fire in the plant and suppress it,
- Control and service air compressors are operational in order to supply dry air for layup and preservation of piping systems,
- Building heating, ventilating, and air conditioning systems are operated in order to maintain the environments in various plant buildings, thereby contributing to preservation of installed equipment,
- The auxiliary boiler and supporting systems are used to provide building heating during cold weather months, and
- The 500 kV and 161 kV switchyards are energized.

2.1.3 Organization/Workforce

The current work force of 80 personnel will continue to support layup and preservation of the plant. Of that number, approximately 50 personnel are involved in operations and maintenance.

2.1.4 Current Environmental Status

The current environmental status of Bellefonte is as follows:

- Air - Minor Source Status granted June 24, 1996 by the Alabama Department of Environmental Management (ADEM) there is no expiration date for a minor source permit,
- Toxics -No PCB transformers onsite,
- Wastes:
  - Hazardous - Small quantity generator
  - Solid - Presently disposed of off site by contract at an ADEM permitted facility,
- Wastewater - NPDES Permit No. AL0024635/Construction and permanent sewage currently routed to Hollywood Sewer System, expiration date: September 30, 1997, and
- Water - Drinking water is purchased form the City of Hollywood, a community public water system regulated by the state.

2.2 Description of the Proposed Action Alternative

2.2.1 Identification of Options for Accomplishing the Proposed Action

2.2.1.1 Results of Energy Vision 2020

Options for the conversion of Bellefonte to fossil fuel were considered in Energy Vision 2020. [1] TVA created an extensive list of generating options to meet new peaking, intermediate, baseload, and storage power supply needs through the year 2020. These included traditional technologies as well as potential renewable advanced combustion facilities. Overall, TVA characterized and considered over 100 supply-side resource options based on their performance, cost, and environmental impacts. Energy Vision 2020 also considered actions available to end-use customers to improve energy efficiency and to manage load requirements, but these are not addressed in this FEIS.

The culmination of Energy Vision 2020 was the development of a long-term plan, and a short-term action plan, which contain portfolios of options projected to best meet TVA's objectives and to be the most robust and flexible given key uncertainties. [1] Resource alternatives to aid in managing risk and uncertainty were also identified.

Seven strategies were developed which provided hedges against key uncertainties, namely load growth, natural gas prices, possible environmental regulations for air and water, and nuclear performance. Three of the strategies involve the use of Bellefonte. TVA developed eight evaluation criteria to consider the merits of various options. Attributes and indices were identified for measuring compliance with the critieria. This criteria/attribute matrix (Table 2.2-1) reflects TVA's goals and objectives and the concerns and values of the public.

Table 2.2-1 Energy Vision 2020 Evaluation Criteria

Issues and Values

Translation into Evaluation Criteria

TVA Goals/Objectives

Type of Evaluation Criteria	Attributes/Measurements
Long Run Cost/Value	Present Value of Revenue Requirements Total Resource Cost Tests Participant Test/Electric Bill Total Value Test
Rates	Rate Impact Measure Electric Rates (Cents/kWh) 1996-2000, 2001-2005
Reliability	Reserve Margin Loss-of-Load Expectation
Environment	Emissions Human Health - Inhalation Visibility Impairment Forests and Crops Materials Human Health - Ingestion Water Supply and Waste Assimilation Fish and Aquatic Life and Biodiversity
Economic Development	Total Employment Total Personal Income
Financial Requirements	Debt
Risk Management	Robustness Flexibility
Equity Among Rate Classes	Rate Changes by Residential and Commercial/Industrial

Seven flexible supply-side fossil fueled options were identified in Energy Vision 2020 specifically for conversion of Bellefonte and operation as a base-load plant (Table 2.2-2). Flexible options are options that can be altered or modified in accordance with TVA needs.

Table 2.2-2 Supply-Side Options for Conversion of Bellefonte

Option[a]	Units/Megawatts Each Unit	Total Megawatts
Bellefonte Conversion with Integrated Gasification Combined Cycle	9/250	2250
Bellefonte Conversion with Pulverized Coal	4/616	2464
Bellefonte Conversion -Phased Combined Cycle/IGCC - Phase A - Combined Cycle	9/222	1998
Bellefonte Conversion Phased Combined Cycle - Phase B - IGCC	9/250	2250
Bellefonte Conversion - IGCC with Coproduction	11/229	2519
Bellefonte Conversion - IGCC with Coproduction with Partners	2/242	484
Bellefonte Conversion - Natural Gas Combined Cycle	10/222	2220

[a] - All technologies are initial or mature commercial

2.2.1.2 Screening of Conversion Options for the FEIS

Following the publication of Energy Vision 2020, improved economic data became available that resulted in changes in the rankings of options and caused other options to be viewed with renewed interest. Much of the new information was in the form of equipment vendor cost estimates which were more competitive than before. TVA staff compiled a more comprehensive list of options for converting Bellefonte, including emerging technologies and technologies which were discounted earlier on the basis of then current technical or cost data. Each technology was considered in terms of three criteria:

- Can the technology be used, based on current data, to completely convert Bellefonte,
- Is the technology considered to be at the initial or mature commercial stage of development (i.e., is further demonstration and testing needed to prove the technology), and
- Is the fuel supply adequate for full conversion of Bellefonte?

Table 2.2-3 presents the results of the technology screening process; the shaded options were carried forward for further consideration. Options that failed to meet all these criteria were dropped from further consideration.

Table 2.2-3 Conversion Options Screening

OPTION	Fully Converts Bellefonte	Initial Or Mature Commercial	Adequate Fuel Supply
Pulverized Coal	**Yes**	**Yes**	**Yes**
Atmospheric Fluidized Bed Combustion (Bubbling)	**Yes**	**Yes**	**Yes**
Atmospheric Fluidized Bed Combustion (Circulating)	**Yes**	**Yes**	**Yes**
Simple Cycle CTs	No	Yes	Yes
Natural Gas Fired Combined Cycle	**Yes**	**Yes**	**Yes**
Cogeneration (Used in conjunction with other options)	**Yes**	**Yes**	**Yes**
Refuse-Derived-Fuel Fired Stoker	Yes	Yes	Sufficient For Cofiring But Not Conversion
Lead Acid Battery	No	Yes	Not Applicable (Storage Technology)
Compressed Air Energy Storage	No	Yes	Not Applicable (Storage Technology)
Biomass	Yes	Yes	Sufficient For Cofiring But Not Conversion
Pressurized Fluidized Bed Combustion	**Yes**	**Yes**	**Yes**
Integrated Gasification Compressed Air Storage	No	No	Yes
Integrated Gasification Combined Cycle	**Yes**	**Yes**	**Yes**
Integrated Gasification Combined Cycle with Coproduction	**Yes**	**Yes**	**Yes**
Integrated Gasification/Cascaded Humidification Advanced Turbine	No	No	Yes
Coal /Refinery	Yes	No	Yes
Intercooled Aeroderivative CT	Yes	No	Yes
Cascaded Humidified Advanced Turbine	No	No	Yes
Fuel Cell	No	No	Yes
Large Solar-Photovoltaic-Fixed Flat Plate	No	No	Yes
Methane - Landfill or Coalbed	No	Yes	No
Biorefinery	Yes	No	No
Advanced Battery Energy Storage	No	No	Not Applicable
Superconducting Magnetic Energy Storage	No	No	Not Applicable
Wind	No	Yes	No

2.2.1.3 Development of Bellefonte Conversion Options for Evaluation

In the following, the word “option” refers to a pathway for converting Bellefonte Nuclear Plant to a plant using fossil fuel. The word “suboption” refers to different processes, equipment, or practices that could be associated with one or more conversion options. For example, Natural Gas Combined Cycle (NGCC) and Integrated Gasification Combined Cycle (IGCC) would constitute conversion options, but the type of combustion turbine that might be used in either NGCC or IGCC would be a suboption. In this context, suboptions comprise the third tier of decision making associated with the conversion of Bellefonte Nuclear Plant to fossil fuel (the second tier being the conversion option itself). This approach provides a way of considering the environmental consequences of a wide range of options and suboptions for Bellefonte without treating each option/suboption permutation as a discrete option. The options/suboptions matrix and its integration into the scope of specific conversion options is described in further detail in Section 2.3.

The eight feasible options presented in bold type in Table 2.2-3 constitute the principal focus of this FEIS since they met all three screening criteria. Information was compiled about the construction and operation of each option, and how each option's facilities would be integrated with existing facilities at Bellefonte. Available information was reviewed to see if options representing relatively similar technologies could be grouped. At the same time, the question was asked whether combinations of technologies should be assessed to cover the full range of future Bellefonte conversion options.

After reviewing the emissions and operational characteristics of the eight options, it was determined that non-IGCC coal burning options could be represented by one conversion option category, as long as their minor differences were defined in the EIS. For this EIS, pulverized coal (PC) combustion will represent (in addition to itself) pressurized fluidized bed combustion (PFBC) and atmospheric fluidized bed combustion (AFBC) (both bubbling and circulating). Differences in these technologies will be addressed in the discussion of process suboptions under boiler type choices (Section 2.3.5), and where necessary, in the discussion of environmental consequences in Chapter 4.

Other options successfully meeting all screening criteria were NGCC, IGCC, and IGCC with chemicals coproduction. Power plants using these technologies would be distinctly different in their emissions, configurations, and operational characteristics and were addressed as discrete conversion options. However, it is possible that these technologies could be employed together at Bellefonte. Consequently, a combination option was devised to reflect a phased conversion process using elements of each of the three options listed above. These five options, along with a consideration of suboption processes, equipment, and practices, represent a broad, flexible suite of possible conversion pathways for Bellefonte.

- **Option 1: PC**
- **Option 2: NGCC (Preferred)**
- **Option 3: IGCC**
- **Option 4: IGCC with chemical coproduction (IGCC/C)**
- **Option 5: Combination of NGCC and IGCC/C (Combination)**

The five Bellefonte Conversion Options are described in the following in terms of their construction and operation aspects. The levels of detail given in each description are similar although repetition has been avoided by cross-referencing. For example, where construction activities for one option are similar to that of another, redundant descriptions are not presented. Table 2.2-4 summarizes key aspects of the five conversion options.

Table 2.2-4 Major Features of Conversion Options Addressed in FEIS

	PC	NGCC (Preferred)	IGCC	IGCC/C	Combination
Total Electricity Production (MW)	2,400	-2,206 - Base Power -2,406 - Peaking Power	2,720	450	-2,565 - Base Power -2,895 - Peaking Power
Fuel(s)	-Coal -Fuel Oil for Startup	-Natural Gas -Fuel Oil as Backup	-Coal -Petroleum Coke -Fuel Oil for startup	-Coal -Petroleum Coke -Fuel Oil for Startup	-Coal -Petroleum Coke -Natural Gas
Fuel Consumed per day	24,974 tons	472 mmscf (with duct burning)	24,000 tons	12,000 tons	12,000 tons 412 mmscf (with duct burning)
Footprint Area (acres)	190	46	190	225	225
Byproducts	-Gypsum -Ash -Flyash	None	-Sulfur(elemental) -Slag	-Sulfur(elemental) -Slag	-Sulfur (elemental) -Slag
Chemicals Produced	None	None	None	-Acetic Acid -Formaldehyde -MTBE -Urea -Methanol -Ammonia -UAN Solution -CO_2	-Acetic Acid -Formaldehyde -MTBE -Urea -Methanol -Ammonia -UAN Solution -CO_2
Max. Employees During Construction	1,612	550	2,155	2,898	3,362
Peak Permanent Employment	580	200	200	430	640
Suboptions Considered	-Boilers -Transportation -Solid Fuels -Coal Conveying	-Gas Pipeline -Gas Turbines	-Transportation -Gas Turbines -Solid Fuels -Coal Conveying	-Transportation -Gas Turbines -Solid Fuels -Coal Conveying -Chemicals Production	-Gas Pipeline -Transportation -Gas Turbines -Solid Fuels -Coal Conveying -Chemicals Production

2.2.1.4 Relationship of Options to Suboptions

As is the case for nearly all projects of the magnitude considered herein, many details concerning construction and operation are not available during preparation of the EIS. TVA and its consultants have evaluated possible uses of Bellefonte and have developed preliminary design and feasibility information for many promising options. This work, substantially summarized in Appendix A, provides the building blocks for the option and suboption descriptions presented in this chapter. Appendix A should be consulted for additional technical details.

It is perhaps intuitive that descriptions of overall conversion options are integrally related to suboption process choices, and that the process and design choices ultimately determine the option. However, the approach used here, hopefully in the interest of efficiency, has been to describe conversion options and suboption choices sequentially. The linkage between Sections 2.2 (which addresses options) and 2.3 (which addresses suboptions) will become clearer as the two sections are read. However, even though suboption choices are discussed later, they are irrevocably embodied in the conversion option descriptions.

Conversion options are described as specifically as appropriate, but flexibility has been "built in" to allow some suboption choices to be made at a later date. An example helps to illustrate this point. For IGCC, it is possible to utilize a variety of fossil fuels to provide the source of energy, with coal and petroleum coke as the most likely fuel choices (explained in Section 2.3) To allow either or a mixture of these fuels to be used for IGCC, the option will be evaluated so as to define the greatest environmental impacts of this technology regardless of fuel type. Coal use would result in the generation of the greatest amount of slag, so the impacts of slag storage have been based on the use of coal. On the other hand, the greatest emission of gaseous sulfur dioxide (SO_2) occurs for petroleum coke use, so the air impact evaluations have been based on the use of petroleum coke fuel. The suboption choices assumed for the impacts analyses in Chapter 4 will be noted where necessary in that chapter to convey the basis for the impacts evaluation.

The ultimate decision on many specific technology and operational aspects will depend on future market conditions and/or regulatory constraints. This approach will provide flexibility for future decisionmaking while yielding information about the worst environmental impacts that would typically be anticipated.

2.2.2 Option 1: Construction and Operation of Pulverized Coal Combustion Units

2.2.2.1 Description of Construction Activities

Construction will be conducted in four phases of 600 megawatt (MW) blocks of power each. Each phase of the project would convert one half of an existing unit at Bellefonte, requiring the completion of two phases of the project to fully convert one Bellefonte generating unit. Phase I will consist of constructing the first unit and the projected start date is Fiscal Year (FY) 1998, 2nd quarter. Phase II, construction of the second unit, will begin 12 to 15 months later in FY 1999, 2nd or 3rd quarter. Phases III and IV, construction of the remaining units, will begin 12 months later.

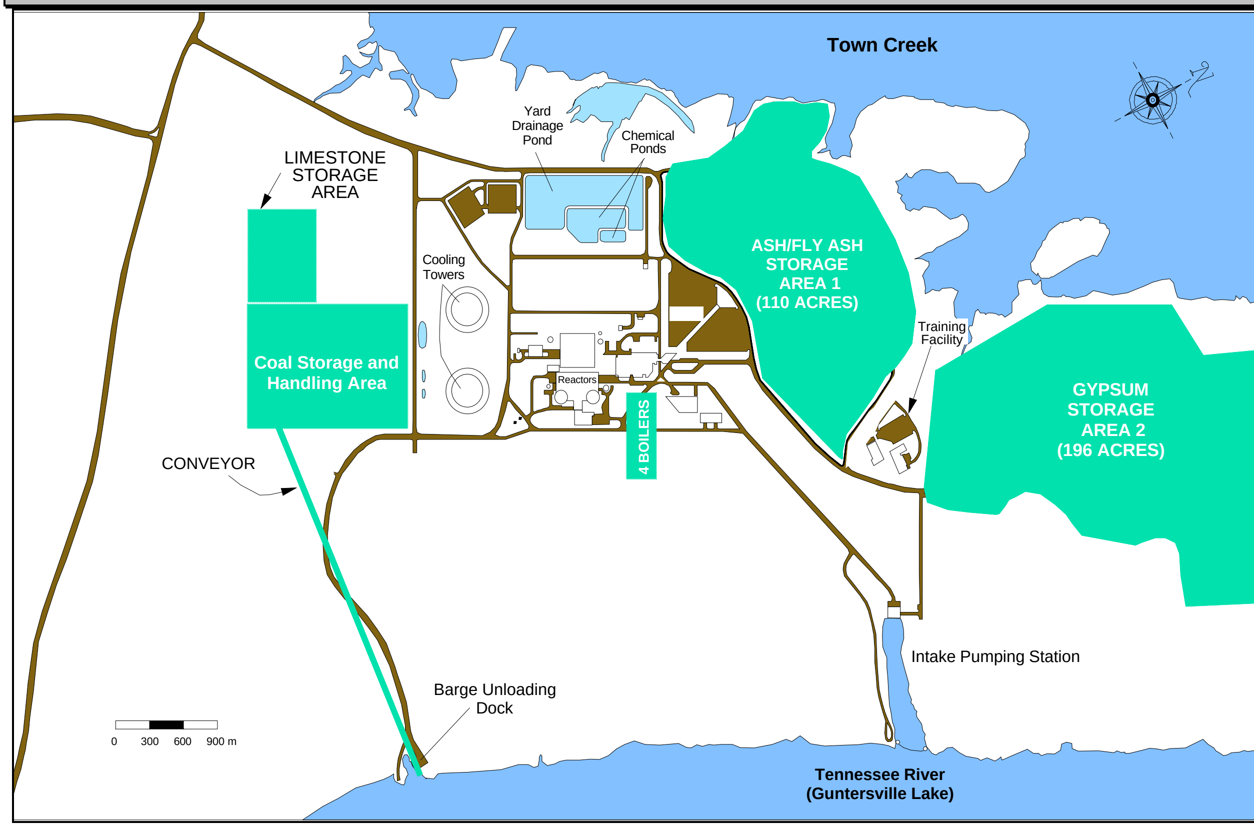
One fully converted unit will provide main steam to two new topping turbine-generators, each of which will generate electric power. The expanded steam is reheated and admitted to a new intermediate-pressure turbine which replaces the existing high-pressure steam turbine which was part of the nuclear plant steam cycle. The new intermediate-pressure turbine will exhaust to the existing low-pressure turbines. The low-pressure turbines and condenser will be re-used, as well as most of the existing condensate system.

New air quality control equipment consists of low oxides of nitrogen (NO_x) burners (and possibly Selective Catalytic Reduction for NO_x removal if required), an electrostatic precipitator system for flue gas particulate removal, and a scrubber system, without flue gas reheat, for sulfur dioxide (SO_2) removal. The exhaust flue gas is released through a single chimney with two flues for each pair of 600-MW boilers.

The flue gas desulfurization system will be designed with facilities to force oxidize the scrubber solids slurry to produce a gypsum which can be processed into wallboard or similar material. Construction will include the preparation of two areas for disposal of unmarketable combustion derived solids (one for ash and fly ash and one for gypsum). The area identified for ash and fly ash is expected to provide at least 14 years of storage capacity, even if none of the solids are marketed. The area identified for gypsum storage is expected to provide at least 19 years of storage capacity.

Figure 2.2-1 is a simplified footprint of a PC facility. A more detailed and larger scale footprint schematic is in Appendix B. Approximately 190 acres will be needed to construct new facilities. The location of the plant was determined from an economic analysis of three possible locations considering such factors as high energy piping requirements and excavation costs. Construction in this location will require the demolition or relocation of several existing buildings, including the Power Stores Warehouse, about 50 construction warehouses and storage buildings, and underground utilities. After completion of demolition, the area will be cleared and grubbed to remove existing vegetation, then leveled to a level above the 500-year floodplain.

Figure 2.2-1 PC Power Plant

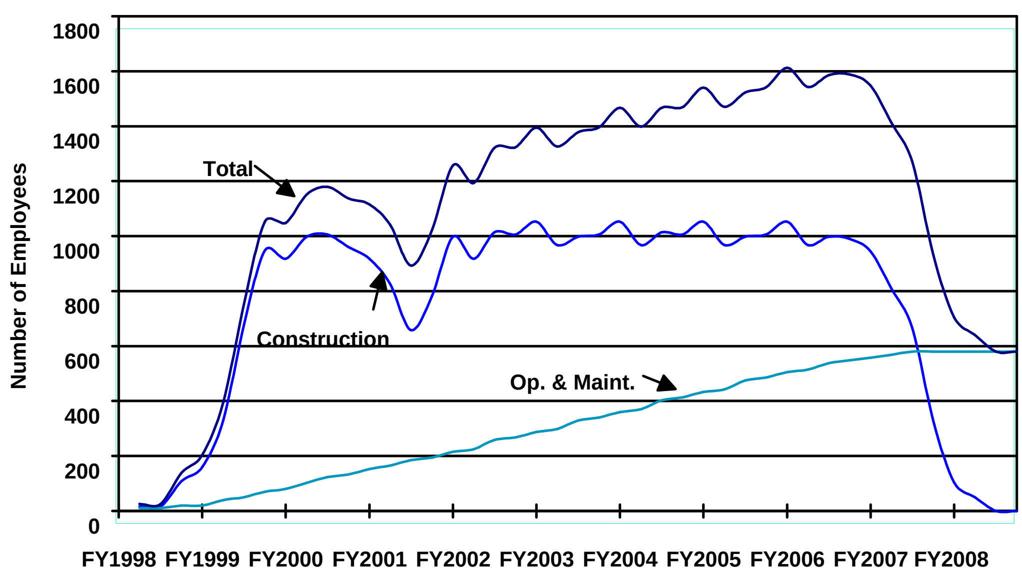


Cooling tower blowdown diffusers and piping in the Tennessee River will be lowered approximately five feet from their present position to allow unrestricted barge movement. The barge unloading area will consist of a loading barge storage dock, unloading dock and empty barge dock. The docks will be constructed of cells interconnected with walkways. Cells will be constructed of sheet piles with a granular fill material. Approximately 50 each 20-foot diameter cells would be needed.

New coal handling facilities are constructed for barge unloading of coal. The existing cooling towers and circulating water system are utilized for cycle heat rejection. The existing substation is augmented and a new auxiliary power system is constructed. A new distributed control and information system is constructed.

The work force size will correspond to the construction phases. Maximum projected work force size is 1,612 people in the 1st quarter of FY 2006, corresponding to the peak of construction for the 4th and final unit. Upon completion and startup of the final unit, the work force will stabilize at 580 people for operating and maintenance. The projected work force throughout construction is shown in Figure 2.2-2. More detailed work force estimates are in Appendix C.

Figure 2.2-2 Work Force Population for the PC Option



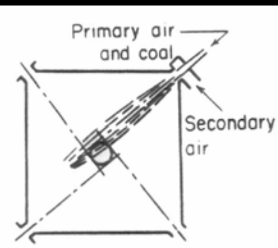
2.2.2.2 Description of Project Operations

The heart of the PC plant is its boiler. Here, in one firing arrangement, coal and air is fired tangentially into a combustion chamber using specially designed burners which yield low concentrations of NO_x, an air pollutant. Such burners are commonly called “low NO_x burners.” A plan view of a tangentially-fired PC boiler is presented in Figure 2.2-3. The steam produced is 2400 psig at 1000ºF. Most of the available energy from the coal is converted to steam in the boiler. The steam drives a steam turbine attached to a generator which produces electricity.

A fabric filter or electrostatic precipitator (ESP) is usually included to separate particulate matter from the flue gas stream. Although very different in the way that they operate, the performance of these two systems in terms of their ability to remove solid particles entrained in flue gas is quite similar. Both system are capable of very high (in excess of 99%) particulate removal efficiencies. Although the final selection of a particulate removal system will be based on future, more refined economic analysis, the impacts evaluations in Chapter 4 will be based on the use of an ESP.

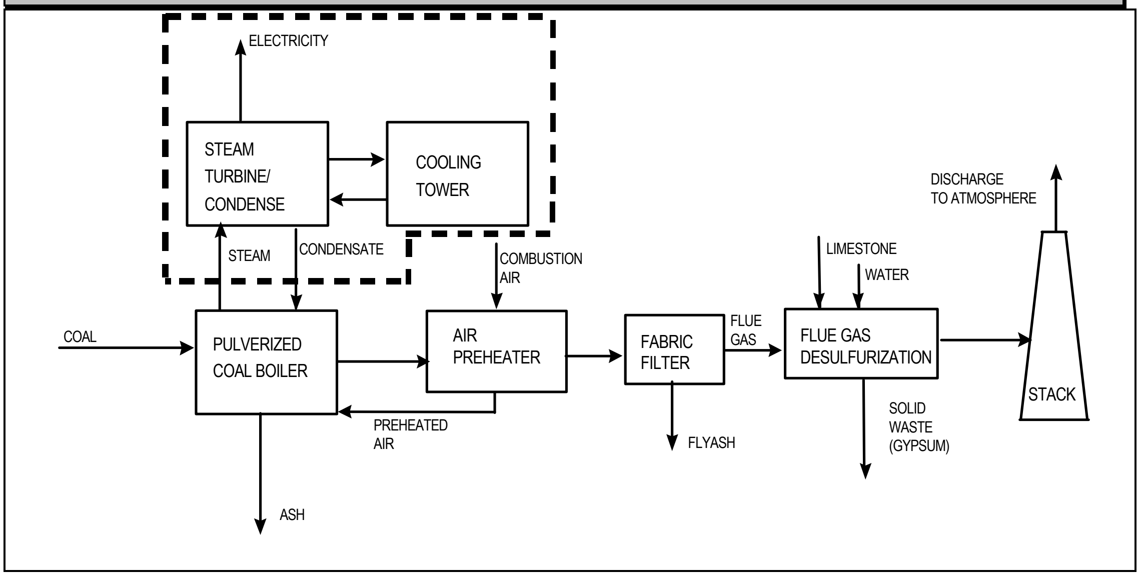
Sulfur in the fuel is converted to SO_2 during the combustion process. The PC Option will include a fuel gas desulfurization system where approximately 95% of the SO_2 is removed from the flue gas stream. Flue gas desulfurization involves the wet contact of an SO_2 absorbent, commonly finely divided limestone particles suspended in an aqueous solution, with the SO_2 gas molecules. The result of the subsequent chemical reaction of SO_2 with calcium carbonate is the production of calcium sulfate, known commonly as gypsum. Because gypsum is in demand as a raw material for the production of wallboard, the flue gas desulfurization will use the wet forced oxidation technology to improve the gypsum properties for this use.

Figure 2.2-3 Tangential Firing - Plan View of Boiler



Research and development are underway to modify PC boilers to generate a supercritical steam, 1100ºF and 4500 psig. The goal of this work is to combine modern boiler and steam turbine designs for high quality (supercritical) steam with the latest emission control technologies. These modifications are currently being tested in Europe and Asia, where efficiency, performance, and capital cost relationships are generally different than in the U.S. Figure 2.2-4 is a block flow diagram of a subcritical PC combustion process.

Figure 2.2-4 PC Power Plant



The steam generated in the PC plant will be routed to the Bellefonte existing steam systems. Each one of the two Bellefonte steam systems will be served by two PC boilers, 600 MW each, with heat rates of at least 9,500 British thermal units per kilowatt hour (Btu/kWh). Optimization of the plant may require modification of Bellefonte steam turbines. The power plant's net output will be approximately 2,400 MW with a total coal consumption of 24,794 tons per day, assuming the use of Illinois No. 6 coal, which has a lower heating value of 11,035 Btu per pound.

New equipment will include:

- Four PC plant modules, each module consisting of coal preparation and handling facilities, PC boiler, and flue gas cleaning system
- Bottom ash and fly ash handling and storage facilities
- Two stacks, each with two flues serving individual units
- Coal receiving, unloading and conveying equipment for coal received by barge
- Gypsum handling and storage facilities

Existing Bellefonte equipment used will include:

- Bellefonte Unit 1 steam turbine and condenser
- Bellefonte Unit 2 steam turbine and condenser
- Unit 1 & 2 natural draft cooling towers
- Station auxiliaries (compressed air and service water)
- Switchyard and transmission system
- Office and service buildings

2.2.3 Option 2: Construction and Operation of Natural Gas Combined Cycle Units (NGCC), Preferred Option

2.2.3.1 Description of Construction Activities

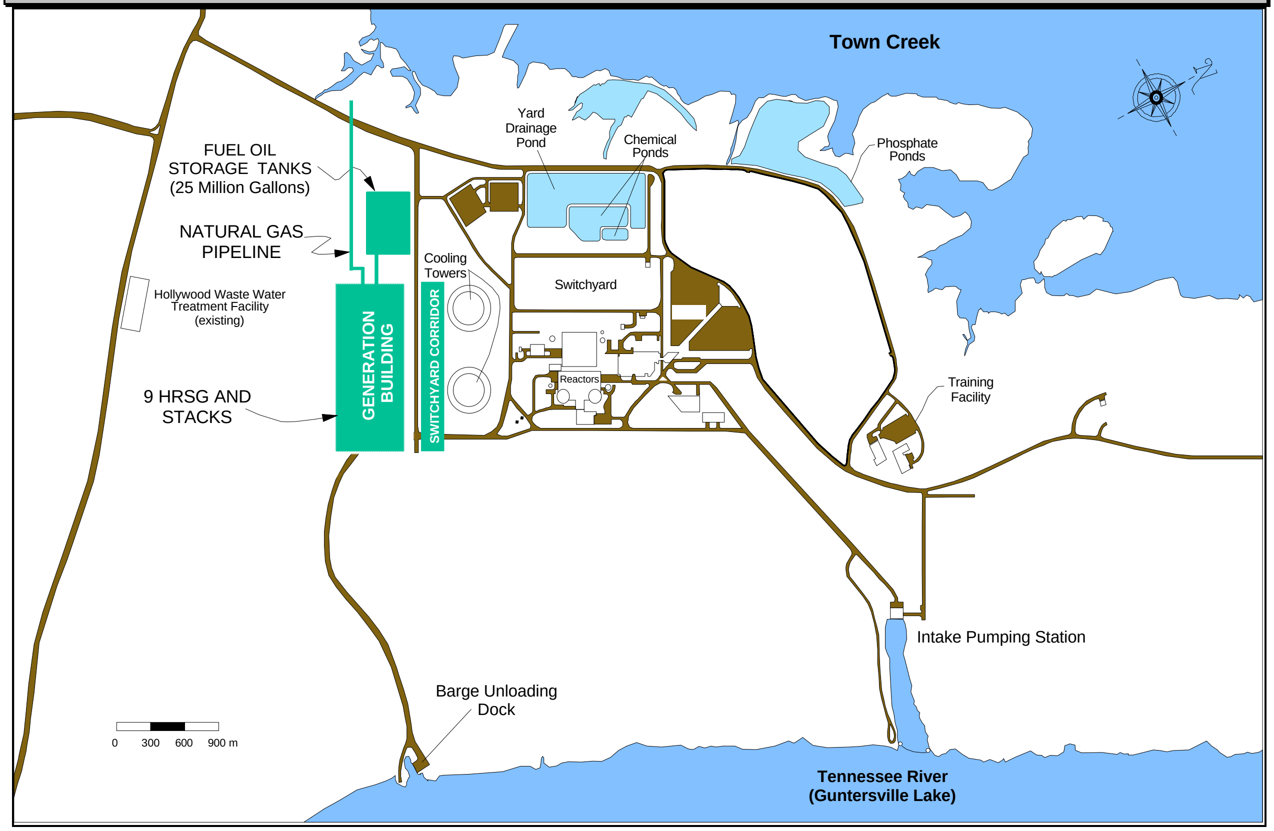
Construction will be conducted in phases with two or three CT heat recovery steam generator systems (CT-HRSG) per phase. For the "F" technology CT choice, phases I and II would involve construction of two CT-HRSG modules for a total of 730 MW and 1,466 MW, respectively. Phase three would add three units bringing net output to 2,206 MW, without duct burning. Duct burning, to augment power production would increase output by approximately 200 MW. In this mode, additional natural gas is injected between the CT and HRSG to provide additional heat to the HRSG.

The most likely configuration would have nine CT-HRSG systems sending steam to the existing Bellefonte Nuclear Plant Unit 2 steam turbine. The existing Unit 2 high pressure (HP) turbine would be replaced and one section of the dual flow low-pressure (LP) turbine would be utilized. HRSGs are a three pressure design with the HP section superheater feeding the new HP turbine section. The HRSG intermediate pressure section superheater supplies steam to mix with the HP turbine section outlet steam, providing steam to the LP section. CTs would be equipped with dry low NO_x burners for natural gas firing.

Natural gas is the primary fuel, but low-sulfur distillate fuel may be used for short periods as a supplemental backup fuel in as many as two CTs. The impacts evaluation reflects construction of about 1500 feet of gas pipeline within the plant boundary to serve the plant.

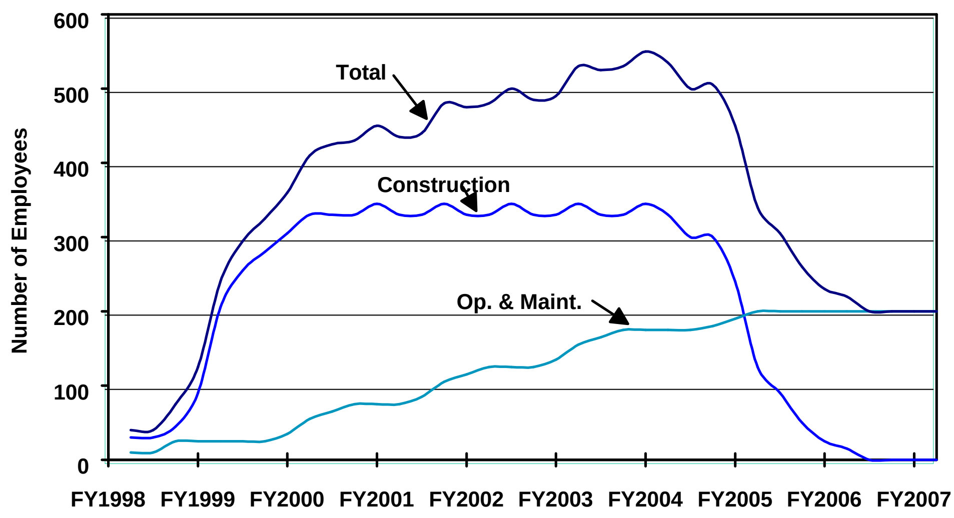
Figure 2.2-5 is a simplified footprint of an NGCC facility. A more detailed and larger scale footprint schematic is in Appendix B. Approximately 46 acres of land to the southwest of the existing cooling towers would be needed to construct the plant. The area proposed was formerly used for "lay down," storage and parking during construction of the nuclear plant. Site preparation would include demolition and removal of several buildings, desilting and alum sludge ponds, clearing and grubbing of site area and earthwork to provide a stepped level base. A new distillate oil storage tank would be constructed between the plant and rail line to provide backup fuel.

Figure 2.2-5 NGCC Footprint



The work force size will correspond to the construction phases. Maximum projected work force size is 550 people in the 1st quarter of FY 2004, corresponding to the peak of construction for the 8th and final unit. Upon completion and startup of the final unit, the work force will stabilize at 200 personnel for operating and maintenance. The projected work force throughout construction is shown in Figure 2.2-6. More detailed work force estimates are provided in Appendix C.

Figure 2.2-6 Work Force Population for NGCC Option



The NGCC Option for conversion of Bellefonte will require natural gas as a fuel. Because natural gas supplies are not currently available, this EIS envisions the development of new pipeline route to Bellefonte. This pipeline's construction and operation is considered to be a "connected action" under NEPA and therefore described in Section 2.3.1 of this FEIS. Section 3.2 describes affected environment and typical pipeline construction and operating practices, and Section 4.3 considers the impacts of these actions for three alternative pipeline corridors. These corridors lead to gas supply pipeliness which either exist or are projected to be constructed for reasons unrelated to the conversion of Bellefonte.

Backup low-sulfur distillate oil (0.05%) will be provided to allow operation of up to two CTs for a two-week period. The storage tank volume is based on an operating scenario of two units for one week followed immediately by one unit for two additional weeks.

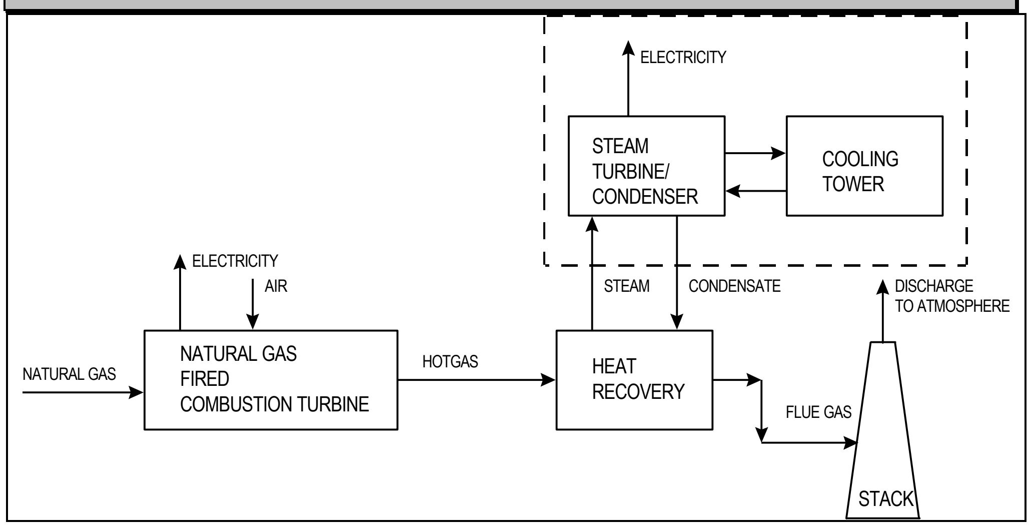
2.2.3.2 Description of Project Operations

Natural gas fired combustion turbine combined cycles, which capture the combustion turbine exhaust heat to generate steam and drive a steam turbine generator, have been in common use for many years. Advanced combined cycles based on natural gas fired advanced CTs boost simple cycle electrical output by about 50% above older simple cycles and yield plant efficiencies greater than 55%.

Process steps are:

- Natural gas is fired in a combustion turbine, which drives an electric generator and typically converts about 35% of the fuel energy to electric power,
- A substantial amount of energy is contained in the hot exhaust gas from the CT. To capture this otherwise wasted energy, a combined cycle adds a heat recovery steam generator (HRSG) which produces steam for use in a steam turbine generator for additional electrical power generation,
- The exhaust gas leaves the HRSG and exits through an exhaust stack. See Figure 2.2-7,
- Steam generated in the HRSG is passed through a steam turbine where additional electrical power is generated, and
- Steam will enter a condenser, where heat is rejected and the condensate is returned to the HRSG for another cycle.

Figure 2.2-7 Natural Gas Combined Cycle



The full-scale NGCC Option for the conversion of Bellefonte includes eight to ten NGCC modules, each consisting of one advanced CT and one HRSG. The steam generated in the HRSGs will be routed to the existing Bellefonte steam turbine systems. One or both of the two Bellefonte steam turbine systems could be served by four modules. Optimization of the plant may require replacement or modification of Bellefonte's existing steam turbines. The power plant's net output will be approximately 2,206 MW with a total natural gas consumption of 434 million standard cubic feet per day (mmscf/day). The installation of duct burners for peak power or intermediate power production would have the capability of increasing the total plant output to 2,406 MW, with a total natural gas consumption of 472 mmscf/day.

New equipment will include:

- Nine gas-fired "F" class CTs and electrical generators
- Nine HRSGs
- Nine primary stacks and 9 HRSG bypass stacks

Existing Bellefonte equipment used will include:

- Bellefonte Unit 1 steam turbine and condenser
- Bellefonte Unit 2 steam turbine and condenser
- Units 1 & 2 natural draft cooling towers
- Station auxiliaries (compressed air and service water)
- Switchyard and transmission system
- Office and service buildings

2.2.4 Option 3: Construction and Operation of Integrated Gasification Combined Cycle Units (IGCC)

2.2.4.1 Description of Construction Activities

The IGCC facilities will be constructed in phases. Phase I will consist of constructing the first unit and the projected start date is FY 1998, 2nd quarter. Phase II, construction of the second unit, will begin 15 months later in FY 1999, 3rd quarter. Phase III, construction of the remaining units, will begin 12 months later.

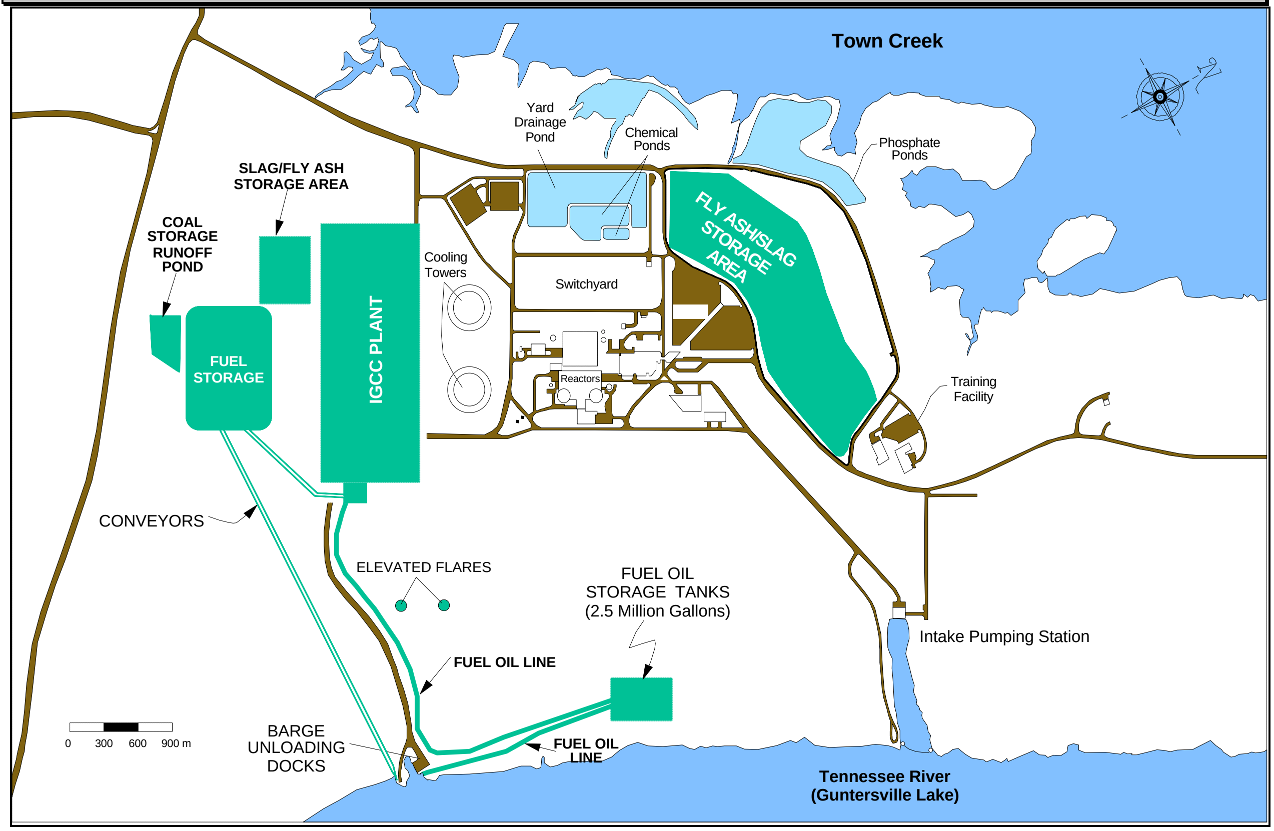
The plant would consist of eight new integrated gasification combined cycle blocks that send steam to a new topping turbine and existing LP steam turbine generator. Coal is gasified in each of the gasification units. Low-sulfur distillate fuel oil is the start-up fuel. The synthesis gas produced in each gasifier is cleaned of impurities and fired in compatible CTs. Steam is generated and superheated in dedicated HRSGs, then expanded through the steam turbine. CTs and HRSGs operate generally as described for NGCC, with modifications to reflect the different fuel.

An air separation plant is constructed for each gasifier to supply the pressurized 95% (by volume) oxygen required for the oxygen-blown gasifiers. The air separation units receive part of their air from the CT compressors and return excess nitrogen to the CTs for power augmentation and NO_x control.

Construction will include the preparation of an area for disposal of unmarketable slag. The area identified is expected to provide at least nine years of storage capacity, even if none of the slag is marketed. It is highly likely that most gasifier slag will be marketed due to its excellent quality and high demand. Conservatively assuming that half is sold, storage area life would be 18 years. If this area was insufficient, the area identified earlier for PC gypsum storage could be explored for slag disposal. The IGCC impacts evaluation addresses the initial disposal area.

Figure 2.2-1 is a simplified footprint of an IGCC facility. A more detailed and larger scale footprint schematic is in Appendix B. Approximately 190 acres to the southwest of the existing cooling towers will be used to construct new facilities. Construction in this location will require the demolition or relocation of several existing buildings and underground utilities. After completion of demolition, the area will be cleared and grubbed to remove existing vegetation, then leveled to an elevation above the 500-year flood plain.

Figure 2.2-8 IGCC Footprint

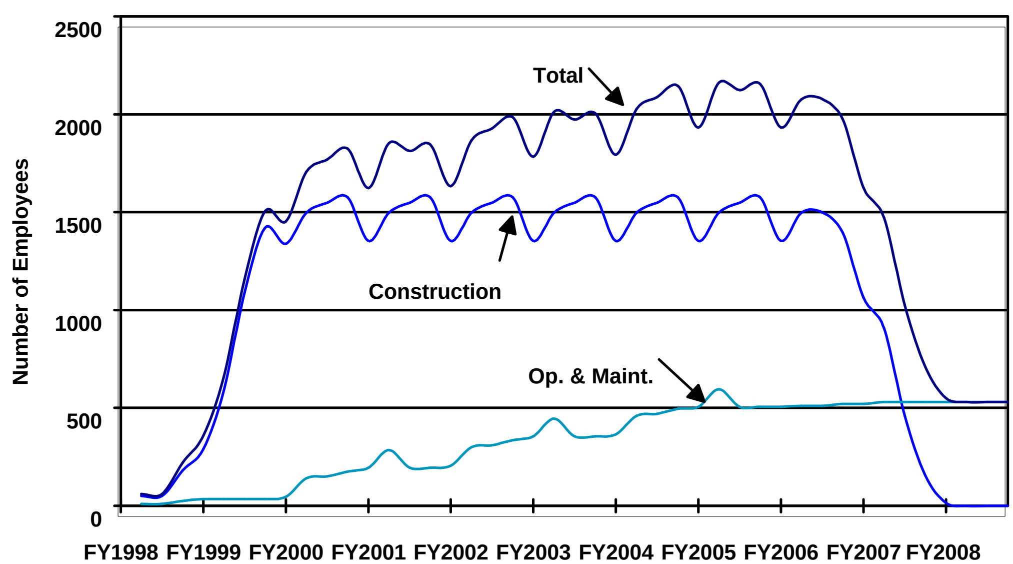


Cooling tower blowdown diffusers and piping in the Tennessee River will be lowered approximately five feet from their existing position to allow unrestricted barge movement. The barge unloading area will consist of a loading barge storage dock, unloading dock and empty barge dock. The docks will be constructed of cells interconnected with walkways. Cells will be constructed of sheet piles with a granular fill material. Approximately 50 each 20-foot diameter cells will be needed.

New coal handling facilities are constructed for barge unloading of coal or petroleum coke. The existing cooling towers and circulating water system are utilized for cycle heat rejection. The existing substation is augmented and a new auxiliary power system is constructed. A new distributed control and information system is constructed.

The work force size will correspond to the construction phases. Maximum projected work force size is 2,155 people in the 1st quarter of FY 2004, corresponding to the peak of construction for the 8th and final unit. Upon completion and startup of the final unit, the work force will stabilize at 500 personnel for operating and maintenance. The projected work force throughout construction is shown in Figure 2.2-9. More detailed work force estimates are provided in Appendix C.

Figure 2.2-9 Work Force Population for IGCC Option



2.2.4.2 Description of Project Operations

The IGCC Option for Bellefonte consists of eight modules, each consisting of one coal gasification plant, one CT, and one HRSG (see Figure 2.2-10). The steam produced by the eight modules is collected and routed to Bellefonte's two existing steam turbine systems. Each steam system will be served by four modules.

Figure 2.2-10 Integrated Gasification Combined Cycle

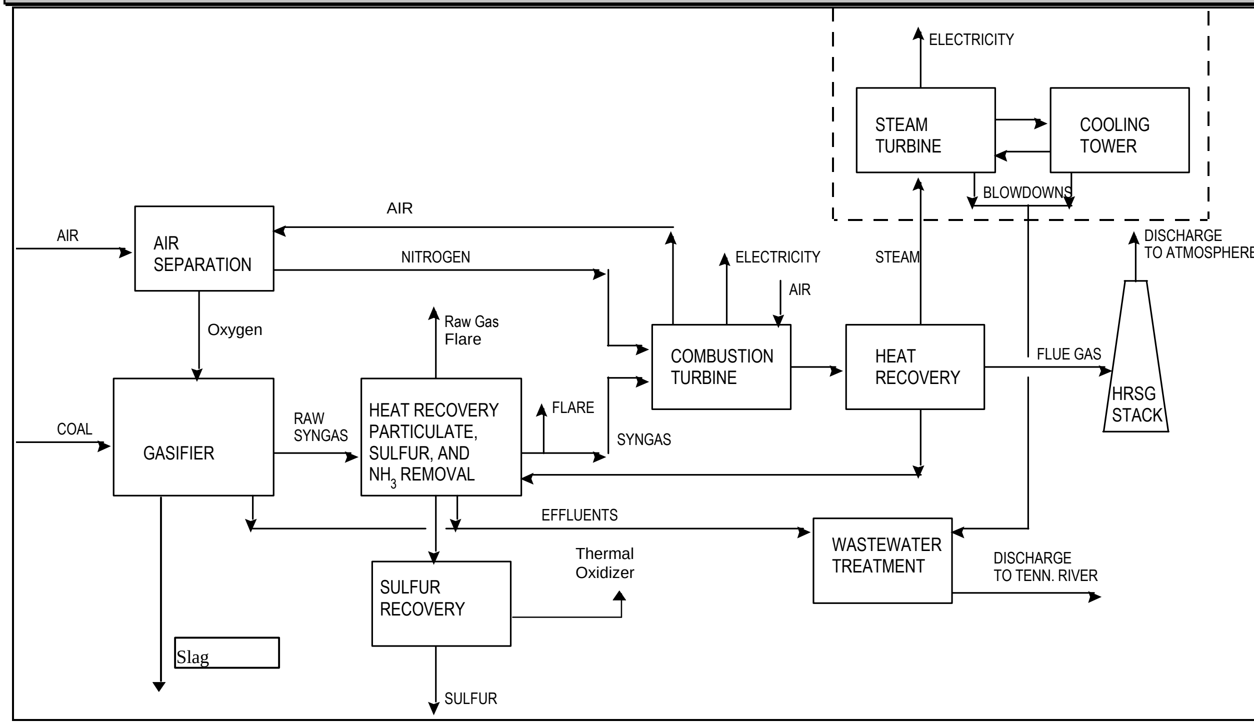


Figure 2.2-10 shows the overall flow scheme for the IGCC facility:

- Coal is pulverized in grinding equipment,
- Coal is then fed either dry or slurried with water (depending on the process selected) to the gasification unit along with oxygen from the air separation plant and steam if the coal is fed dry. The gasification unit uses an oxygen blown pressurized slagging gasifier (such as produced by Shell, Texaco, or Destec). The primary products from the gasifier are hydrogen (H_2) and carbon monoxide (CO), with small amounts of carbon dioxide (CO_2), N_2, methane (CH_4), hydrogen sulfide (H_2S) and some trace sulfur and nitrogen based compounds,
- Hot product gas is quenched with either water or recycle gas (depending on the process selected). Particulates are removed by water scrubbing or filters. Heat can be recovered by generating steam with the hot syngas, thus cooling the syngas,
- Gas flows through catalytic reactors to convert hydrogen cyanide to NH_3 and CO and to convert carbonyl sulfide to H_2S and CO_2,
- Syngas flows to the ammonia removal unit where ammonia is removed by absorption in water in a countercurrent absorber,
- Ammonia is stripped in a vertical stripper using a thermosyphon reboiler and the water is recycled to the ammonia absorber.
- Sulfur and some of the CO_2 are removed in the acid gas removal unit by absorption using a solvent, such as methyl diethanolamine (MDEA),
- Acid gases are stripped from the solvent and sent to the sulfur recovery unit where the sulfur is recovered as elemental sulfur,

- Clean syngas from the acid gas removal unit is combusted in a high-efficiency CT-generator to produce electric power,
- Exhaust from the gas turbine enters the heat recovery steam generator providing heat to generate high-pressure steam, superheat the high-pressure steam, reheat intermediate pressure steam, and preheat boiler feed water, and
- Superheated and reheated steam are used in the steam turbine to generate additional electric power.

The power plant's net output will be approximately 2,720 MW.

The wastewater treatment plant will handle the process effluents from the gasification facility:

- Steam is used to strip the ammonia from the water and at the same time removes essentially all the hydrogen sulfide and dissolved raw gases,
- Ammonia and acid gases are sent to the sulfur unit,
- Stripper bottoms, which contain a small amount of suspended solids, are cooled and given additional treatment before being discharged, and
- Effluent from the sulfur unit is fed to the waste water treatment unit where it is treated before being discharged.

New equipment will include:

- Eight gasification plants
- Eight synthesis gas-fired "F" class CTs and HRSGs
- Coal and combustion waste handling and storage equipment
- Sulfur recovery plants
- Coal receiving and unloading equipment for coal received by barge
- Upgraded railroad services
- Fuel oil storage tanks
- Eight primary stacks and eight HRSG bypass stacks

Existing Bellefonte equipment will include:

- Bellefonte Unit 1 steam turbine and condenser
- Bellefonte Unit 2 steam turbine and condenser
- Unit 1 & 2 natural draft cooling towers
- Station auxiliaries (compressed air and service water)
- Switchyard and transmission system
- Office and service buildings

2.2.5 Option 4: Construction and Operation of Integrated Gasification Combined Cycle Units with Chemical Coproduction (IGCC/C)

2.2.5.1 Description of Construction Activities

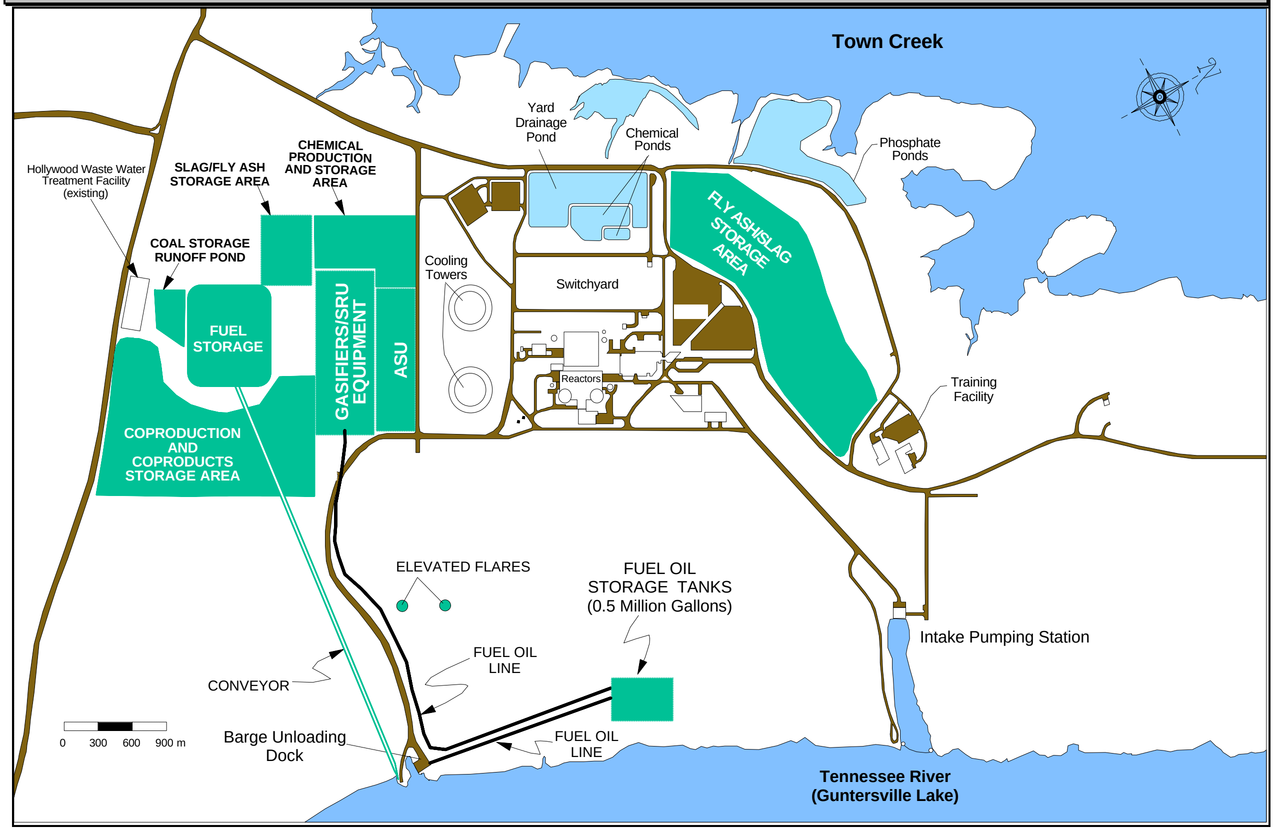
The plant would consist of four new gasifiers configured to produce electricity and marketable chemicals. One gasifier would be integrated into gasification combined cycle block much like the ones described for IGCC. Three gasifiers would produce syngas that would be routed to a suite of chemical processes. The heat and combustible vapors produced during chemicals production would be sent to the CT for burning.

Many details concerning the construction and configuration of an IGCC/C plant, particularly the chemical processes, are not available since project development has not reached the point when preliminary designs are available. Appendix A contains more details for one conceptual configuration. Construction will include the preparation of an area for disposal of unmarketable slag from gasification. The area identified is expected to provide at least 18 years of storage capacity, even if none of the slag is marketed. The comments presented for slag marketing and area storage life in the IGCC Option apply to IGCC/C as well.

Figure 2.2-12 is a simplified footprint of an IGCC/C facility. A more detailed and larger scale footprint schematic is in Appendix B. Approximately 225 acres will be needed to construct new facilities. Construction in this location will require the demolition or relocation of several existing buildings and underground utilities. After completion of demolition, the area will be cleared and grubbed to remove existing vegetation, then leveled to an elevation above the 500-year floodplain.

Cooling tower blowdown diffusers and piping in the Tennessee River will be lowered approximately five feet from their current elevation to allow unrestricted barge movement. The barge unloading area will consist of a loading barge storage dock, unloading dock and empty barge dock. The docks will be constructed of cells interconnected with walkways. Cells will be constructed of sheet piles with a granular fill material. Less than 50 each 20-foot diameter cells will be needed to handle the smaller fuel demand of the IGCC/C plant.

Figure 2.2-11 IGCC with Chemical Coproduction Footprint

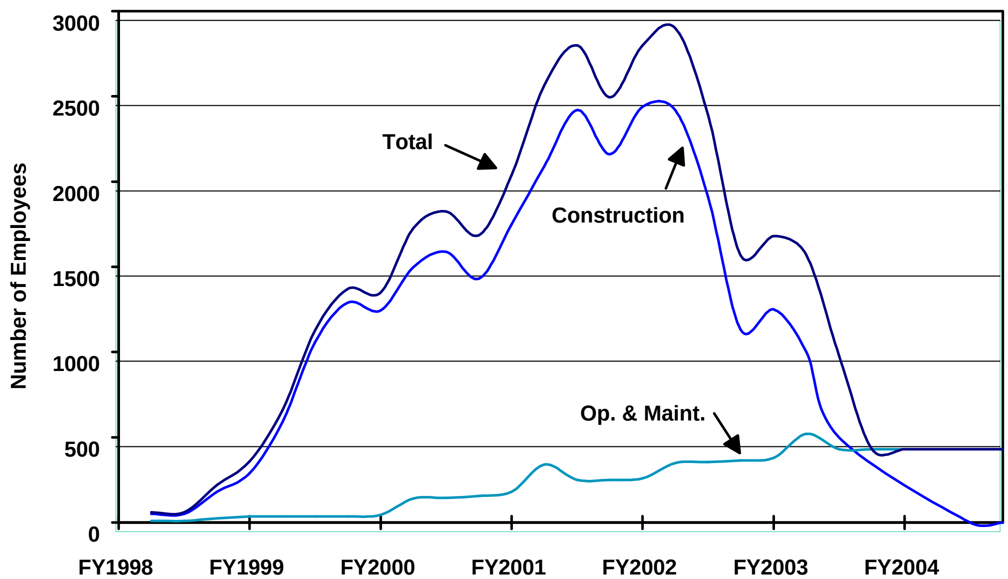


New coal handling facilities are constructed for barge unloading of coal. The existing cooling towers and circulating water system are utilized for cycle heat rejection. The existing substation is augmented and a new auxiliary power system is constructed. A new distributed control and information system is constructed.

The IGCC/C facilities will be constructed in phases. Phase I will consist of constructing the first unit and the projected start date is FY 1998, 2nd quarter. Phase II, which combines gasification with the first phase of construction of the coproduction setup will begin 18 months later in FY 2000, 3rd quarter. Phase III, construction of the two remaining gasification units, will begin 12 months later.

The work force size will correspond to the construction phases. Maximum projected work force size is 2,898 people in the 2nd quarter of FY 2002 or the peak of construction for the coproduction units. Upon completion and start up of the final unit, the work force will stabilize at 430 personnel for operating and maintenance. The projected work force throughout construction is shown in Figure 2.2-12. More detailed work force estimates are provided in Appendix C.

Figure 2.2-12 Work Force Population for IGCC/C



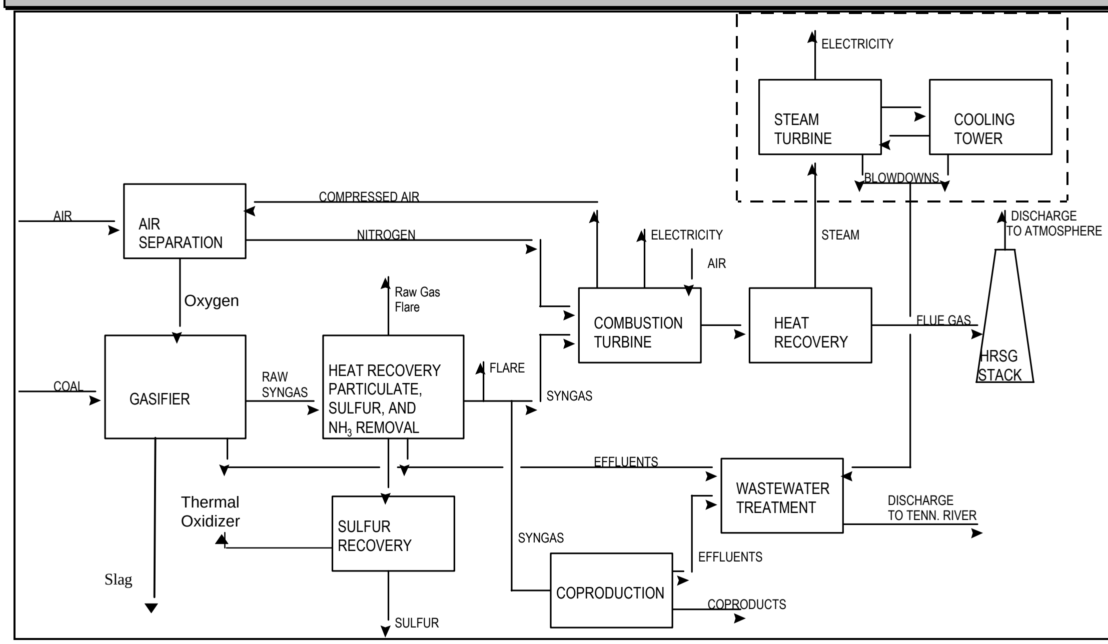
2.2.5.2 Description of Project Operations

The IGCC/C Option for Bellefonte consists of four modules, one consisting of a coal gasification plant, an advanced CT, and a HRSG, and three consisting of a coal gasification plant each and the related chemical coproduction plants. Approximately 70% of the synthesis gas produced by the four gasification plants is routed to the chemical plants. The remaining synthesis gas is routed to the CT Combined Cycle (CTCC), which generates approximately 190 MW. Within the combined cycle, Bellefonte's existing

Unit 2 steam turbine system may be modified to generate about 260 MW. The plant's net output will be approximately 450 MW. Total coal /petroleum coke consumption would be 12,000 tons/day.

Figure 2.2-13 shows the overall flow scheme for the IGCC/C facility. Except for the differences in number of units, the process description for the IGCC portion of the facility is the same for Conversion Option 3.

Figure 2.2-13 IGCC/C (4 Gasifiers, 1 Combined Cycle and Coproduction)



New equipment will include:

- Four gasification plants
- A synthesis gas-fired CT and HRSG
- Chemical production units
- Sulfur recovery plants
- Coal and combustion waste handling and storage equipment
- Coal receiving equipment for coal received by barge
- Upgraded railroad services
- Facilities for shipping chemicals
- Fuel oil storage tanks
- One primary stack for the HRSG

Existing Bellefonte equipment will include:

- Bellefonte Unit 2 steam turbine and condenser
- Unit 2 natural draft cooling tower
- Station auxiliaries (compressed air and service water)
- Switchyard and transmission system
- Office and service buildings

It is important to note that this option results in the conversion of Bellefonte Unit 2 steam turbine and Unit 2 cooling tower only. This means that Unit 1 steam turbine and Unit 1 cooling tower would remain unused and would be available for completion as a nuclear unit or converted fossil unit.

Several different chemicals and chemical production mixes are being considered for this option. Studies are underway by TVA to assess market opportunities and economic risk associated with the production of various coproducts that can be made from syngas. Study results are not available at this time to support the identification of specific chemical plant systems and equipment that would be employed in connection with this option. However, it is possible to describe two examples of chemical production scenarios that would provide an indication of the types of facilities that might be involved. Two example chemical production scenario choices are discussed in section 2.3.7. Scenario B was determined to represent the most likely product mix and therefore constitutes the basis for impacts evaluations in Chapter 4. Table 2.2-5 describes generally each of the chemicals involved in both scenarios. [2,3,4] More detailed information about chemical and physical properties of each product is provided in Appendix D.

Scenario B would involve the production of the following chemicals:

• Methanol	740,000 tons/year
• MTBE	462,000 tons/year
• Formaldehyde	444,000 tons/year
• Acetic Acid	48,000 tons/year
• Granular Urea	155,000 tons/year
• Urea Ammonium Nitrate	496,000 tons/year
• Ammonia	31,000 tons/year
• CO_2	205,000 tons/year

Table 2.2-5 Chemical Coproducts Description

Chemical and Name	Physical Description	Flammability	Uses and Descriptions
Methanol	Colorless liquid with characteristic pungent odor	Class IA Flammable Liquid - Flash point at or below 73ºF, Boils below 100ºF	Chemical intermediate, antifreeze solvent , denaturant for ethanol, dehydrator for NG, fuel cell
Methyl-*tert*-Butyl ether	Colorless liquid	Flammable - equivalent to a Class IA Flammable Liquid - Flash point at or below 73ºF, Boils below 100ºF	Octane booster for Unleaded Gasoline (7% Vol)
Formaldehyde - (37% soln with water also known as - Formalin)	Soln: Colorless liquid with pungent odor, pure: Nearly colorless gas with pungent odor	Class IIIA Combustible Liquid- Flash point at or above 140ºF, Boils below 200ºF	Resin, ethylene glycol, embalming fluids, preservative, durable press treatment of textile fabrics, foam insulation particle board, plywood.
Acetic Acid - Glacial - 99.8 %	Colorless liquid or crystals with sour, vinegar-like odor	Class II Combustible Liquid- Flash point at or above 100ºF, Boils below 140ºF	Acetic anhydride, cellulose acetate, plastics, pharmaceuticals, dyes insecticides, photographic chemicals, latex coagulant, textile printing - Vinegar.
Granular Urea	Solid white crystals or powder, almost odorless, with saline taste	Non Combustible	Fertilizer, animal feed, plastics, chemical intermediate, stabilizer in explosives, medicine (diuretic), adhesives, pharmaceuticals, cosmetics.
Ammonia, Liquid Anhydrous - refrigerated	Colorless gas with pungent, suffocating odor - easily liquefied under pressure	Should be treated as a flammable gas	Fertilizer, Nitric acid, urethane acrylonitrile, refrigerant, synthetic fibers dyeing latex preservatives, explosives, fuel cells, rocked fur; yeast nutrient
Carbon Dioxide	Colorless, odorless gas	Nonflammable	Refrigerant, carbonated beverages, aerosol propellant, chemical intermediate, inert atmospheres, shielding gas for welding.

2.2.6 Option 5: Construction and Operation of Integrated Gasification Combined Cycle Unit, Natural Gas Combined Cycle Units and Gasification Units with Chemical Coproduction (Combination)

2.2.6.1 Description of Construction Activities

The plant would consist of the facilities described for IGCC/C combined with and adequately sized NGCC plant to allow full utilization of transmission facilities serving Bellefonte (approximately 2400 MW). To provide the full generating capacity, six “F” technology CTs (coupled with HRSGs) would be constructed. Descriptions of the construction aspects and systems of the Combination Option are the same as for NGCC and IGCC/C (Conversion Options 2 and 4), including the use of low-sulfur distillate oil in a supplemental backup mode.

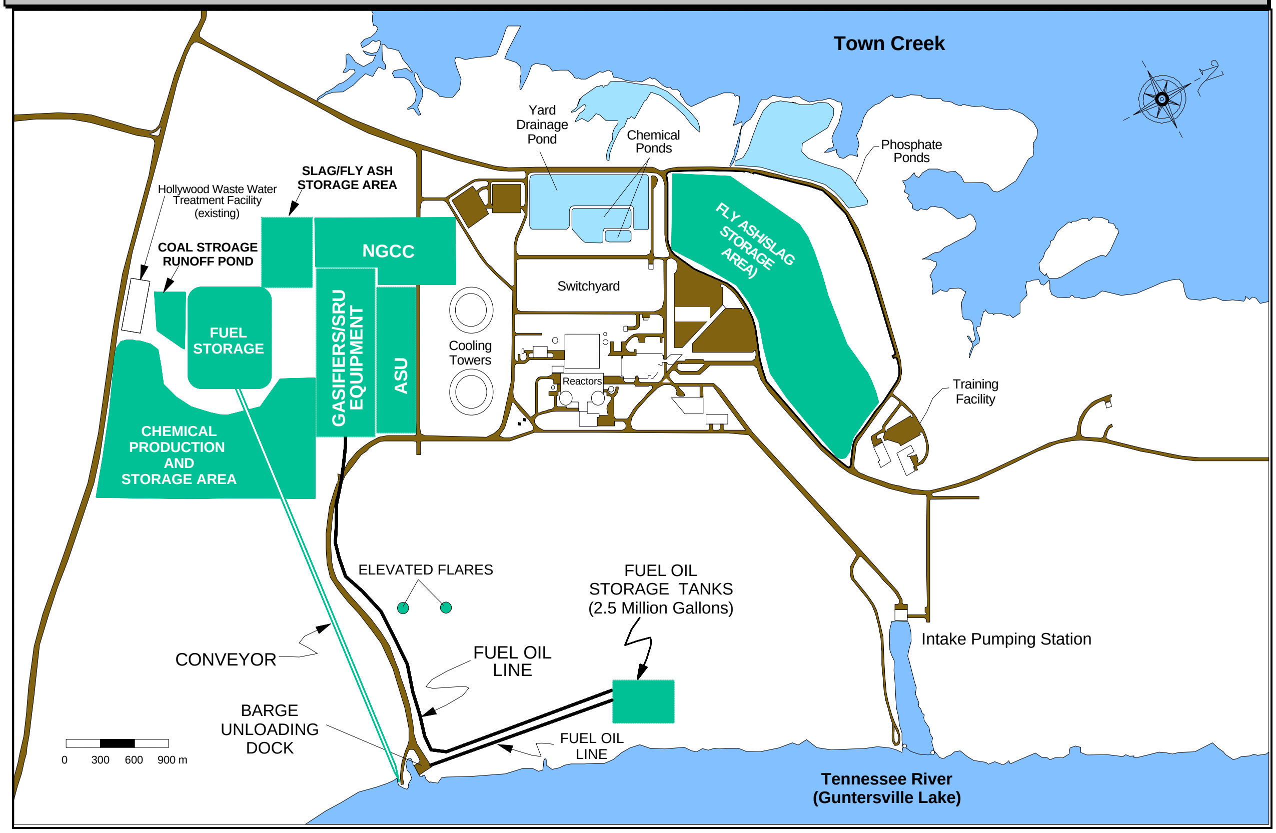
Construction will include the preparation of an area for disposal of unmarketable slag from gasification. The area identified is expected to provide at least 18 years of storage capacity, even if none of the slag is marketed.

Figure 2.2-14 is a simplified footprint of a Combination facility. A larger more detailed schematic is in Appendix B. Approximately 225 acres would be needed to construct new facilities. Construction in the area shown will result in the demolition or relocation of several existing buildings and underground utilities. After completion of demolition, the area will be cleared and grubbed to remove existing vegetation, then leveled to an elevation above the 500-year floodplain.

Cooling tower blowdown diffusers and piping in the Tennessee River will be lowered approximately five feet from their current elevation to allow unrestricted barge movement. The barge unloading area will consist of a loaded barge storage dock, unloading dock and empty barge dock. The docks will be constructed of cells interconnected with walkways. Cells will be constructed of sheet piles with a granular fill material. Less than 50 each 20-foot diameter cells will be needed to handle the smaller fuel demand of the Combination plant.

New coal handling facilities are constructed for barge unloading of coal. The existing cooling towers and circulating water system are utilized for cycle heat rejection. The existing substation is augmented and a new auxiliary power system is constructed. A new distributed control and information system is constructed.

Figure 2.2-14 Combination Footprint

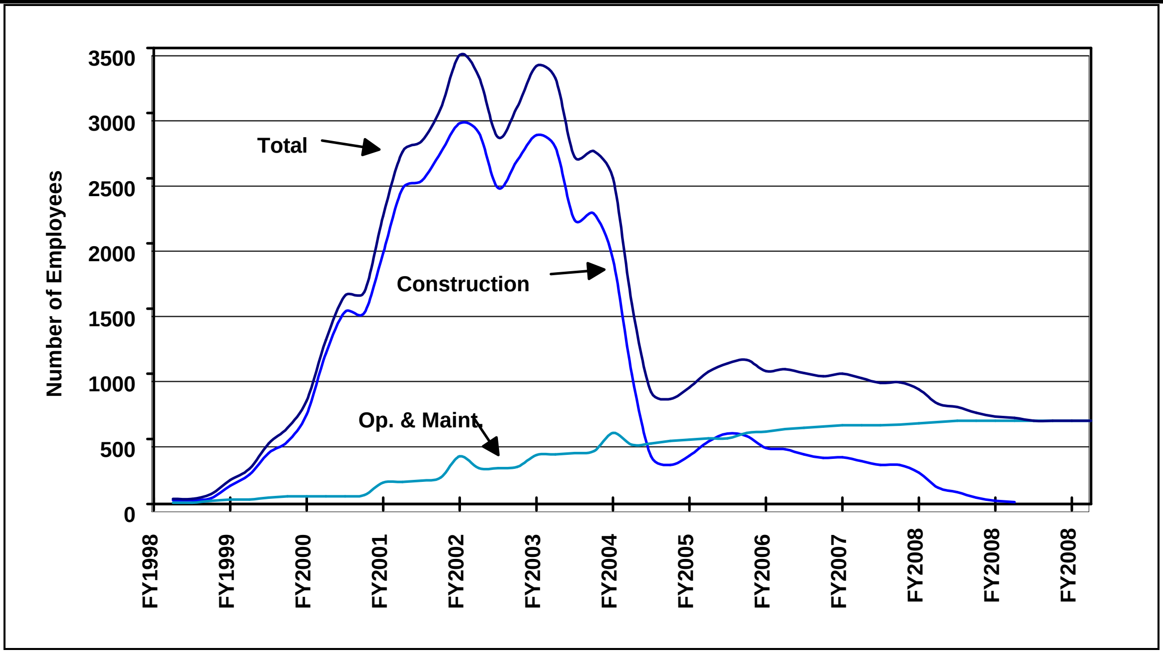


The NGCC, IGCC, and Coproduction facilities (referred to hereafter as the Combination Option) will be constructed in phases.

Phase I	1st NGCC Unit	2^{nd} Qtr, FY 1998
Phase II	1st IGCC Unit	1^{st} Qtr, FY 1999
Phase III	Coproduction Setup	1^{st} Qtr, FY 2000
Phase IV	IGCC Coproduction Units	1^{st} Qtr, FY 2001
Phase V	2nd NGCC Unit	4^{th} Qtr, FY 2003
Phase VI	Remaining NGCC Units	4^{th} Qtr, FY 2006

The work force size will correspond to the construction phases. Maximum projected work force size is 3,362 people in the 1st quarter of FY 2003 during the peak of construction of the coproduction units. Upon completion and startup of the final unit, the work force will stabilize at 640 personnel for operating and maintenance. The projected work force throughout construction is shown in Figure 2.2-15. More detailed work force estimates are provided in Appendix C.

Figure 2.2-15 Work Force Population for Combination Option



The Combination Option for conversion of Bellefonte will require natural gas as a fuel. Because natural gas supplies are not available in the plant vicinity, pipeline construction and operation is treated as a "connected action" under NEPA and is described in Section 2.3.1 of this FEIS. Section 3.2 describes the affected environment and typical pipeline construction and operating practices, and Section 4.3 considers the impacts of these actions for three alternative pipeline corridors leading to gas supply pipelines which either currently exist or are projected to be constructed for reasons unrelated to the conversion of Bellefonte.

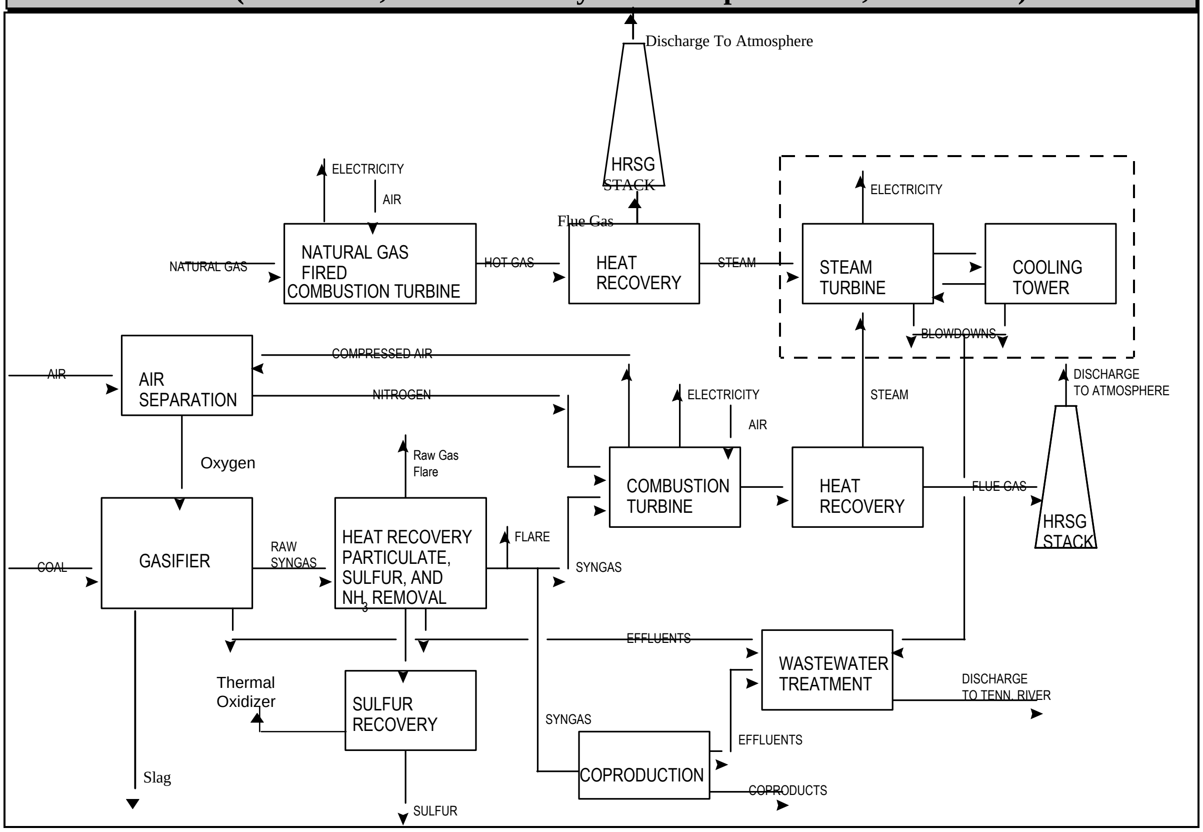
Backup low-sulfur distillate oil (0.05%) will be provided to allow operation of up to two CTs for a two-week period. The storage tank volume is based on an operating scenario of two units for one week followed immediately by one unit for two additional weeks.

2.2.6.2 Description of Project Operations

The combination scenario combines the equipment configurations of the NGCC and IGCC/C Options with the concept of phased construction. The first phase for the Combination Option will be the construction of one NGCC module. An NGCC module will consist of:

- One natural gas-fired CT,
- One HRSG, and
- An existing Bellefonte steam turbine system (Unit 2) may be modified to accept steam from the HRSG. (See Figure 2.2-16).

Figure 2.2-16 Combination Option
(4 Gasifiers, 1 Combined Cycle and Coproduction, and NGCC)



After construction of the initial NGCC Unit is completed, the second phase, an IGCC/C facility, will be constructed. The coproduction phase consists of four modules:

- one consisting of a coal gasification plant, an advanced CT, and a HRSG, and
- three consisting of a coal gasification plant each, and the related chemical coproduction plants.

Excess steam from the gasifiers is routed to Bellefonte Unit 2 steam system, raising the net power output of the gasification block to 785 MW.

Two chemical coproduct scenarios are contemplated. The production quantities and process descriptions for the coproduct complexes are the same as Option 4.

In the final phase, a NGCC facility is added. This facility consists of:

- Six NGCC units with each NGCC unit containing one advanced CT and one HRSG,
- Duct burners will be included in each HRSG to boost total output of the plant for peak power generation, and
- In addition, Bellefonte Unit 1 steam system may be modified.

The steam produced by four of the NGCC units will be collected and routed to Bellefonte Unit 1 steam systems. Steam from the remaining NGCC unit will be routed to Bellefonte Unit 2 steam system. Bellefonte's net output will be approximately 2,565 MW at the end of this phase with a total natural gas consumption of 325 mmscf/day. Total coal/petroleum coke consumption would be 12,000 tons per day. The installation of duct burners will have the effect of increasing the total plant output to 2,895 MW with a total natural gas consumption of 412 million standard cubic feet per day. At the end of the project,

New equipment will include:

- Four gasification plants
- One synthesis gas-fired CT and HRSG
- Six natural gas-fired CT and related HRSG
- Chemical production units
- Coal and combustion waste handling and storage equipment
- Coal receiving and unloading equipment for coal received by barge
- Upgraded railroad facilities
- Facilities for shipping chemicals

Existing Bellefonte equipment will include:

- Bellefonte Unit 1 steam turbine and condenser
- Bellefonte Unit 2 steam turbine and condenser
- Unit 1 & 2 natural draft cooling towers
- Station auxiliaries (compressed air and service water)
- Switchyard and transmission system
- Office and service buildings

2.2.7 Ranking of Conversion Options by Cost

As noted in Chapter 1, TVA has embarked on a study of conversion options to identify which options offer the best investment options and least financial risk. The final results of that study will become available at about the same time that this FEIS is completed. The completion of these two efforts will allow TVA to make an investment decision based on the best and most timely economic, technical, and environmental information.

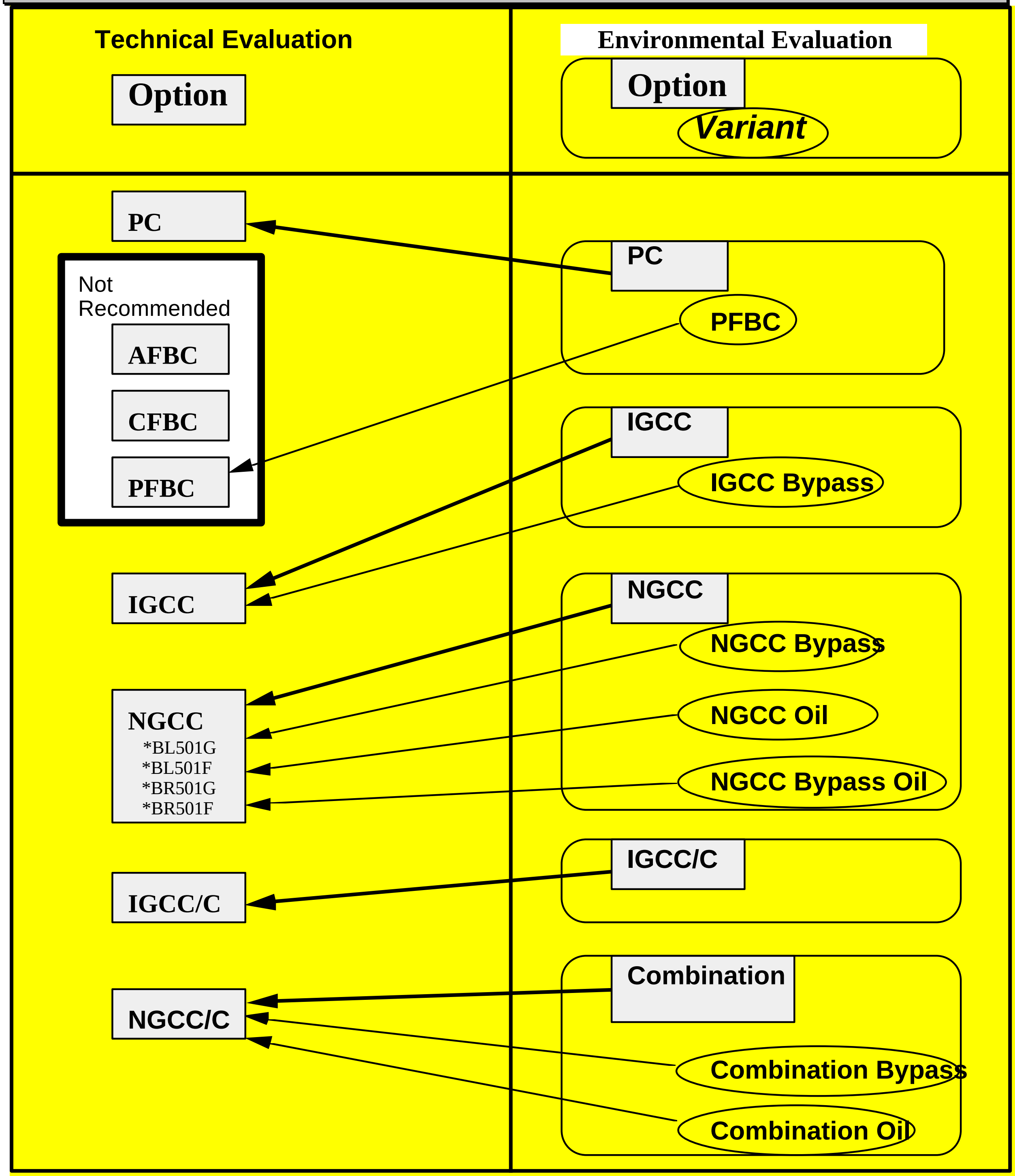
TVA and its contractors have developed conceptual designs, cost estimates, schedules, performance parameters, mass and energy balances, flow diagrams, environmental data, site layout and equipment drawings and other information for various conversion options. The market potential for chemicals which could be produced in connection with an gasification based option, such as the IGCC/C and Combination Options, was assessed to determine the additional revenue expected from such coproducts. The technical information from these concurrent studies was folded as it became available into the options descriptions provided earlier in this section to ensure that the actions being assessed for environmental impacts were indeed those being assessed for financial and risk aspects.

2.2.7.1 Mapping of Environmental Review onto Ongoing Technical Evaluations

Figure 2.2-17 shows the relationship between the environmental and technical evaluations. The five conversion options for which environmental impacts are described in this FEIS provide full coverage of the somewhat more numerous conversion options concurrently being assessed for technical feasibility and financial risk. Although not shown in the figure, many AFBC configurations would fit within the envelope of impacts evaluations provided for PC and PFBC.

Note that AFBC, CFBC, and PFBC are shown in Figure 2.2-7 as being “not recommended.” These fluidized bed technologies were not included in detailed technical and economic analyses because of technical and implementation shortcomings if used in a full conversion of Bellefonte facilities.

Figure 2.2-17 Mapping of Environmental Review onto Technical Evaluation



Definitions:
Bypass - operation with flue gases bypassing the HRSG, i.e., simple cycle mode
Oil - operation of two combustion turbines on low sulfur distillate fuel for three months during winter; reflects temporary interruption of natural gas supply
Bypass Oil - combination of above

2.2.7.2 Ranking of Selected Conversion Options

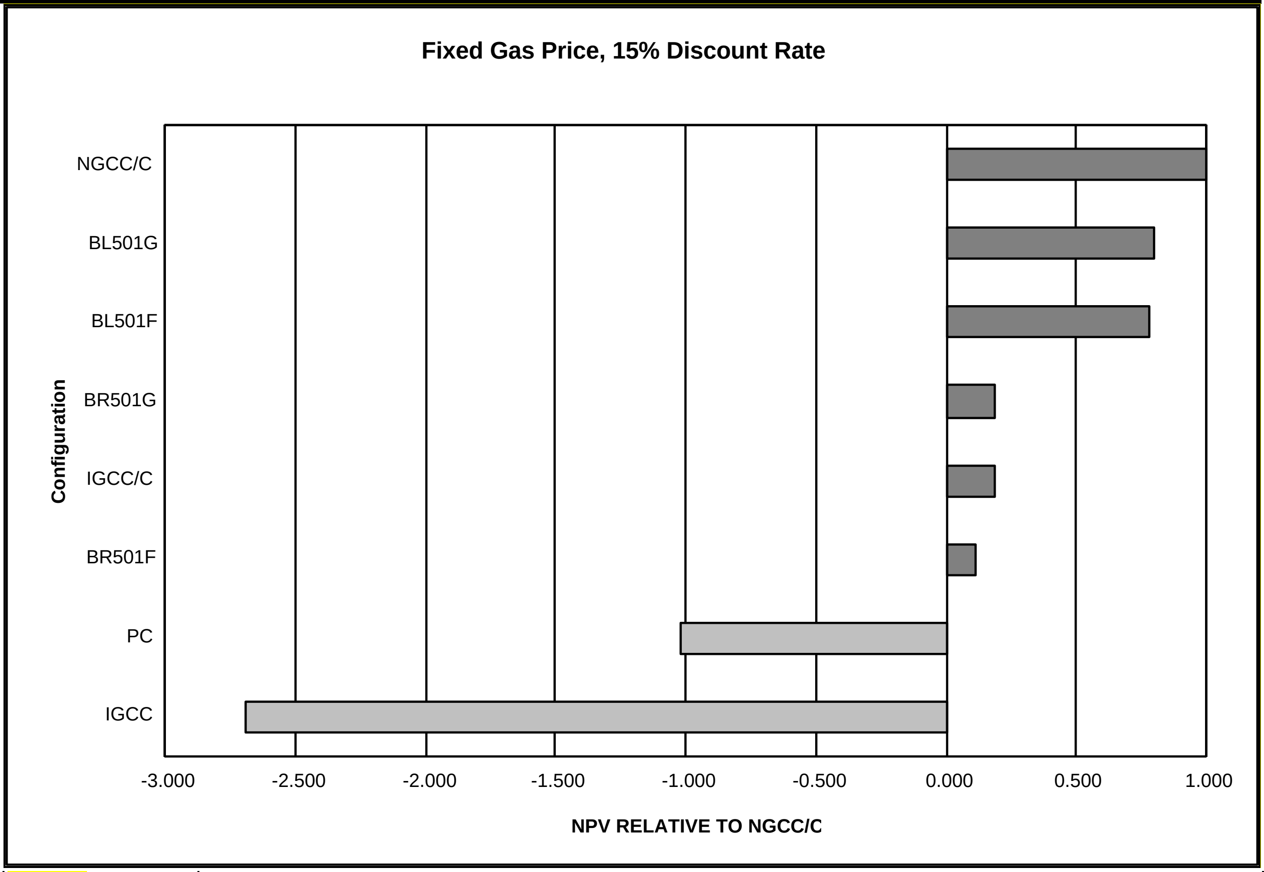
The results of economic evaluations for the conversion of Bellefonte are considered business sensitive information. However, an economic ranking is provided below to provide the reader with an understanding of the relative cost-benefit of various conversion options .

One economic method used to assess financial aspects of conversion options is Net Present Value (NPV). NPV considers the cashflows of an investment opportunity based on a discount (interest) rate and fixed or variable pricing information. Higher values of NPV indicate improved economics of the conversion option. Any number of combinations of inputs can be evaluated and compared. Figure 2.2-18 shows a relative ranking of NPVs for several conversion options.

The rankings are based on a 15% discount rate and a fixed price for natural gas. Coal price projections used are based on TVA’s fuel option forecast. These forecasts are relatively stable and the economics of coal-fired plants are not particularly sensitive to coal price. Use of coal forecast data, versus current fixed price quotes, is consistent with TVA’s vast past experience in the purchase of this commodity. Ranking values for each conversion option were calculated by dividing each NPV into the NPV for the option having the highest NPV. This results in the conversion option with the highest NPV having a value of one, others are arithmetically lower. Conversion options with negative NPVs have negative NPV ranking values. In summary, NGCC/C is projected to be the best configuration from a revenue producing standpoint with five other configurations also producing revenue. Two of the configurations would be revenue consuming.

The rankings are sensitive to discount rate, gas pricing, useful equipment life, and many other factors. These results are indicative of only one set of model inputs and assumptions. Changes in discount rate alone can result in a change in the rankings of conversion options.

Figure 2.2-18 Relative NPV for Bellefonte Conversion Options



Option: Configuration	Description
PC:PC	Full conversion with conventional pulverized coal-fired boilers (converts both Bellefonte units)
NGCC:BL501G	Full conversion with 501G natural gas-fired combined cycle units
NGCC:BL501F	Full conversion with 501F natural gas-fired combined cycle units
NGCC:BR501G	Two 501G natural gas-fired combined cycle units installed as a brownfield plant (conversion)
NGCC:BR501F	Three 501G natural gas-fired combined cycle units installed as a brownfield plant (no conversion)
IGCC:IGCC	Full conversion with IGCC, no chemical coproduction
IGCC/C:IGCC/C	One gasifier with chemical coproduction with combined cycle fuel supply supplemented with natural gas
Combination: NGCC/C	Full conversion with 501G natural gas-fired combined cycle units plus one gasifier with chemical coproduction

2.3 Description of Suboption Process, Control, and Design Alternatives

As described earlier, the analysis of alternatives in this FEIS involves three tiers. The first tier is the decision between the No-Action Alternative and the Proposed Action. Assuming that the decision is made to convert Bellefonte to fossil fuel power production, the second tier decision is to select from among five conversion options. NGCC is TVA's preferred conversion option. The third tier analysis involves nine suboptions that apply to one or more of the five conversion options. A suboption may be an alternative process, an alternative environmental design, or an alternative siting configuration. To allow decisionmakers to select a preferred Bellefonte conversion option without the complications of considering an array of process, design, and siting variables, certain simplifying assumptions were made with respect to these suboptions. The selection of these suboptions has important environmental implications for the conversion options of which they are a part. This section discusses these various options.

Suboption choices were considered for the following items.

- **Natural gas pipeline corridors** - Large supplies of natural gas for conversion alternatives which involve the use of this fuel do not exist in the Scottsboro area. This FEIS considers the impacts and implications of three corridors leading to three points in northeast Alabama where high pressure gas pipelines currently exist or are expected to exist by the time fuel is needed at Bellefonte: west, northeast, and south.
- **Fuels, feedstocks, and by-products transportation modes** - Transportation mode choices include barge, rail and truck for delivery of fuel and feedstocks to Bellefonte and for transport of products and by-products to markets.
- **CTs** - Choices include two generations of new CTs (F and G/H). Refurbished simple cycle turbines modified to run in combined cycle mode were considered.
- **Solid fuels** - Solid fuels considered for Options 1, 3, 4 and 5 include coal, biomass, petroleum coke, coal/petroleum coke mix, refuse derived fuel, and char from coal refining. Biomass and refuse derived fuel were eliminated from detailed consideration because these fuels are not available in sufficient quantities for converting Bellefonte.
- **Boilers** - Three types of conventionally fired boilers were considered for use at Bellefonte depending on cost at the time of selection: PC combustion, AFBC, and PFBC. A detailed analysis of AFBC was not completed because of its low probability of selection.
- **Gasifiers** - Three types of entrained flow gasification technologies (Shell, Destec, and Texaco) were considered for use at Bellefonte.
- **Chemicals Production** - Two chemical production scenarios (one involving methanol derivatives and another agricultural chemicals) were considered for Options 4 and 5.

- **<u>Coal and Limestone Conveying</u>** - For the conversion options involving coal and limestone handling, two conveying methods were considered: horizontal curve (flat trough) and pipe conveyor.

Table 2.3-1 shows the applicability of suboption alternatives to conversion options.

Table 2.3-1 Applicability of Process Suboptions to Bellefonte Conversion Options

No.	Process Suboption	PC	NGCC (Preferred)	IGCC	IGCC/C	Combination
1	Gas Pipeline Corridor		X			X
2	Transportation Mode	X		X	X	X
3	CT		X	X	X	X
4	Solid Fuel	X		X	X	X
5	Boiler	X				
6	Gasifier			X	X	X
7	Chemicals Production				X	X
8	Coal Conveying	X		X	X	X

The primary goal of this FEIS is to provide information about the environmental impacts of several options for converting Bellefonte to fossil fuel. A suite of five reasonable and conservative conversion options (NGCC is preferred) representing a broad range of technologies was developed for evaluation. As noted in Section 2.2.1.4, it is also important to preserve flexibility at the third tier of choices, which involves alternative processes, controls, and designs. To ensure maximum flexibility at tier three, option descriptions presented in Section 2.2 are based on the most conservative suboption choices (i.e., those which would likely result in the highest environmental impacts). Reasonable competing choices are discussed and compared in the following. Suboption choices selected for evaluation in this FEIS are summarized in Section 2.3.9. These choices comprise the Proposed Action Alternatives described in Section 2.2.

The pipeline issue is connected to the NGCC (the preferred option) and Combination Conversion Options and its impacts need to be addressed. The impacts are considered to be incremental to their respective conversion options. For example, in comparing the environmental impacts of the NGCC Option with the IGCC Option, the TVA decisionmaker may elect to take into account the impacts of constructing and operating a natural gas pipeline. The incremental impacts of constructing and operating a natural gas pipeline are discussed in Chapter 4 of this FEIS.

2.3.1 Natural Gas Pipeline Corridors

2.3.1.1 Introduction

Two of the five Bellefonte conversion options would require natural gas. These include NGCC and the Combination Options which includes use of some NGCC. For either of these options, a natural gas pipeline connecting Bellefonte to existing supplies of gas will be required. Accordingly, pipeline construction and operation are addressed in this FEIS.

The most likely supply of natural gas will be a lateral line from a large capacity natural gas transmission line that now exists or will likely exist in the future. The construction and operation of a pipeline serving Bellefonte may be accomplished by the owner and operator of the natural gas transmission line, a third party company contracted to TVA, or a TVA entity. Regardless, the pipeline would be required to transport approximately 470 million cubic feet per day under the NGCC Option. Assuming that a compressor station is established at the point of departure from the existing pipeline, this quantity of gas would require a 36- to 42-inch diameter pipeline with pressures of at least 500 pounds per square inch.

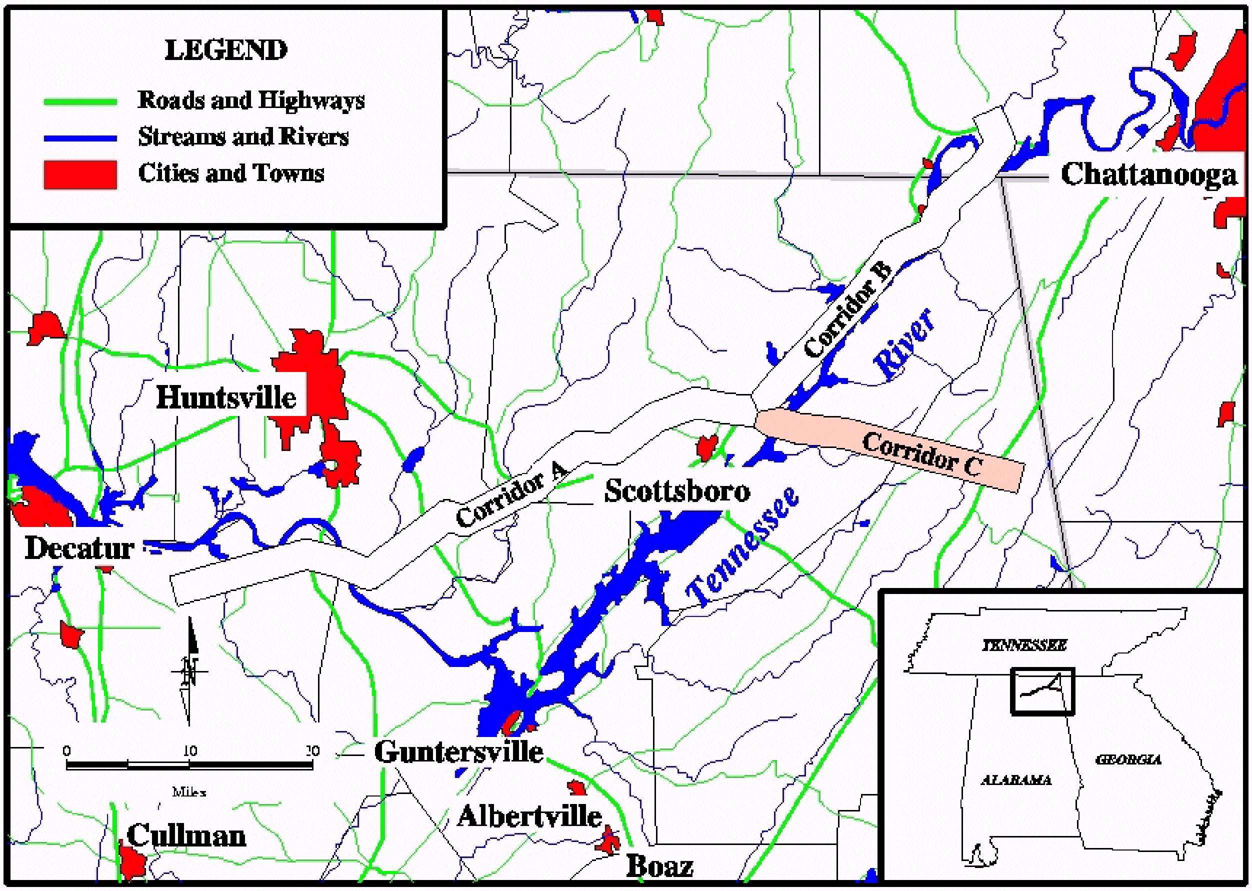
If natural gas is required, TVA will negotiate the least cost supply consistent with its need for reliable deliveries. There are no planned routes for a pipeline to bring natural gas to Bellefonte at this time. Nevertheless, in order to evaluate the range of potential impacts from pipeline construction and operation for this FEIS, TVA developed three likely corridors connecting existing, proposed, or possible future interstate natural gas pipelines. The three corridors approach Bellefonte from different directions and traverse a range of terrain and environments that any future line would likely encounter.

Each of the corridors selected for this impact analysis has a width of two miles. Selection of a more specific route would be speculative at this juncture. The following subsections describe the three pipeline corridor routes and typical construction and operating practices for this region of the U. S. Impacts in the potential corridors are addressed in Chapter 4 based on existing information sources. [5] If constructed, more specific pipeline routes would be identified for environmental review.

2.3.1.2 Identification of Potential Corridors

Figure 2.3-1 shows three corridors that would be likely for a future natural gas pipeline to supply Bellefonte. These corridors were developed by TVA to illustrate the range of terrain and environment through which an actual line might pass. They were not based on any proposal, plans, or designs from any natural gas suppliers.

Figure 2.3-1 Locations of Three Natural Gas Pipelines to Supply Bellefonte



The corridors:

- connect Bellefonte with three expected future gas supply points,
- follow existing rights-of-way (ROW) and logical terrain features, and
- are reasonably direct connections that minimize transport distances and costs.

Corridor A, in Figure 2.3-1, is approximately 50 miles in length. It would connect Bellefonte with a proposed natural gas line currently being constructed by Southern Natural Gas. [5] The Southern Natural Gas line will connect Huntsville with Southern Natural Gas's main east-west line across central Alabama. From Bellefonte, Corridor A goes north of Scottsboro in a west-southwesterly direction crossing U.S. Highway 72 approximately 14 miles west of Scottsboro and then proceeding south-southwest crossing the Tennessee River south of Huntsville then proceeding generally west (south of the Tennessee River) to a point on the proposed Southern line about 13 miles east southeast of Decatur.

Corridor B is approximately 31 miles in length. It would connect an existing natural gas pipeline, the East Tennessee line, near Jasper, Tennessee. From Bellefonte, Corridor B proceeds northeast between the Tennessee River and U. S. Highway 72. Much of the length is parallel to existing electric power transmission lines. It would require two crossings of the Tennessee River.

Corridor C is approximately 22 miles in length. It would connect with a possible new gas transmission line between Gadsen, Alabama, and Chattanooga, Tennessee. Unlike the Southern line, the Birmingham to Chattanooga line has not been proposed and therefore has no defined alignment. The assumed alignment for this possible new line is parallel to an existing railroad. Although the shortest of the three corridors, Corridor C would traverse Sand Mountain and other ridges and has little opportunity for ROW sharing along its length.

2.3.1.3 Description of Typical Pipeline Construction Practices

The construction of a natural gas pipeline in the Southeastern U. S. would require several sequential activities. These activities are conducted by separate crews specialized in particular facets of pipeline construction. Maximum construction work force could range from 100 to 300 persons depending upon the corridor selected and the time required to conduct the construction. The work is done pursuant to standards (49 CFR Part 192) set out by the Office of Pipeline Safety in the U. S. Department of Transportation. [6]

<u>Right of Way Acquisition</u>

Typical ROW acquisition widths to be acquired from landowners are 70 to 90 feet for construction (the typical permanent ROW easement for operation is 50 feet). Where topsoil needs to be segregated (e.g., agricultural areas), the construction ROW width will be 90 feet. In most nonagricultural areas, the construction ROW widths will be 70 feet. The pipeline company will negotiate with landowners for both construction and permanent ROW easements, but can acquire the ROW through condemnation if necessary.

Survey and Staking

The pipeline alignment will be surveyed by a survey crew. Other pipeline crossings will be marked.

Clearing

In upland areas, trees and brush in the path of the construction ROW will be cleared with bulldozers. The woody debris will be burned or buried in an approved landfill.

Grading

To prepare for excavation in upland areas, the surface will be leveled and graded.

Ditching

Backhoes or trenching machines will be used to excavate an 7- to 9-feet deep trench. To provide working room in the trench, the width of the excavation will be 5 to 7 feet. Soil removed from the ditch will be placed within the construction ROW and used for cover. In agricultural areas, topsoil will be segregated and placed on top of the excavation so that the area above the line can be used for farming. Mechanical rippers will be used in rocky areas; drilling and blasting may be necessary for trenching through hard rock.

Stringing

Once the ditch has been dug, individual joints of pipe will be laid end to end along the ROW using special "stringing" equipment.

Bending

To accommodate moderate changes in vertical or horizontal alignment, a mechanical pipe bending machine will bend individual joints of pipe to the required angle. If the sharp turns are required, prefabricated fittings will be used to make the turns.

Coatings

In addition to factory coatings applied to protect the pipe from corrosion, weld joints will be coated.

Welding and Lowering In

Crews will weld individual joints together to form longer sections which are then lowered into the trench by side-boom tractors. The longer sections are welded together in the ditch. Welds will be inspected by a qualified third-party using radiographic techniques prior to lowering in.

Backfilling

The rock and soil removed in the trenching step will then be used to backfill the ditch after the pipeline has been laid in. To avoid damage to the line, soil will be placed around the line followed by the rock. The surface will be graded and revegetated to approximate original contour and to meet specific agreements with the landowner.

Testing

Before the pipeline is placed into service, it will be tested hydrostatically. Clean water from a nearby source will be pumped into the line and pressurized for several hours at pressures that will substantially exceed maximum pressures anticipated during service.

Cleanup

The final step in the pipeline construction process is the removal and disposal of any construction debris and the restoration of the surface to its original conditions including approved revegetation practices and the repair of any fences, gates, or other improvements that may have been affected by the construction.

Often nonconventional construction will be required where stream or highway crossings make trenching economically or environmentally impractical. For example, crossing railroads, highways, and water bodies, it will be necessary to avoid disturbing the surface. This is accomplished through boring or directional drilling techniques described below.

Boring and Directional Drilling

Boring and directional drilling are techniques used to cross linear and sensitive environmental features such as a railroad or a river. These techniques allow for the pipeline to pass under the feature without disturbing the surface.

Boring is accomplished by special crews that first dig a bore pit in a construction ROW area that is several times wider than that used for conventional open trench construction. A typical bore pit will have sloping sides and an outside dimension of 60 by 30 feet and a depth of 12 feet. The pipeline will be installed from one bore pit to another by drilling horizontally. The pipe is either pulled through the bore hole or pushed through by either the "slick" or "dry" boring technique. Pipe used in bores is usually thicker (to protect against abrasions) and is protected through either outside casings or a coating called "powercrete" that resists abrasives.

Directional drilling is accomplished with a computerized guidance system that curves under the feature to be crossed. More sophisticated equipment and techniques are used in directional drilling to allow for deeper and longer crossings.

Compressor Station Construction

Given the relatively short lengths of these corridors, it is likely that no compressor stations would be required to boost gas pressures within the corridor segments. However, a single compressor station may be required at or near the point of departure from the gas supply line.

Compressor stations occupy relatively large (15 to 30 or more acres) tracts of land that are used primarily for maintenance and operation of the pipeline. As the name implies, a compressor station's main function is to increase the pressure of the gas inside the pipeline consistent with the existing line pressure, the distance that the gas is to be transported, and the required pressure by the receiving facility. Other functions of the station are to provide a site for equipment storage and maintenance activities. The construction of the compressor station will entail grading and clearing of several acres and fabrication of several metal buildings to house the compressors and other equipment. Sometimes the pipeline company will purchase additional land to serve as a buffer between the equipment and future development. The buffer serves to reduce noise impacts, mitigate any possible releases of gas (and possible fires or explosions), and aesthetic concerns. Therefore, some land may be left relatively undisturbed with woodlands serving as visual screens around some of the perimeter of the facility.

2.3.1.4 Description of Typical Pipeline Operation Practices

Following construction of the pipeline and ancillary facilities, the line will be placed into service. Maintenance activities could include periodic mowing of the ROW, gas-leak survey, maintenance of fence posts, markers and decals, inspection of water crossings, periodic fly-overs inspecting the line from the air and annual walk-overs inspecting the line from the ground, valve inspection and lubrication, and cathodic protection monitoring (cathodic protection is used to prevent corrosion of the steel pipeline).

Given the required flow for the preferred option (NGCC) and typical operating pressures, a plausible gas compressor scenario would include a compressor station with a total of five reciprocating engines at about 2,250 horsepower each. The flow would only require three or four engines but five would be needed for backup and maintenance. Alternatively, two large turbine compressors could be required, electric-powered or gas turbine powered.

2.3.1.5 Conclusion

As noted earlier, it is not certain that a natural gas pipeline would need to be constructed for the sole purpose of providing fuel to Bellefonte and it is premature to state with certainty where such a line would be built. It is possible that a natural gas pipeline company would extend a pipeline to the Scottboro area to meet existing and other future demands and that such a line would meet Bellefonte requirements. Given these uncertainties, the impacts of constructing and operating a pipeline along three likely corridors are evaluated for the two conversion options that require natural gas as a fuel.

2.3.2 Fuels, Feedstocks, and By-products Transportation Modes

2.3.2.1 Introduction

The purpose of this section is to identify and characterize various modes of transportation that could be used during normal operation to move raw materials to Bellefonte and products and byproducts from Bellefonte. Transportation considerations, at least in this section, does not include modes such as sluicing, pipe or belt conveying, pneumatic systems or other means of conveyance which maybe used to relocate materials from one place to another within the confines of the Bellefonte property.

Raw materials, products, and by-products and their transportation would differ depending on the conversion option (see Table 2.3-2). The preferred option, NGCC, would involve moving no bulk materials of any consequence (except fuel oil for use as a backup fuel) to or from the site. This FEIS cannot fully assess the impacts of all possible routes for materials. However, the use of barge, rail, and truck, the three modes of transportation available for transporting materials in bulk quantities, can be described for the immediate vicinity of Bellefonte. The fuel cycle analysis in Section 4.2.18 addresses impacts beyond the vicinity of Bellefonte. Land resource impacts resulting from coal mining are addressed in Section 4.2.14. The most desirable mode of transportation is a function of the material being transported, its rate of production and shipping frequency, cost of transport, market demands, and a number of other factors.

For combustion derived solids, the TVA Environmental Assessment (EA) entitled “Coal Combustion By-Product Marketing/Utilization and Listing of Approved Uses,” established unconditional by-product uses for slag, bottom ash, fly ash, and gypsum produced at TVA fossil plants.[6] This EA will serve as a guide to potential markets for combustion by-products produced at Bellefonte. The EA is expected to cover all by-products associated with the five conversion options. However, if new by-products are generated, the EA would be updated to include these materials in the listing of approved uses.

Table 2.3-2 Materials to be Transported

	Conversion Option				
	PC	**NGCC (Preferred)**	**IGCC**	**IGCC/C**	**Combination**
Incoming Materials					
Coal or Petroleum Coke	X		X	X	X
Fuel Oil	X	X	X	X	X
Limestone	X		X	X	X
Outgoing Materials					
Sulfur			X	X	X
Bottom Ash	X				
Gypsum	X				
Fly Ash	X		X	X	X
Slag			X	X	X
Spent Catalysts			X	X	X
Sludges			X	X	X
Chemicals				X	X

2.3.2.2 Description of Typical Transportation Modes and Trips

Estimates for shipping and transportation requirements were based on knowledge of market locations, a plant capacity factor of 85%, chemical production rates stated earlier in this section for normal operation, and typical container capacities for the materials listed. Barge capacities were assumed to be 1,500 tons for bulk solids and two million gallons for liquids. Truck capacities are 25 tons for solids and 7,500 gallons for liquids. Rail car capacities are 100 tons for solids or 30,000 gallons for liquids.

Shipments of ash, fly ash, slag, and gypsum were computed from estimates of typical generation rates and material properties. The estimates are of total trips are without consideration of destination, which could be onsite or off site. The impacts analysis presented in Chapter 4 of this FEIS is based on the assumption that all materials are transported off site since this would be the most conservative case. In reality, a portion of the fly ash will not meet ASTM specifications (C-618 and C-311 are the applicable standards) typically 1 to 5% of the total fly ash generated. TVA expects to market about 50 to 60% of the fly ash generated at its plants, leaving the remaining material to onsite disposal. By contrast, marketing of 90 to 95% of the bottom ash, slag, and gypsum generated at Bellefonte could be expected, with the remainder going to onsite disposal. Market estimates depend heavily on the proximity of suitable consuming industries, but the relative desirability of the materials to be generated at Bellefonte is expected to be high.

Coal, limestone, petroleum coke, and fuel oil would most likely be delivered by barge to take advantage of the best delivery prices available. The quantities of coal required would be greater than the quantities of petroleum coke required. Therefore the transportation requirements for feedstock will be based on coal. The shipment of coproducts would probably be primarily by barge to take advantage of least expensive shipping rates to markets, although rail transportation is an alternative. Sulfur would be shipped as a molten liquid in insulated rail cars. Slag, ash, fly ash, and gypsum would be moved by truck to off site markets.

PC

Delivery of coal and limestone would be required for PC operations. Table 2.3-3 reflects the transportation of these items by barge; however, it is likely that rail and truck could be used also. The origin of the coal is assumed to be Southern Illinois, which is the source of the coal (Illinois No. 6) used in the design basis. Large quantities of ash, fly ash, and gypsum would be generated for marketing or for disposal. Table 2.3-3 reflects the transportation of these by-products by truck. The likely destination of marketable by-products would be local industries capable of utilizing such materials, probably within a 30-mile radius of Bellefonte. Long hauls would probably not be incurred due to marginal profits of such industries and the significant costs of transporting bulk materials.

Plant construction phasing involves changes in the mode of transportation of limestone after construction is 50% complete. Initially, coal receiving will be by barge only and limestone receiving will be by truck only. When construction begins on phase three (addition of the 600 MW that will raise plant capacity from 1,200 to 1,800 MW) barge facilities and conveyors will be modified to allow delivery of limestone by barge. This approach provides economic benefits and reduces truck traffic for the completed plant.

Table 2.3-3 Transportation Requirements (PC)

INCOMING SHIPMENTS					
			UNITS/YEAR		
Material	Daily (tpd)	Annual (tpy)[a]	Barge	Rail Car	Truck
Coal				-	-
600 MW	6,640	2,060,000	1,373	-	-
1,200 MW	13,280	4,120,000	2,747	-	-
1,800 MW	19,920	6,180.000	4,120	-	-
2,400 MW	26,560	8,240,000	5,493	-	-
Limestone					
600 MW	614	224,000	-	-	8,960
1,200 MW	1,192	435,000	-	-	17,400
1,800 MW	1,789	653,000	435	-	-
2,400 MW	2,384	870,000	580	-	-
Subtotal[b]			6,073	0	0
OUTGOING MATERIAL					
Bottom ash	583	181,000	-	-	7,300
Fly ash	3,110[c]	965,300[c]	-	-	38,612[c]
Gypsum	6,010	1,865,000	-	-	74,600
Subtotal[b]			-	-	120,512
TOTAL[b]			**6,073**	**0**	**120,512**

[a] - reflects 85 % capacity factor
[b] - at build out
[c] - with 25 % moisture added for conditioning

Coal unloading equipment and facilities for the first 600 MW will be designed such that, with minor modifications, the unloading equipment can be converted to allow limestone unloading for the third construction phase of 600 MW. Barge unloading of coal will be initially by clamshell to a belt conveyor. A bucketwheel unloader would be added for the second (to 1,200 MW) phase, and the clamshell placed on standby. Phase three involves the addition of a second bucketwheel unloader and two conveyors (one to serve the clamshell and one to serve the second bucketwheel unloader). The addition of these facilities would provide capacity for the fully completed 2,400 MW plant.

	LIMESTONE UNLOADING	COAL UNLOADING
600 MW	Truck Unloading Station 4-1/2 Trucks Per Hour, 108 tph	Barge Unloading Area #1 1800 tph
1,200 MW	Truck Unloading Station 6 Trucks Per Hour, 144 tph	Barge Unloading Area #1 Upgrade to 3,500 tph
1,800 MW	Barge Unloading Area #1 Modify the coal unloading equipment for Limestone unloading, 360 tph	Barge Unloading Area #2 Upgrade to 7,000 tph
2,400 MW	Barge Unloading Area #1 No changes required except for daily throughput, 500 tph	Barge Unloading Area #2

NGCC (THE PREFERRED CONVERSION OPTION)

There are no significant materials transportation requirements associated with NGCC, except for the delivery of fuel oil needed as a backup fuel for up to two CTs during a few weeks each year. Shipments would be scheduled to replenish the fuel oil supplies depleted during periods of backup fuel use. Fuel use estimates are based on the assumption that fuel oil would be used in two nonoverlapping periods: one CT for two consecutive weeks and two CTs for three consecutive weeks. Delivery by rail car is assumed since no barge terminal would be constructed for the NGCC Option. Truck delivery is a secondary option for fuel oil delivery.

There is no delivery of solid fuels and there is no production of products or by-products for sale. The removal of sludges or spent catalysts is expected to produce an insignificant increase in traffic.

Table 2.3-4 Transportation Requirements (NGCC)

INCOMING SHIPMENTS					
			UNITS/YEAR		
Material	Daily	Annual	Barge	Rail Car	Truck
Fuel Oil		25,600,000 gal/yr	-	853	-
TOTAL			**-**	**853**	**-**

IGCC

Delivery of coal and/or petroleum coke will be required for IGCC. If coal is used, the origin would likely be Southern Illinois, based on the design assumption of Illinois No. 6 coal. If petroleum coke is used, the origin would likely be Texas or Louisiana, states with extensive refining industry. Delivery of a small quantity of limestone may be required, if Shell gasification technology is used, and is therefore included in the transportation needs. Limestone is not needed for Texaco or Destec gasification technologies. Trucking would be used for the small amount of limestone needed for this option. Fuel oil will be required for startup of CTs and gasifiers, but would not be used as a backup fuel.

The gasification process produces sizable quantities of slag, fly ash, and sulfur for sale as by-products. As noted earlier, much of the slag and fly ash would be sold in local markets. Table 2.3-5 reflects the transportation of these by-products by truck. The likely destination of marketable by-products would be local industries capable of utilizing such materials, probably within a 30-mile radius of Bellefonte. Long hauls would probably not be incurred due to marginal profits of such industries and the significant costs of transporting bulk materials.

It is possible that limestone delivery will be by barge although cost for the smaller volumes may dictate utilization of local limestone supplies, in which case trucks would be used. Since trucking would likely result in greater environmental impacts and may be of more concern to local citizens, the table reflects the trucking scenario for limestone.

The sulfur would most likely be shipped to Florida for use in the fertilizer industry located there. Small amounts of catalysts would be returned to manufacturers for reclamation. Sludges would have to be delivered to local landfills. Table 2.3-5 shows the transportation requirements for IGCC.

Table 2.3-5 Transportation Requirements (IGCC)

INCOMING SHIPMENTS					
			UNITS/YEAR		
Material	Daily (tpd)	Annual (tpy)[a]	Barge	Rail Car	Truck
Coal	24,000	7,446,000	4,964	-	-
Limestone	240	74,600		-	2,980
Fuel Oil		10,368,000 gal/yr	6	-	-
Subtotal[b]			4,970	0	2,980
OUTGOING MATERIAL					
Sulfur		240,000	-	2,400	-
Slag		504,000	-	-	20,160
Fly ash		40,800	-	-	1,632
Spent Catalysts		520	-	-	21
Sludges		2,180	-	-	87
Subtotal[b]			-	2,400	21,900
TOTAL[b]			**4,970**	**2,400**	**24,880**

[a] - reflects 85% capacity factor
[b] - at build out

IGCC/C

The introductory discussion presented for IGCC raw materials and combustion related by-products applies to IGCC/C as well.

Material volumes are based on a plant design which utilizes half as many gasifiers as does IGCC. It is possible that limestone delivery will be by barge although cost for the smaller volumes may dictate utilization of local limestone supplies, in which case trucks would be used. Since trucking would likely result in greater environmental impacts and may be of more concern to local citizens, the table reflects the trucking scenario for limestone.

The coproduction of chemicals would require transportation of products to markets. Most of the chemical products would be transported by barge to larger markets in other regions. Some of the products would be sold locally and shipped by truck or train. Table 2.3-6 shows the transportation requirements for IGCC/C.

Table 2.3-6 Transportation Requirements (IGCC/C)

INCOMING SHIPMENTS					
			UNITS/YEAR		
Material	Daily (tpd)	Annual (tpy)[a]	Barge	Rail Car	Truck
Coal	12,000	3,723,000	2,482	-	-
Limestone	120	37,250	-	-	1490
Fuel Oil	---	1,296,000 gal/yr	1	-	-
Subtotal[b]			2,483	0	1490
OUTGOING MATERIAL					
Slag		252,000	-	-	10,080
Fly ash		20,400	-	-	816
Catalysts		260	-	-	11
Sludges		1,060	-	-	43
Methanol		740,000	179	1,493	-
Sulfur		120,000	-	1,200	-
MTBE		462,000	150	-	-
Formaldehyde		444,000	57	1,903	-
Acetic Acid		148,000	24	338	-
Granular Urea		155,000	73	310	620
UAN Solution		496,000	-	4,960	-
Ammonia		31,000	-	388	-
Subtotal[b]			483	10,592	11,570
TOTAL[b]			**2,966**	**10,592**	**13,060**

[a] - reflects 85 % capacity factor
[b] - at build out

Combination Option

The introductory discussion presented for IGCC and IGCC/C raw materials and combustion related by-products applies to the combination option as well. Fuel oil will be needed for use as a backup fuel for up to two CTs (normally natural gas fired) during a few weeks each year. Fuel oil shipments would be scheduled to replenish supplies depleted during periods of backup fuel use. Fuel use estimates are based on the assumption that fuel oil would be used in two nonoverlapping periods: one CT for two consecutive weeks and two CTs for three consecutive weeks. Delivery by barge is expected.

Table 2.3-7 shows the transportation requirements for the Combination Option.

Table 2.3-7 Transportation Requirements (Combination)

INCOMING SHIPMENTS			UNITS/YEAR		
Material	Daily (tpd)	Annual (tpy)[a]	Barge	Rail Car	Truck
Coal	12,000	3,723,000	2,482	-	-
Limestone	120	37,250		-	1,490
Fuel Oil		25,600,000 gal/yr	13	-	-
Subtotal[b]			2, 524	0	1,490
OUTGOING MATERIAL					
Slag		252,000	-	-	10,080
Fly ash		20,400	-	-	816
Catalysts		260	-	-	11
Sludges		1,060	-	-	43
Methanol		740,000	179	1,493	-
Sulfur		120,000	-	1,200	-
MTBE		462,000	150	-	-
Formaldehyde		444,000	57	1,903	-
Acetic Acid		148,000	24	338	-
Granular Urea		155,000	73	310	620
UAN Solution		496,000	-	4,960	-
Ammonia		31,000	-	388	-
Subtotal[b]			483	10,592	11,570
TOTAL[b]			**2,965**	**10,592**	**13,060**

[a] - reflects 85 % capacity factor
[b] - at build out

2.3.2.3 Conclusion

The delivery of raw materials to Bellefonte and the shipment of products and by-products to markets would be accomplished by using a combination of barge, rail, and truck. A breakdown of projected rates for each of these modes of transportation was presented for each Conversion Option based on current knowledge and typical industry practices.

The information presented here will be used to compare and assess the environmental impacts of each of the five Conversion Options. The results of the evaluations, reported in Chapter 4, are not expected to be very sensitive to substantial changes of the amounts assumed, and therefore changes would offer no significant environmental advantages to the mix of transportation modes evaluated. The economic advantages of various transportation mixes have not been calculated.

2.3.3 Combustion Turbines

2.3.3.1 Introduction

All five conversion options being considered for Bellefonte involve the use of combustion turbines (CTs) for electrical power generation. The conversion options and their expected power from CTs are listed in Table 2.3-8. The remainder of the power for each option will be generated by steam turbine/generators.

Table 2.3-8 Power Generated from CTs for each Option

Conversion Option	% of Power Generated from CT
PC	0
NGCC (The Preferred Conversion Option)	66
IGCC	66
IGCC/C	66
Combination	66

This places major emphasis on the selection of the CTs with respect to capital and operating cost, as well as other factors such as reliability, availability, plot areas, emissions, and etc.

Even though conventional and “F” class CT technologies are presented here as suboption choices, the lower capital and operating cost, lower emissions, higher power density, etc., associated with the advanced technology turbines (i.e., “G” and “H” machines) likely outweighs any risk associated with their use. In addition, there are contracted provisions that can protect against potential losses and to lower risk. Therefore, the selection process is primarily between the “F” technology CTs and the “G” and H” CTs. This does not include PFBC which utilizes expansion turbine technology. The final selection must consider the type of fuel to be burned (natural gas or syngas) and the performance factors, including technical risk, associated with the particular fuel type.

One major factor which must be considered before rendering a decision on which CT class to use is weighing the advantages of the lower specific cost ($/KW) and higher efficiency of each advanced class versus its operating experience and thus its reliability. At present, no operating experience has been obtained for some of the advanced class CTs, thus increasing technical risk. Hopefully, within a few years, operating experience will be sufficient to support evaluations pertaining to these issues.

2.3.3.2 Description of Combustion Turbine Choices

Conventional Technology

Conventional CT technology refers to heavy frame, utility grade CTs with conventional firing temperatures. The large conventional CTs have compression ratios of 12:1 to 16:1, and have combustor firing temperatures up to 2,200°F.

The simple cycle output for conventional CTs has an upper range of around 100 MW. The simple cycle lower heating value (LHV) efficiencies of the conventional CTs typically range from 32 - 33.5%. This results from their relatively low firing temperatures and low compression ratios, which are relatively poor when compared with the advanced class technology. The combined cycle conventional turbine output has an upper range of around 150 MW with fuel-to-power efficiencies ranging from 47 - 51% LHV.

"F" Technology

The "F" technology CTs are heavy frame, utility grade CTs with higher firing temperatures than the conventional technology machines. Improvements in blade profiles, improved cooling techniques, and improved coatings and materials have allowed the "F" technology CTs to have higher compression ratios (14:1 to 30:1) and higher firing temperatures (2,300 - 2,350°F) than their predecessor conventional CTs.

Nominal simple cycle output for the "F" technology CTs is around 160 MW with natural gas fuel, and simple cycle efficiencies range from 35 to 37 % efficiency. The natural gas combined cycle output of the "F" technology CTs range from 220 to 240 MW with efficiencies around 50 to 54 %.

New "G" and "H" Technology

The next step in CT technology evolution was recently introduced. The "G" and "H" technology CTs have expected combined cycle LHV efficiencies which range from 56 - 60%. Advances in blade profiles, coatings, cooling techniques, materials, and manufacturing methods have allowed the turbines to push the envelope on compression ratios and firing temperatures.

In addition, the manufacturers have implemented cooling techniques which use steam in place of air bled from the compressor as the cooling medium. For this reason, this technology is more suited for combined cycle plants. The better heat transfer coefficient of steam allows the CT to operate at a higher firing temperature while maintaining “F” class metal temperatures. This heated steam is returned to the bottoming steam cycle to produce electricity. These advances allow pressure ratios ranging from 19:1 to 30:1 with firing temperatures between 2600°F and 2700°F. The “G” and “H” technology increases the firing temperature without increasing combustion temperature, which is a major factor in minimizing the production of NO_x. [7]

One of the key differences between “G” and “H” technology is the amount of steam cooling utilized by each. The “H” machines use steam cooling extensively throughout the combustor and turbine nozzles and blades. The “G” machines use steam cooling only in the combustor lining and transition piece. Steam cooling requires high steam purity and proper flow distribution to maintain cooling of the hot-gas-path components. The extensive use of steam cooling by the “H” machine, requires a dedicated control system. The difference in the amount of steam cooling technology utilized increases the technical risks slightly for the “H” machines with respect to “G” machines. [7]

2.3.3.3 Comparison of Combustion Turbine Choices

Performance Factors

All other things considered equal, the higher output and higher efficiencies associated with each advancement in turbine technology gives the following performance, production, and economic advantages on a per MW output basis:

- Lower installed cost,
- Lower fuel cost,
- Smaller fuel distribution and supply system,
- Smaller plot areas, and
- Emissions per unit of energy input.

Therefore the higher output and higher efficiency associated with the new “G” or “H” technology offers favorable economics on a per MW basis as well as the cost of electricity.

Equipment Siting

Due to the difference in output of the CT technologies, fewer CT modules would be required for each step up in technology. For full NGCC conversion of Bellefonte project to 2,680 MW, 16 to 18 conventional technology machines would be required, compared to 8 to 10 "F" machines, and 6 to 8 "G" or "H" machines.

Therefore, for the same CT, HRSG, and stack arrangement, each step down in technology would require more stacks (i.e., points of emission). For equivalent stack heights and exit velocities and temperatures, an increased number of stacks generally has a negative effect on the air pollutant dispersion characteristics. The number of CT stacks can be managed by installing multiple CT/HRSG modules per stack. Multiple arrangements such as this can require more controls and involve certain operational restrictions.

Due to a lower power density (output per plot area) of the "F" technology compared to the "G" and "H", 35% to 40% more plot space would be required for the equivalent amount of power from "F" machines. The equivalent power in conventional machines could require over 50% more plot space than the "G" or "H".

Emissions

Air pollutants emitted from CTs include NO_x, SO_2, particulate matter, and minor quantities of uncombusted hydrocarbons. The rates that these compounds are emitted depend on the technology type, type and quality of fuel, combustor design, and control device efficiency. The type of control technology that will be considered to be Best Available Control Technology (BACT) has not been determined. This determination is part of a regulatory permitting process that will occur following the completion of this EIS. To allow flexibility in that process, conservative emission rates have been developed and used for the impacts analyses contained later in this document. However, the design basis for conversion cptions involving CTs assumes that dry low NO_x (DLN) combustor systems will be used as a minimum. DLN combustors are effective on CTs fired with a variety of fuels. Another type of possible control for CTs involving a HRSG is water or steam injection, which can be used in tandem with DLN. A post combustion control system that is increasingly used because of its high NO_x removal efficiency, but involves higher cost, is selective catalytic reduction.

Fuels being considered for CTs depend on the particular conversion option. The range of possible fuels includes natural gas, low-sulfur distillate fuel oil, and syngas from gasification of coal, or petroleum coke. NO_x emissions from a typical CT equipped with steam water injection, which is generally considered to the minimum control system that could receive a permit, range from 25 to 42 ppmv for natural gas to 42 to 75 ppmv for distillate and syngas (at 15% O_2). Additional controls, although expensive, can easily reduce these concentrations by 50 to 90%. The New Source Performance Standards for NO_x from large CTs is 75 ppmv, although higher limits are allowed for highly efficient units. In reality, the limit established through the PSD BACT process would likely be well less than 50 ppmv.

New improved combustors promote efficient combustion which also minimizes emissions of CO, unburned and volatile hydrocarbons, volatile organic compounds (VOC), CO_2, and particulate matter. As shown in the table below, the lower efficiencies of conventional CTs mean higher fuel consumption and higher levels of certain pollutants, such as SO_x and certain particulates that are a direct result of fuel consumption and fuel quality only.

Table 2.3-9 Turbine Efficiency vs. Fuel Consumption and Emissions

CT Technology	Combined Cycle Efficiency (ave.) %	Fuel Consumption (mmscfd)	Fuel Consumption Increase, %
“G” and “H”	58	378.7	Base
“F”	53.5	410.6	8.4
Conventional	49	448.2	18.4

mmscfd - million standard cubic feet per day
Fuel consumption calculation based on natural gas at 1000 Btu/scf and 2,680 MW plant.

Conventional CT technology has the advantage of extensive operating experience on a variety of fuels. Emissions data are readily available and reliable. Dry low NO_x combustion systems are available for most CTs in this class for operation on natural gas and distillate oil.

There is an element of risk associated with the emissions guarantees of “F” and “G” or “H” turbines operating on syngas due to little to no operating experience. DLN combustion systems cannot typically be used for operation on syngas. The combustion systems available for operation on syngas require water, steam, or nitrogen injection to control NO_x emissions. These combustion systems can be applied to all the technologies with only slight restrictions for conventional turbines.

"G" and "H" technology combustion temperatures are comparable to the "F" technology. Therefore NO_x emissions are expected to be similar to the "F" technology.

Operating Experience

The conventional CT technology has the most operating experience of the other technologies. A large number of these units have been in operation for over 25 years. These CTs have remained relatively unchanged over the last five to six years with the exception of minor upgrades, and they have an excellent track record with regard to reliability and availability. Each of the CT manufacturers have a large number of conventional CTs in their respective fleets, and they are able to support the operation and maintenance of these machines in a timely manner.

The "F" technology CTs have been in commercial operation in limited numbers since 1990, and are presently considered to be commercially viable. Each of the major turbine manufacturers has developed an "F" class CT, but there is little commercial operating experience as yet, especially with syngas. General Electric and Westinghouse have the largest fleets, with General Electric having the highest number of fired hours and most units sold. Some risk exists due to current problems, but those problems have been identified and are expected to be resolved in the near future. A competitive market is currently being established with improving stability in cost and delivery schedule.

Considerable operating experience with the "G" and "H" CTs is not anticipated until the year 2000 or later. The first "H" for natural gas will be available in late 1998. The first "H" for syngas service will not be available for shipment until 1999. [7]

Reliability and Availability

Commercial risk for conventional CTs is low due to the manufacturer's extensive experience with these machines. Warranties will be available at low cost, and there is minimal risk of the occurrence of significant technological problems. Durations of forced outages are minimized due to the availability of spare parts and the experience of the manufacturer's field service personnel.

The reliability and availability records for "F" CTs, presented by many of the manufacturers, are based on a small population of CTs but there is evidence to predict good reliability.

For the "G/H" technology, commercial risk is significant because of the unproven nature of the "G" and "H" technologies. These machines combine new and untested compressor and turbine designs which represent a major advance beyond currently demonstrated technology. It is expected that significant operating experience will not be available until after year 2000. The first "G" machine is currently on the assembly line and is scheduled for delivery in late 1996. The first "H" machine for natural gas fuel will be available in late 1998.

Fuel Types

The conventional CTs have operated on standard fuels, such as natural gas and distillate, as well as lower-Btu fuels such as refinery off-gas and syngas. The "F" class CTs have very little operating experience burning any fuel other than natural gas. The "G" and "H" class CTs will be demonstrated on natural gas and or distillate and should be available in 1998. The availability of the first unit for syngas service is expected sometime in 1999.

The advantages and disadvantages are summarized below for the three types of gas turbines available for use in converting Bellefonte to fossil fuel.

Conventional Technology CT

Advantages:

- Proven technology.
- Operating experience on a wide range of fuels (including syngas).
- Few recent major problems.
- Spare parts readily available.
- Relatively short delivery time
- High reliability and availability
- Available from all major CT manufacturers

Disadvantages:

- Lower output and efficiency than the advanced CT technologies.
- Higher installed cost per kilowatt ($/KW) than the advanced CT technologies
- Requires multiple CTs to convert Bellefonte, thus complicating operation and maintenance.
- Higher emission per unit of energy.
- Not being seriously considered based on expected growth in power requirements.

"F" Technology CTs

Advantages:

- Typically high output and efficiency.
- "F" turbines have been manufactured and delivered for syngas operation.
- Some operation experience on syngas by the end of 1996.
- Lower installed cost per kilowatt ($/KW).
- Spare parts readily available.
- Lower emissions per unit of energy than conventional.

Disadvantages:

- Much less operating experience than conventional units.
- Recent design problems; however manufacturers expect to have these resolved in the near future.
- Replacement and refurbishment schedules for hot-gas-path components have not been sufficiently tested and may be underestimated.
- Only two manufacturers with significant operating experience.

"G" and "H" Technology CTs

Advantages:

- Highest output and efficiency.
- Predicted lowest installed cost per kilowatt ($/kW).
- Favorable from the standpoint of matching the larger, more economical gasifiers.
- Lower emission per unit energy than conventional or "F" technologies.

Disadvantages:

- No commercial operating experience on any fuel.
- Performance is expected based on theoretical modeling, and has not been demonstrated.
- New and unproven technology (i.e. blade profiles, coatings, cooling techniques, materials, etc.)
- Higher compression ratios may require syngas booster compressors and/or higher gasifier pressures than previously demonstrated for some gasification technologies.
- Spare part availability is unknown, but will likely be limited.
- Schedule risk due to manufacturing problems.
- Operational risk due to potential design problems.

2.3.3.4 Conclusion

The “F” CT technology provides a reasonable representation of the emission charateristics of combined cycle technology in general. At this time, the “F” CT technology is considered the likely alternative for implementation because of the unproven nature of the “G/H” CT technology and because of the performance improvements of the “F” CT technology over conventional CT technology. However, “G/H” CT technology should improve environmental performance through improved efficiency and higher specific output. The successful prove-out of “G/H” CT technology and/or adequate performances guarantees on the “G/H” CT technology could make the “G/H” CT technology more favorable. Thus, economics, reliability, and environmental aspects at the time of implementation will determine the CT technology for implementation.

It is concluded that the impacts evaluations contained in this FEIS of those options involving CTs will be based on the use of “F” generation turbines. Emission rates will reflect the expected fuel type and possible backup fuel use scenarios. Sulfur dioxide emission rates will reflect the approximate limits of sulfur in the applicable fuels, or in the case of syngas, the expected control efficiency of sulfur removal equipment in the hot gas cleanup system. Particulate emissions will be based on EPA guidance for calculating emissions of this pollutant for CTs. NO_x emissions will be based on a flue gas concentration of 50 ppmv, which will provide flexibility for considering a range of possible technologies during the PSD BACT determination. Consequently, the evaluations in this FEIS provide an envelope which contains, i.e., allows the use of, each of the three technologies using a variety of fuels.

2.3.4 Solid Fuels

2.3.4.1 Introduction

Solid fuels are needed for conversion options 1, 3, 4, and 5. Possible solid fuels include bituminous coal, the dominant fuel for fossil plants in the Southeastern U.S., petroleum coke, biomass, fuel derived from municipal waste, and coal refining char. An equal mix of coal and petroleum coke was also considered. Although gasification could use any of these fuels, IGCC units are typically designed to burn coal, coke, or some mixture of the two. PC, the other conversion option requiring solid fuels, would probably use only coal but cofiring should not be ruled out.

TVA will continue to evaluate available fuel choices based on environmental, economic, availability, and technological factors. The following discussion outlines the current knowlege of each of the fuels under consideration.

2.3.4.2 Comparison of Solid Fuel Choices

Coal

Bituminous coal can be purchased at reasonable cost and its performance is well known. Information about the chemical and physical characteristics, properties, and commercial use of various types of coals is widely available in literature. [8] Consequently coal will not be described in this FEIS at the level of detail found for less conventional fuels being considered for Bellefonte. The use of Illinois No. 6 coal is assumed for the sake of comparing coal with other fuel choices. Table 2.3-10 provides constituent information about Illinois No. 6 coal. [8,9,10]

Table 2.3-10 Carbon Fuel Constituents

Coal Analysis	Illinois No. 6	Petroleum Coke	50%/50% Blend
Btu/lb	11,035 (a)	13,930	12,483
Water	15.00% (b)	8.99%	12.00%
Carbon	58.70%	81.34%	70.02%
Hydrogen	4.00%	3.27%	3.64%
Nitrogen	1.11%	1.38%	1.25%
Chlorine	0.20%	0.00%	0.10%
Sulfur	3.05%	4.50%	3.78%
Ash	11.00%	0.31%	5.66%
Oxygen	7.90%	0.21%	4.06%
Trace Elements (ppm)			
Arsenic	12.59	1.33	6.96
Beryllium	4.73	0.10	2.42
Cadmium	1.93	3.00	2.47
Chromium	28.00	3.00	15.50
Fluoride	81.00	9.00	45.00
Lead	4.70	7.35	6.03
Mercury	0.28	0.02	0.15

[a] - minimum
[b] - minimum moisture content is 7% as received basis

Petroleum Coke

The reasons for considering petroleum coke are its increasing availability and reasonable cost. Petroleum coke, which is produced as a by-product during the refining of high sulfur crude oils, has few uses but does contain significant heating value. This property, along with its non-toxic and stable characteristics, makes it an excellent candidate for gasification either by itself or in combination with other fuels such as coal. The typical constituents of petroleum coke are shown in Table 2.3-10 which also shows the typical assays for coal and a blend of coal and coke. Due to its low ash content, a flux has to be added to a petroleum coke fuel to ensure the gasification process produces an inert frit (necessary for producing high quality slag). Because of the high sulfur content of petroleum coke and a lack of operating experience, burning petroleum coke in PC boilers is not an option. [8]

Biomass

Biomass could be used for firing gasifiers but would not be suitable for PC or PFBC due to its high water content. Biomass includes organic matter such as wood wastes, crop residues, and municipal solid wastes. For biomass to be feasible for significant use at Bellefonte, supplies would have to be available nearby, and/or the cost of their transportation to Bellefonte must be cost effective and dependable.

TVA has conducted several studies of the feasibility of using biomass for power production. Among these studies is an evaluation of Colbert Fossil Plant, the nearest evaluated site to Bellefonte. The most available power generated would be 22 MW from the 500 tons per day of refuse derived fuel (RDF) available in the Shoal area. [12,13] RDF is the material remaining after the recyclables, metals, and undesirables have been removed from Municipal Solid Waste (MSW). Another study evaluated the logging and mill wood waste residue available to the Widows Creek Fossil Plant. This study assesssed whether reasonably available residue would be significant to fire a 350-MW IGCC unit. It was concluded that the available residue would provide only about half of the heat necessary to fully power the unit. [12,13] The TVA Bellefonte Energy Park Study addressed the use of biomass, including wood waste, as feedstock for a dedicated gasifier. [11] The study concluded that available biomass would provide only 20% of the fuel for a gasifier that would lead to the generation of 350 MW of electricity in a gasification combined cycle arrangement.

Even with the tipping fees associated with MSW and other inducements, RDF and biomass, are not expected to be cost effective for use at Bellefonte when compared with coal or petroleum coke. Also, the quality of the syngas produced from biomass varies and would probably not be acceptable for use in the Options 4 and 5. The lack of operating experience for biomass in anything other than conventional boilers introduces additional risk. Table 2.3-11 provides information about common properties of the various types of biomass which could be used at Bellefonte. [12,13]

Table 2.3-11 Composition of Various Biomass Feedstocks (weight percent)

	Hard Wood	Logging/ Mill Residue	Switch Grass	RDF
Hemicellulose	17.0	13.8	25.1	4.4
Cellulose	26.2	26.4	34.8	17.5
Lignin	14.6	13.8	8.1	4.8
Ash	0.6	7.6	3.2	4.4
Metals	0.0	0.2	0.0	0.0
Others	1.4	0.0	9.7	3.4
Water	40.0	40.0	40	65.5

Coal Refining Char

Coal refining is a process capable of producing end use products and chemical feed stocks (coproducts) directly from coal. This concept could be integrated with many technologies that are commercially available in the petroleum refining industry with a coal/hot gas reactor design for coal hydrocracking and char separation. It is the char (which remains after the coal is reacted) that could be used to fire the gasifiers that are part of Conversion Options 3, 4, and 5. Coal refining offers considerable promise as a future fuel for power and chemicals productions. However, not enough is known about this choice to fully assess its availability, technical feasibility, or economic viability for converting Bellefonte. More information about coal refining is included in Appendix E. [4]

Coal/ Petroleum Coke Blend

A blend of coal and petroleum coke is being considered for use at Bellefonte for Conversion Options 3, 4, and 5. [7] Typical constituents and annual emission rates are shown in Table 2.3-12 for three possible fuel combinations. [5] The emission rates are for a single gasifier based on a heat input of 2,759 mmBtu/hr. Blending overcomes one negative property of petroleum coke which is the absence of a slagging agent (due to low ash content) needed during gasification for the production of high quality slag. In the blended mode, the addition of flux would not be needed. The syngas produced by the blended fuel would be acceptable for chemicals production. [6]

Table 2.3-12 Emissions from a Typical Single IGCC Unit (tons per year)

	100% Coal Feed	**100% Petroleum Coke Feed**	**50%/ 50% Blend Feed**
SO_2	629.12	925.91	777.51
NO_x	1,637.72	2,263.05	1,950.40
CO	532.38	532.38	532.38
PM	146.37	146.37	146.37
VOC	19.05	19.05	19.05
H_2SO_4	3.80	5.61	4.71
H_2S	1.42	2.13	1.76
COS	1.46	2.18	1.81
CO_2	2,005,872	2,773,007	2,389,438

2.3.4.3 Conclusion

No fuel source is eliminated from possible use at Bellefonte, but to facilitate the evaluation of the conversion options, only one fuel type will be evaluated for each option. Coal refining char will not be considered as an acceptable fuel at this time for any option. However, as the technology develops, char could become more attractive as a fuel. The emissions and environmental characteristics of char are not expected to be significantly different from coal. Biomass feedstock should not be excluded from use at Bellefonte but its possible use given the low quantities available, is not likely except for cofiring. Coal is an obvious fuel choice for all gasification options and for PC. Because of the lack of experience of PC technology with the use of petroleum coke, a 100% coal fuel will be evaluated for Option 1. Petroleum coke would be a possibility for the gasification options, but it is unlikely that only petroleum coke by itself would fuel all of the gasifiers in any option.

To conservatively envelope air emissions for options involving gasification and to allow the use of coal, petroleum coke, or a blend, petroleum coke was selected as the fuel basis for the air impact evaluations for Options 3, 4, and 5. However, the combustion solids impacts evaluations will assume the use of 100% coal since this fuel would yield the largest waste and/or by-product volumes.

2.3.5 Boiler Type

2.3.5.1 Introduction

For the conversion option using coal combustion in a conventional sense, at least three boiler types would be considered by TVA: PFBC, PC, and AFBC. This section will explore the environmental and energy efficiency aspects of the three boiler types.

2.3.5.2 Description of Boiler Technology Choices

Pressurized Fluidized-Bed Combustion (PFBC)

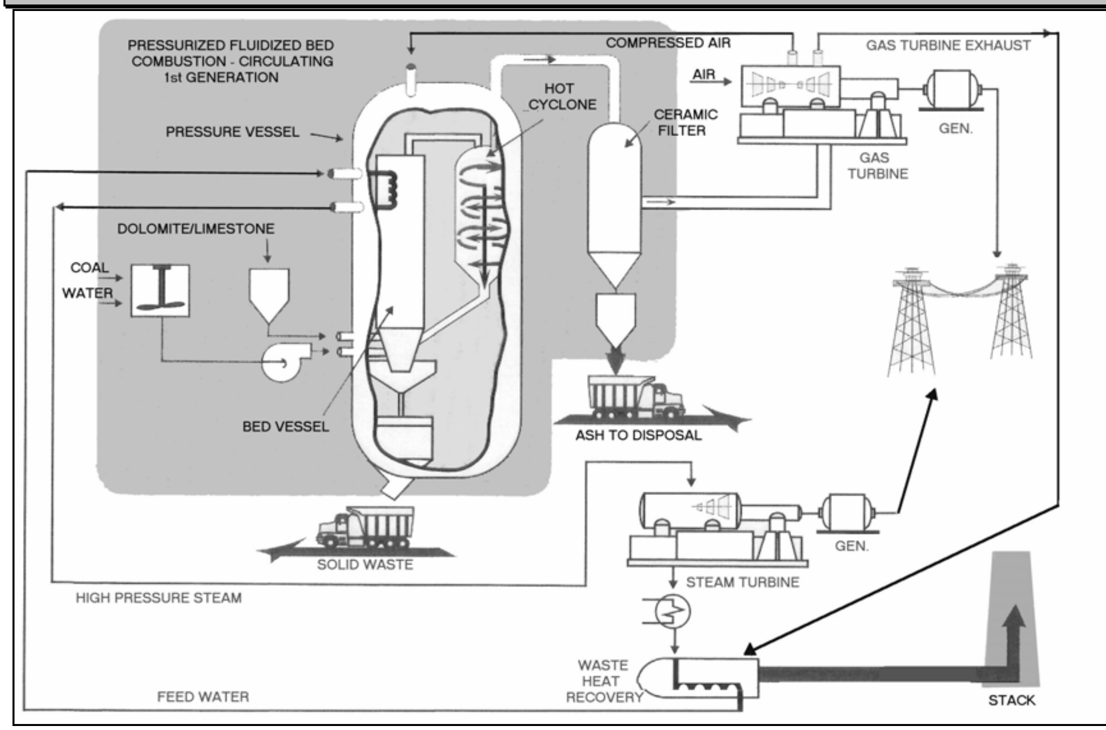
The process philosophy of the PFBC technology combines elements of both the IGCC technology and the PC technology as well as some unique elements. Studies show PFBC power plant technology has the potential to raise overall generation efficiency to over 45%. [8] The capital and operating costs are projected to be lower than for other advanced fossil power technologies. The advanced PFBC process, when fully commercialized, has been estimated to have a life cycle cost of electricity 20% below the cost of conventional coal technologies. The savings are due to higher thermal efficiency, lower capital, operating, and maintenance costs, and shorter construction times compared to other coal fueled power plants.

However, until PFBC is successfully demonstrated, a high degree of risk must be assumed. Meaningful results from a full scale demonstration of second generation PFBC technology are not expected until at least the year 2000. Also, market conditions affecting the capital cost of all power generation technologies are constantly changing, as is fuel cost. Any decision at this time would be premature, unless the technical and economic risk can be justified. In the meantime, this risk must be weighed against fully demonstrated and/or commercial technologies, such as PC and AFBC power plants.

At present there are two categories of PFBC plants, referred to as conventional or first generation, and advanced or second generation. Each system has unique design and operating features, but both achieve higher efficiencies by combining combustion and steam turbines in the generating cycle.

In conventional fluidized-bed boilers compressed air is supplied to the combustor, which also serves as a boiler, and the coal is burned under pressure (Figure 2.3-2). Dust is removed from the flue gas, which then passes through a combustion expansion turbine that drives a generator and an air compressor. High pressure steam is raised in tubes positioned in the boiler, and the steam turbine generates approximately 80% of the net power output. A sorbent, such as limestone, is fed to the boiler to capture between 90 to 95% of the sulfur released from the coal.

Figure 2.3-2 Conventional Fluidized-Bed Boilers Diagram



Source: Clean Coal Technology Program [17]

The conventional fluidized-bed boiler can be either bubbling or circulating. These boilers operate at similar pressures but the circulating technology operate at higher fluidizing velocities than the bubbling version (15 feet per second [fps] compared to three fps). The circulating technology is expected to have heat rates similar to the bubbling version but with the following advantages:

- More compact, allowing more modular construction and shop assembly with corresponding lower capital cost,
- Better coal and sorbent distribution with fewer feed nozzles,
- No lowering or raising of bed levels for load following, therefore no bed storage vessels required, and simplified solids handling may increase reliability and availability,
- Finer sorbent can be used, allowing sorbent to be more fully utilized, potentially reducing demand to levels similar to those of wet scrubbers,
- No in-bed tubes to suffer wastage, and
- Lower calcium to sulfur ratios

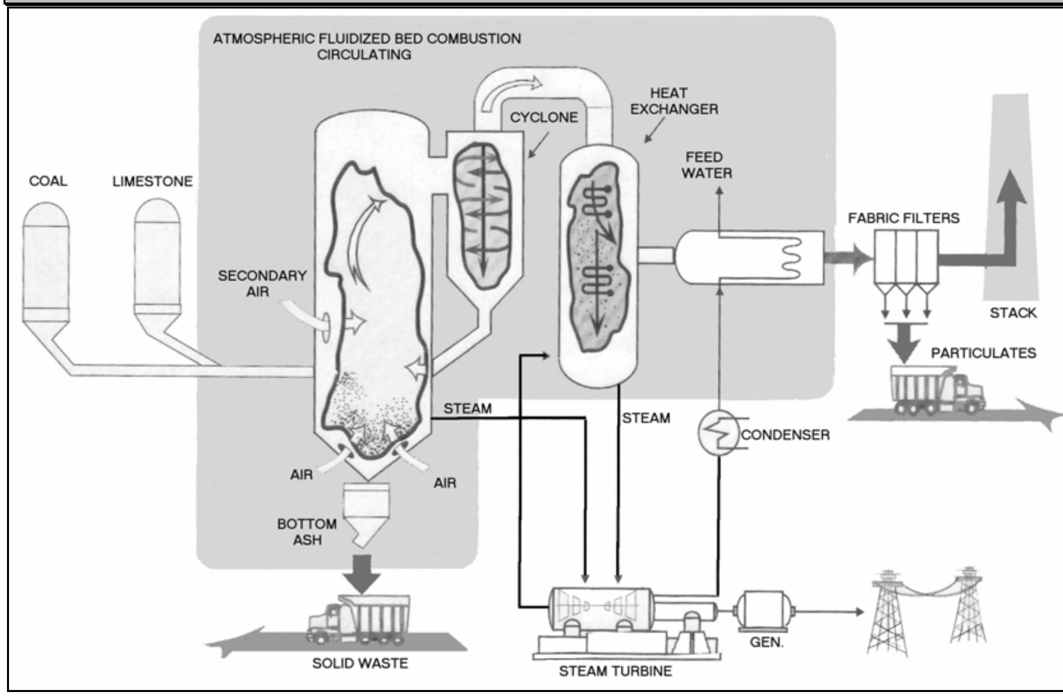
The advanced or second generation PFBC process, widely considered the most promising of the advanced fossil fuel generating technologies, has been in active development for the past several years. PFBC involves the partial oxidation of coal in a vessel separate from the combustor, called a pyrolyzer. The fuel gas from the pyrolyzer is burned with cleaned, hot, pressurized air from the combustor in a topping combustor. This stream is expanded in a combustion turbine to drive the combustion turbine's air compressor and an electric generator for electric power output. The turbine exhaust raises additional steam in the HRSG. The HRSG steam flows to the PFBC combustor, fueled by char from the pyrolyzer, where it receives additional heat and combines with the steam generated in the PFBC boiler. This steam is used to drive the steam turbine generator for additional electrical power output. To date, all second generation PFBC studies and pilot tests have been with circulating technology.

AFBC

Except for the boiler island and absence of the SO_2 scrubber, an AFBC generating unit is similar to a conventional PC unit, and includes coal receiving and handling, air heater, steam turbine generator and auxiliaries, particulate removal, ash handling, plant cooling, and other balance of plant equipment. AFBC is similar to PFBC in the method of SO_2 control. A sorbent, such as limestone, is fed to the boiler to capture between 90 and 95% of the sulfur released from the coal. However, AFBC does not incorporate a combustion turbine, and all its power is generated from steam turbines.

As with PFBC, there are two types of AFBC boilers: bubbling bed and circulating bed. In bubbling-bed AFBC generating units, the heat transfer surface is located in the bed and the convection pass above the bed. Crushed coal and limestone are injected through multiple underbed feed nozzles distributed across the floor of the fluidized bed. For 95% SO_2 removal, the calcium-to-sulfur molar ratio required is about 3.2. [8] In circulating-bed AFBC generating units, the coal and limestone are injected through nozzles located at the bottom of the furnace (Figure 2.3-3). The heat transfer surface is located downstream of the cyclone separators and in a separate fluidized-bed heat exchanger that recovers heat from the cyclone catch before the solids are reinjected into the furnace.

Figure 2.3-3 Circulating-Bed AFBC Diagram



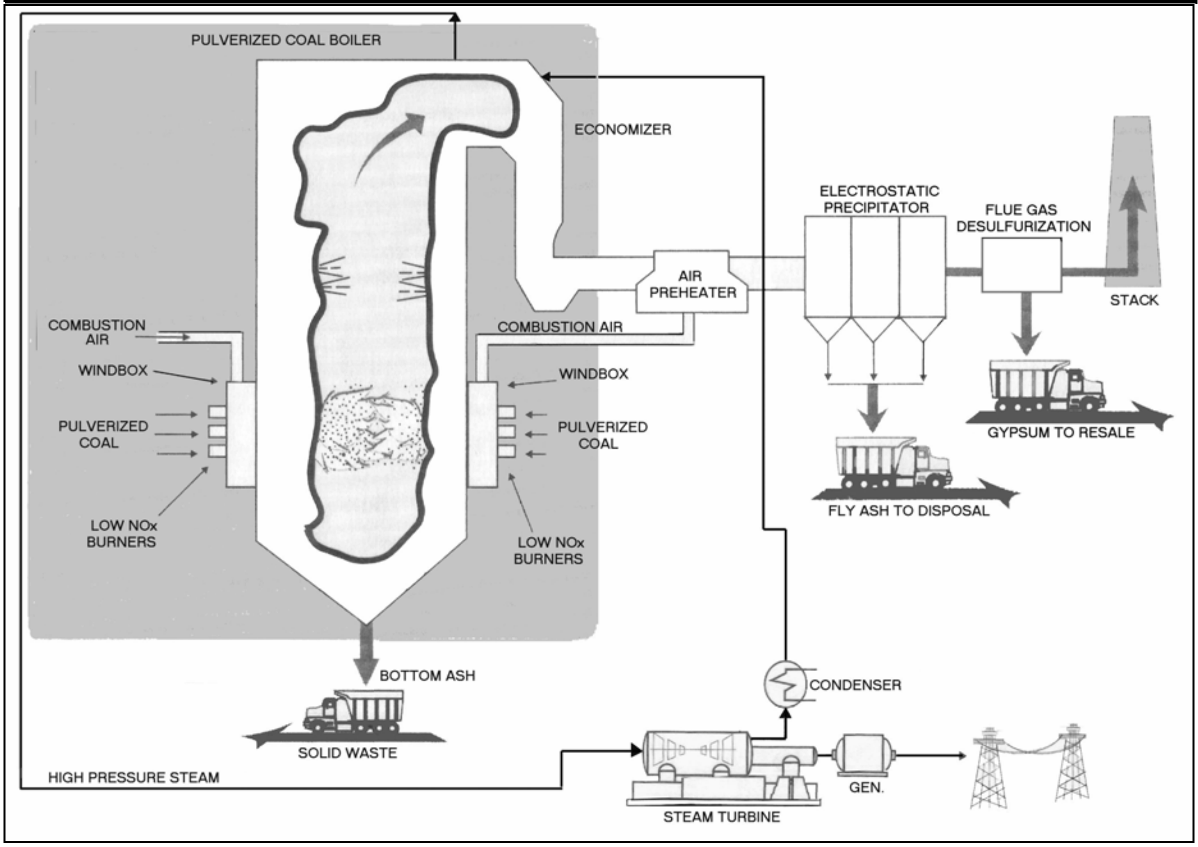
Source: Clean Coal Technology Program [17]

Pulverized Coal (PC)

The PC fired boiler with steam turbine power generation is the principal electricity generation technology in the U.S. SO_2 emissions are controlled by post-combustion treatment of the flue gas with lime or limestone for SO_2 removal. Particulate emissions must be controlled by either baghouses or electrostatic precipitators. NO_x emission can be controlled with combustion controls such as low NO_x burners or with post-combustion devices such as selective catalytic reduction (SCR).

The major components of the PC units include coal receiving and handling, air heater, steam generator island, turbine-generator island, FGD system, particulate removal, bottom and fly ash handling system, plant cooling, and other balance of plant equipment (Figure 2.3-4).

Figure 2.3-4 Pulverized Coal Diagram



Source: Clean Coal Technology Program [17]

For subcritical PC units, typical steam conditions are 2,400 psig/1,000°F superheated steam, with a single reheat to 1,000 °F. Higher efficiencies can be achieved by supercritical PC plants with boilers operating at pressures greater than 3,200 psig with main and reheat steam temperatures of 1,000°F. [8]

2.3.5.3 Comparison of Boiler Technology Choices

Emissions

SO_2 emissions from PC fired power plants are controlled by post-combustion treatment of the flue gas prior to it being released to the atmosphere. Most of these designs scrub the flue gas with some form of lime (usually limestone slurry) to capture the SO_2, as gypsum solids. Removal efficiencies of these systems are in the range of 90 to 96%.

SO_2 emissions from PFBC and AFBC power plants are controlled by the addition of limestone directly to the combustion area. This method is inherent in the design of the process and can attain removal efficiencies of 95 to 98%.[8]

The SO_2 emission rate, as measured in typical units of lb/MWh, is a function of the following performance and fuel related parameters:

Performance Parameters
- Heat Rate
- SO_2 removal efficiency

Fuel Parameters
- Fuel Sulfur content
- Heating Value

Table 2.3-13 compares typical heat rates for conventional and advanced coal fueled plants.

Table 2.3-13 Heat Rate for Coal Fired Boilers

Coal Fired Technology	Heat Rate (nominal) Btu/kWh
PFBC (advanced)	7,400
PFBC (conventional)	8,450
PC (supercritical)	9,500
PC (subcritical)	9,800
AFBC	10,000

Source: Technical Assessment Guide [8]

As evident from the above table, for a given coal and for the same SO_2 system removal efficiency, AFBC and subcritical PC will yield higher SO_2 emissions than PFBC.

NO_x control is inherent in AFBC and PFBC technologies and requires no additional cost to meet regulated emission levels. The moderate combustion temperature used results in low NO_x emissions. Uncontrolled NO_x levels from these units are typically between 0.42 and 1.43 lb/mmBtu.[9]

NO_x emissions in newer PC plants is controlled by low-NO_x burners and/or overfire air (OFA). Low NO_x burners limit NO_x formation by limiting combustion temperatures and delaying mixing of fuel and air. Low NO_x burners/OFA controls do increase capital cost slightly but do not increase O&M costs. Additional NO_x control can be obtained by incorporating post-combustion controls such as SCR. The SCR process reacts NO_x with ammonia on a catalyst matrix to form nitrogen and water. Typically SCR reduces NO_x by 80% from the uncontrolled level. [8] The table below gives typical NO_x emissions for the three technologies being reviewed.

Table 2.3-14 Typical Flue Gas Emissions

Coal Fired Technology	NO_x Emissions lb/MWh	NO_x Emissions (w/SCR) lb/MWh
PFBC	0.42 - 0.44	NA
AFBC	0.89 - 1.43	NA
PC (Low NO_x Burners)	3.4 - 5.3	0.6

Source: Technical Assessment Guide [8]

As indicated by the table, NO_x emissions for PC plants equipped with SCR are only slightly higher than for PFBC.

To meet the New Source Performance Standards for particulate emissions (presently 0.03 lb/mmBtu), PC power plants use post-treatment flue gas devices such as baghouses or electrostatic precipitators (ESPs). [8] Both contribute to capital cost and operating cost, and therefore have an affect on the cost of generating electricity.

The type of coal used determines the amounts of flue gas and fly ash and the characteristics of the fly ash. These factors affect the size and cost of the particulate control device used. Baghouse costs are mainly dependent on flue gas volumetric rate. Baghouse capital and operating cost are lowest for coals with low flue gas volumes and low sulfur content which minimizes sulfur-induced short bag life. ESP costs are lowest for coals with low flue gas volumes and coals with optimum resistivity fly ash.

Particulate control for AFBC and PFBC units is similar to that for PC units, except that the particulates removed are a combination of fly ash and spent sorbent. ESPs or baghouses may be used for particulate control for these technologies. High temperature candle filters are required for second generation PFBC.

For a given plant size, coal type, and particulate control device, the particulate emissions, as with SO_2 emissions, are primarily dependent on heat rate (i.e., the amount of fuel consumed per kWh). Higher heat rate plants produce more particulate emissions and vise versa. For this reason the higher heat rates expected from the AFBC and PC technologies will yield approximately 20% higher particulate emissions than PFBC.

Solid Waste

The composition, treatment, and disposal methods of the solid waste generated from the burning of coal by these technologies vary. Solid waste generated from the burning of coal includes coal ash (both bottom ash and fly ash) and spent sorbent (for the control of SO_2 emissions). This section will compare the solid waste generated from the three technologies, primarily from a volumetric standpoint rather than chemical analysis. In accordance with ADEM regulations, combustion solid waste will either be marketed or be disposed of onsite.

Coal ash produced from the burning of coal is in the form of fly ash and bottom ash. Fly ash represents about 80% of the total ash generated and is collected from the effluent flue gas as particulate with a baghouse or ESP in PC and AFBC, and candle filters in PFBC, at very high removal efficiencies (i.e., 99+%). Fly ash is composed of fine particles and is readily leachable. "Leachability" refers to the tendency of water soluble ions, such as calcium and sulfate ions, to react with and be carried away by water molecules moving through a porous material. The remaining 20% is collected as bottom ash or slag from the base of the boiler. Bottom ash has essentially the same chemical composition as fly ash from the same coal, but it consists of larger particles, has less carbon, is more dense, and is less leachable. Bottom ash is typically transferred wet to holding ponds and then dewatered before disposal or further handling. [8]

The amount of ash waste generated is a function of the amount of coal burned and the type of coal being burned. Ash content can vary from 5% for anthracite to as high as 15% for lignite. Therefore, plants with high heat rates and coals with high ash content will generate more ash solid waste. For a given coal, the ash solid waste generated from each technology varies only due to differences in heat rate.

The amount of spent sorbent generated depends on the type of SO_2 control, and varies considerably between the different technologies. PC plants use flue gas desulfurization processes which treat the effluent flue gas at a ratio of around 1.0 mole of calcium per mole of sulfur. By contrast, in the AFBC and PFBC processes, SO_2 emissions are controlled by injection of sorbent into the combustion area at a rate of around 2.5 moles calcium per mole of sulfur. [8]

Table 2.3-15 presents solids generation rates for different technologies based on the given heat rates and the coal indicated.

Table 2.3-15 Typical Solids Generation Rates for Direct Fired Boilers

Technology	Heat Rate Btu/kwh	Ca/S Ratio (molar)	Total Ash Generated lb/MWh	Spent Sorbent Generated lb/MWh	Total Solids Generated lb/MWh
PC/FGD (supercritical)	9,000	1.0	83	68	151
PC/FGD (subcritical)	9,800	1.0	90	74	164
PFBC (advanced)	7,400	1.5	68	83	151
PFBC (conventional)	8,450	2.5	78	158	236
AFBC	10,000	2.5	92	188	280

Calculations based on coal with 11% ash, 3% S, and 12,000 Btu/lb .

As seen from the table above, conventional PFBC and AFBC technology generates 57% and 85% more solid waste, respectively, than does PC or advanced PFBC. Therefore from a solid waste disposal standpoint, larger removal and transport systems, as well as larger disposal areas (holding ponds, etc.) would be required for conventional PFBC and AFBC plants.

One of the FGD processes for PCs, called wet limestone forced oxidation (LSFO), can be designed to produce wallboard-grade gypsum, a marketable by-product, thereby eliminating most of the sorbent waste disposal requirements. This would further enhance the PC plant’s solid waste disposal advantage over PFBC and AFBC. Economic studies of existing markets would be required to evaluate the feasibility of marketing this product. However, even if not marketable, LSFO may be the choice of FGD processes due to calcium sulfate’s favorable dewatering characteristics and its dry-stacking capability.

Apart from the strictly volumetric considerations, the solid discharge from advanced PFBC has the potential for greater environmental impact because of the presence of sulfides. Sulfides can leach into groundwater or surface water if individual particles in the solids become fractured, exposing the sulfide bearing interiors of the particles. This problem is unique to the advanced form of PFBC, in that the reducing conditions in the carbonizer promote the capture of sulfur by limestone in the form of calcium sulfide. When the solids from the carbonizer are combusted in the circulating boiler, not all of the sulfides are oxidized to innocuous calcium sulfate. The issue of sulfides in the solids remains as a critical development issue for advanced PFBC.

Water Usage and Discharge

The largest single demand for water in a steam power plant is for makeup water to the condenser cooling system, followed by the FGD and ash handling systems. Millions of gallons per day of cooling water is circulated through the steam condenser to reject heat, and then passed through cooling towers which loses water to evaporation, drift, and blowdown. The cooling water system requires high-quality makeup water. The makeup water is monitored to avoid corrosion, biofouling, or scale formation, but normally does not require treatment. FGD and ash systems can accept lower quality water in some situations. Low-quality water is typically used for FGD reagent preparation, mist eliminator washing, and dust control. Other water usage include high quality (demineralized) water for boiler makeup.

Since the conventional and advanced PFBC technologies only generate about 80% and 55% of its power output, respectively, in the steam turbine (remainder by gas turbine), less condenser cooling water will be required. This results in 20 to 45% less need for condenser cooling water. This can lead to capital and operating cost savings for the PFBC in addition to siting advantages in locations with limited water supply.

A major waste water stream from a steam power plant is the cooling tower blowdown. The volume of this stream is directly dependent on the hardness of the raw water. This stream is often reused for lower quality plant water needs and/or permitted for release following some treatment. However, as discussed above, due to the lower amount of condenser cooling water makeup, PFBC can be expected to require 20 to 45% less cooling tower blowdown.

Other possible aqueous effluents from a coal-fired power plant include FGD discharges, coal pile runoff, fly ash pond overflow, floor and yard drains, demineralizer regenerant, boiler blowdown, treatment sludges and brines, sanitary waste, and waste oils. PC and AFBC power plants have similar water effluents with similar permitting requirements and water management cost. Again, PFBC should show a slight advantage in several of these effluents due to its smaller steam cycle.

2.3.5.4 Conclusion

PC boiler technology was chosen to represent the conversion option using a coal-fired nongasification approach (Option 1). Advanced PFBC technology offers a potential for improved fuel efficiency and environmental performance, but this technology has not been demonstrated in a commercial application. At this time, AFBC is considered the least likely of these alternatives to be implemented due to economics and environmental performance. Consequently, the impacts analysis presented in Chapter 4 will focus on most likely conservative configurations of PC and PFBC. However, many AFBC configurations, both bubbling and circulating would fit within the impacts evaluation envelope provided for PC and PFBC. Specific AFBC configurations would have to be developed and evaluated should this technology become more attractive in the future.

2.3.6 Gasifier

2.3.6.1 Introduction

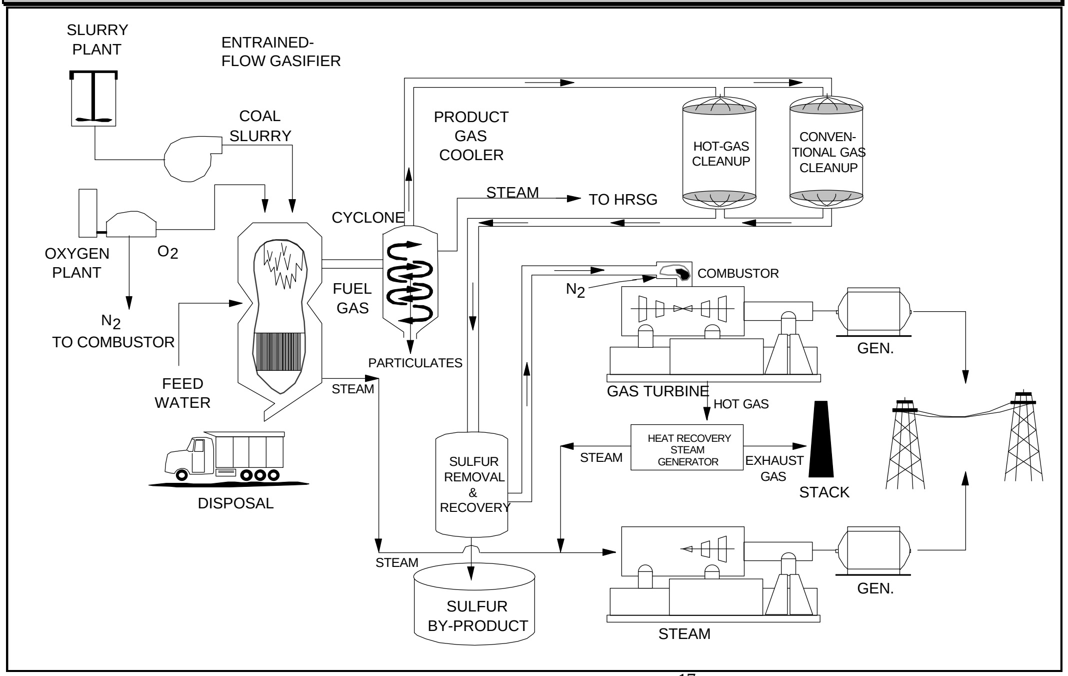
Gasification is involved in conversion options 3, 4, and 5. Consideration in this FEIS was given only those gasifiers classified as entrained flow, since the performance of this class of gasifiers offers coproduct compatibility, fuel flexibility, and economic competitiveness, and environmental superiority over competing gasification technologies. In addition, the oxygen blown, entrained flow gasifiers have operated commercially for over 10 years. For the conversion options using gasification, three developer specific technologies were considered: Shell, Destec, and Texaco. This section will describe the environmental, operational, and performance tradeoffs associated with different gasification technologies.

2.3.6.2 Description and Comparison of Gasifier Choices

Three gasifier developers (Shell, Texaco, and Destec) collectively represent a cross section of available commercial or commercial demonstration technologies. [18,11] Figures 2.3-5 and 2.3.-6 show two oxygen blown gasifier types while Figure 2.3-7 shows an air-blown gasifier. [17] Inside an entrained-flow gasifier reactor, finely ground coal and oxidant react in concurrent flow. Flow direction can be either upflow or downflow, depending on the developer’s design. The operating temperature is generally 2,500°F or more, and promotes rapid reaction, high carbon conversion, and complete gasification of the coal to the simplest gas forms. Hydrocarbon content in the raw gas is usually less than one percent, and is mostly in the form of the simplest hydrocarbon, methane. This characteristic gives entrained-flow technology an advantage for coproduction of chemicals, since the simplest compound forms (usually CO and H_2) are desirable for chemical synthesis, and since hydrocarbon compounds, which are often poisonous to the synthesis catalyst, are either not present or are easy to remove due to their presence in small quantities. The lack of hydrocarbons in the gas also enables simpler downstream processing and easier waste water cleanup.

All three gasification technologies are entrained-flow gasifiers and the startup procedures are very similar. Generally they all begin with a 24-to-48 hour preheat of the gasifier using air and fuel such as natural gas at minute quantities compared to the coal feed rate. After preheat to the desired temperature, the natural gas firing is stopped, the gasifier is readied for startup, and then the gasifier is started up by injecting coal or coal slurry and then oxygen. When the oxygen is fed to the gasifier, the combustion of the coal and thus production of the raw syngas begins.

Figure 2.3-5 Oxygen-blown, Entrained-Flow IGCC Diagram



Source: Clean Coal Technology Demonstration Program [17]

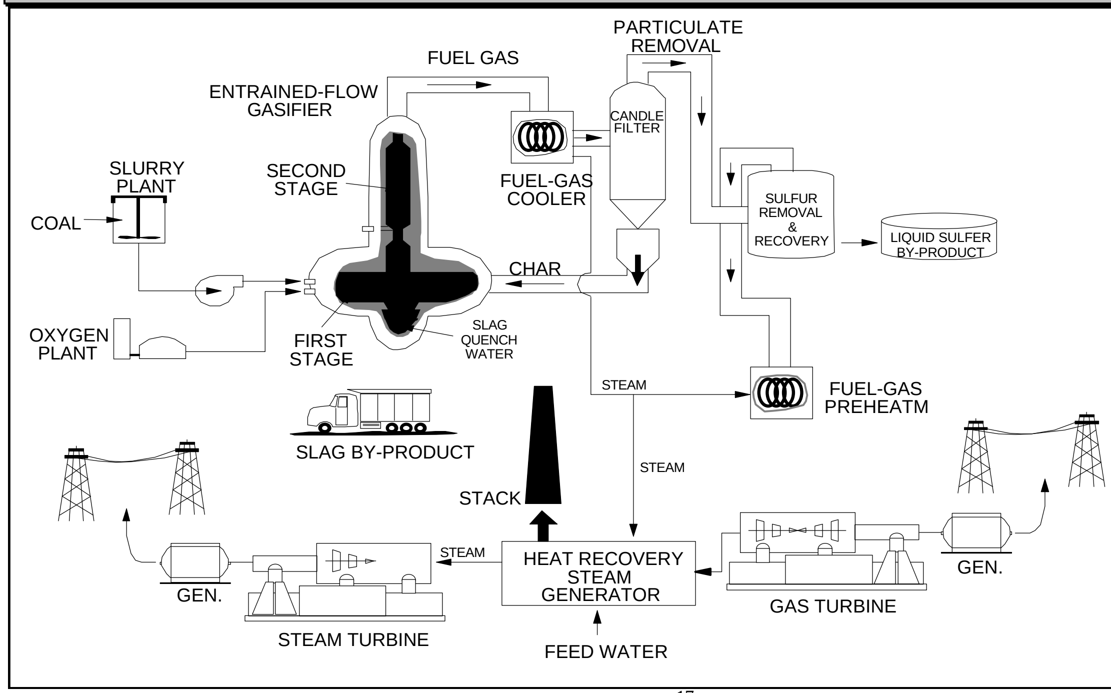
For the Texaco and Shell technologies, as the pressure of the gasification plant rises to the design pressure, operation of the gasifier stabilizes. This period of stabilization may take up to 60 minutes depending on the startup technique and the design of the plant. Historically, these technologies have sent the raw syngas (no sulfur removed) to the flare during the stabilization period.

In contrast, Destec gasifiers increase the internal pressure of the gasifier during the preheat stage, so when the coal or coal slurry and oxygen are injected, there is no stabilization period. The syngas produced initially is sent directly to the sulfur recovery and other syngas cleanup equipment.

The duration of raw syngas flaring varies from none (Destec) to 60 minutes for the Texaco technologies. The Shell technology currently recommends flaring raw syngas for at least 40 minutes during startup.

Flaring duration and frequencies are normally reduced as operators and engineers become familiar with equipment. [23]

Figure 2.3-6 Oxygen-Blown, Two Stage, Entrained-Flow IGCC Diagram



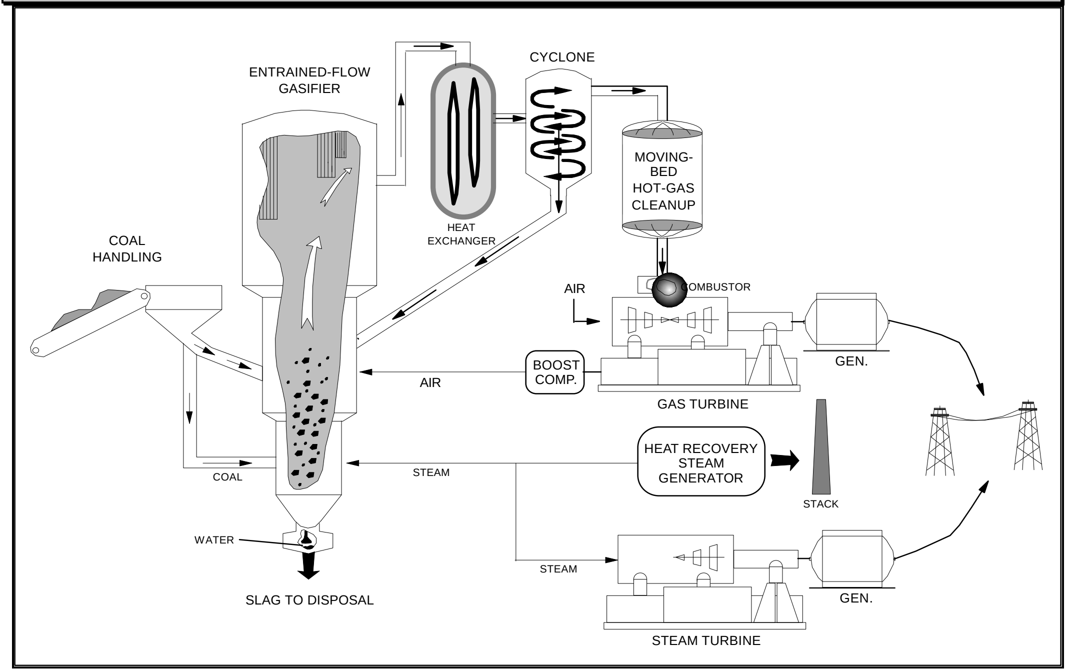
Source: Clean Coal Technology Demonstration Program [17]

For entrained-flow gasifiers, the methods of feeding coal to the gasifier reactor fall into two basic categories:

- Dry feed: coal is pulverized to a fine powder and transported to the gasifier through entrainment by a gas, generally nitrogen.
- Slurry feed: coal is pulverized, mixed with water, and then pumped to the gasifier. The Shell gasification technology employs dry feed, whereas Texaco and Destec use slurry feed.

The feed method has a major impact on the process characteristics, mechanical operation, and economics of a gasification technology. Dry-feed systems are more advantageous with certain feedstocks. Slurry-feed gasifiers incur a thermal penalty with high ash coals, since, in effect, additional slurry water is required just to transport the mass of the ash. Low rank feedstocks, such as some high-moisture lignites, can also be a problem for slurry-feed systems. Much of the moisture in lignite is bound within the solid matter and thus does not offset the quantity of added water needed to achieve a pumpable slurry. The solids content of a pumpable lignite slurry can be as low as 50%, whereas a slurry made from a typical bituminous coal can exceed 65% solids. Excessive slurry water produces a thermal penalty during gasification, in that a large portion of the heating value of the fuel is required just to evaporate the water. This is also detrimental in that more oxygen is required and that the raw gas contains more CO_2. Dry-feed systems, therefore, tend to be more consistent from the standpoint of operating parameters and gas composition, when dealing with wide variations in feedstock ash content and water content. However, slurry-feed systems offer increased flexibility over dry-feed systems when dealing with co-feeding liquid fuels or MSW/wood/waste with coal.

Figure 2.3-7 Air Blown, Dry Feed, Entrained-Flow IGCC Diagram



Source: Clean Coal Technology Demonstration Program [17]

The chief advantages of a slurry-feed system are low capital cost, ease of operation, and compatibility with high pressure operation. This last advantage, high pressure operation, has not traditionally been an issue since both dry-feed and slurry-feed entrained-flow systems are capable of operating at the pressure necessary to deliver gas to the CT (about 400 psig). However, because the advanced “G/H” CT technology requires higher pressures than 400 psig as does chemicals coproduction, the capability of high pressure operation is important. Texaco technology has operated commercially at pressures above 900 psig for over 10 years while Shell and Destec technology have not operated at these high pressures. For pressures higher than this, the economics of a dry-feed design may tend to indicate that the gasifier operating pressure should be held at 400 psig, and any additional pressure should be achieved by compression of the fuel gas. This method adds considerably to the capital cost, maintenance cost, and complexity of the operation.

Two factors now suggest that operating pressure will become an issue. First is the concept of coproducing chemicals with electricity. The coproduction and sale of chemicals, such as methanol or urea fertilizer, can dramatically reduce the cost of electricity borne by the plant facility. The synthesis of most chemicals from hydrogen and carbon monoxide is favored by higher pressure, which speeds the reaction and shifts the reaction equilibrium toward chemical production. Methanol, for example, generally requires a synthesis pressure in the vicinity of 1,000 psig. If production is carried out in the "once-through" mode, that is, by passing all of the gas from the gasifier through the chemical synthesis reactor and allowing the unreacted portion to pass downstream to the CT, then the maximum allowable operating pressure of the gasifier becomes a major factor of importance. If, however, synthesis is carried out in a slipstream mode, where a relatively small compressor could be used to provide pressure for a synthesis loop, then gasifier pressure is less of a factor but still important.

The second issue regarding pressure relates to the new, higher-temperature, higher-efficiency CTs (such as the Westinghouse “G” machine), which will be commercially available in the near future. These new machines require higher operating pressure ratio (25:1 versus 14:1), which in turn raises the needed gasifier pressure, probably from 400 psig to about 500 psig.

An additional advantage of slurry-feed gasification with respect to coproduction is the relatively high H_2/CO ratio in the raw gas stream. This ratio tends to be higher with slurry-feed gasification, because the shift reaction that occurs inside the gasifier favors the production of hydrogen when water is present, as follows:

$$CO + H_2O \Leftrightarrow CO_2 + H_2 + \text{heat}$$

The synthesis of most organic chemicals is favored by a high H_2/CO ratio in the gas stream. Slurry-feed gasifiers tend to have ratios greater than 0.75, whereas dry-feed systems have ratios generally less than 0.5.

2.3.6.3 Conclusion

In summary, the Shell gasification technology will tend to be favored for applications emphasizing the flexibility to feed high ash/high water coal and/or thermal efficiency. Texaco and Destec will tend to be favored for applications requiring low capital cost, higher pressures, and/or a high H_2/CO ratios.

Destec technology is distinguished from Texaco technology primarily by the configuration of the gasifier reactor. Destec employs a two-stage reactor, in which most of the coal slurry is reacted with the oxidant at high temperature (2,600°F) in the first stage, and the remaining coal slurry is fed to the second stage to partially cool the gas (1,900°F) in preparation for downstream processing. This second stage has the advantage of producing a gas with a higher fuel value, but has the disadvantage of producing higher amounts of unburned carbon and undesirable organic chemical contaminants (which are captured and recycled to the gasifier reactor).

Destec's strength over Texaco is its thermal efficiency. A distinct advantage, from an environmental standpoint, of Destec over both Texaco and Shell is that Destec avoids flaring during startup by routing raw syngas through the hot gas cleanup system. This design avoids the air quality and noise impacts associated with either Shell or Texaco. Texaco's strength over Destec is that it has commercial operating experience. Texaco technology has been applied commercially in a variety of chemical synthesis and power applications for over 10 years. Texaco employs a water quench which results in a shorter structure height than would be the case for Shell. The shorter structure height means that "good engineering practice" would establish lower stack heights in the HRSG and sulfur recovery tail gas treatment system. For this FEIS, with the feedstocks assumed, the performance characteristics of these gasification technologies should be similar and thus Texaco should conservatively represent the three technologies reasonably well.

2.3.7 Chemical Production

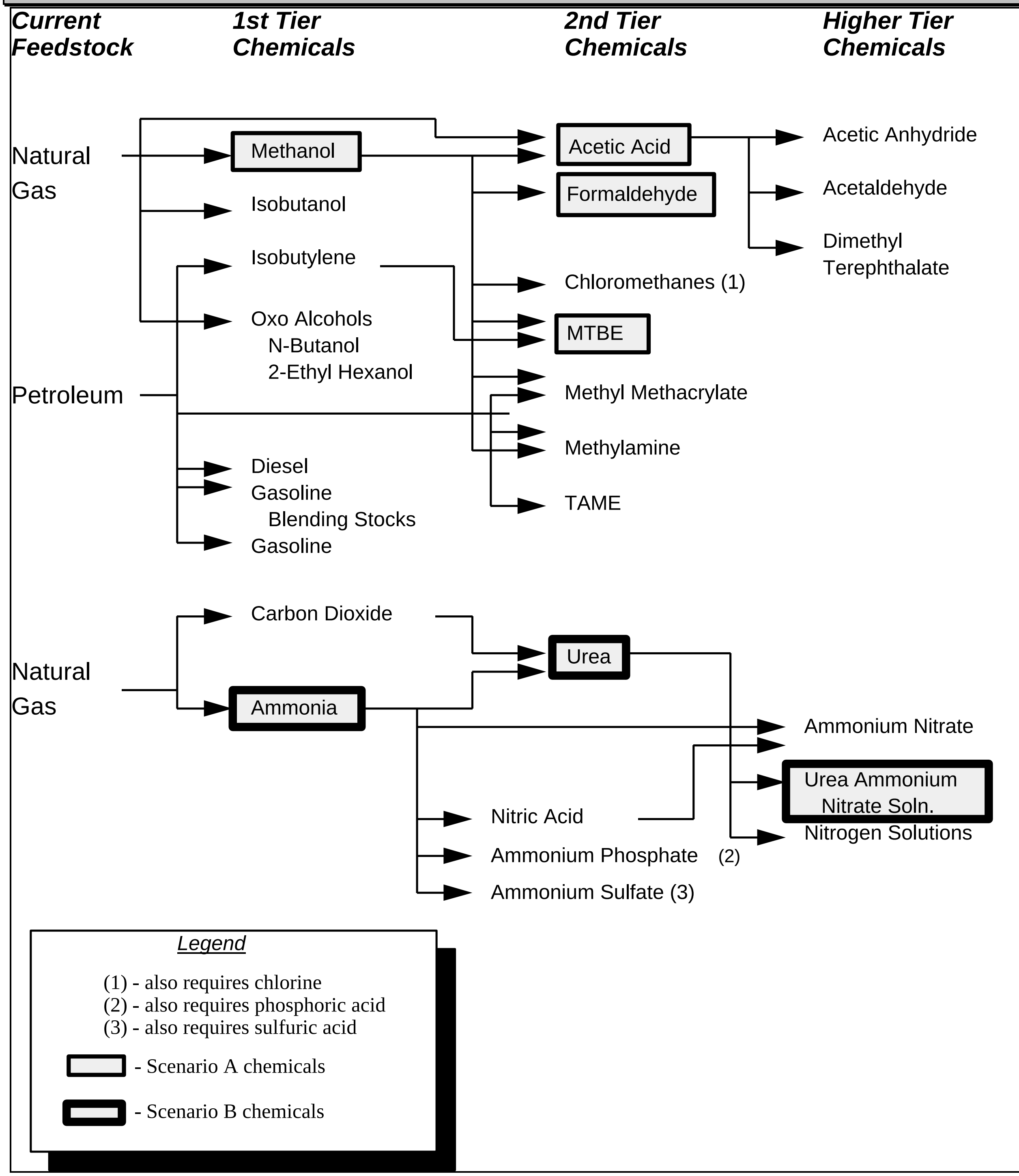
2.3.7.1 Introduction

Studies are underway to assess market opportunities and economic risks associated with the production of various products that can be made from syngas. The possible chemical products are shown in Figure 2.3-8. Note that currently used feedstocks are identified for the tiered production scheme, but syngas produced by the gasification of coal might be used partially or wholly instead of natural gas or petroleum as shown. Production of chemicals is associated with Conversion Options 4 and 5. A table in Appendix D describes likely chemical products in terms of physical and chemical properties, hazards, and typical uses. This section will consider two chemicals production scenarios and present a rationale for selection of a scenario.

2.3.7.2 Identification and Comparison of Production Scenario Choices

The production of chemicals is likely to be implemented in one of two scenarios. Scenario B differs from Scenario A only by the addition of an ammonia plant, urea plant, nitric acid plant, and ammonium nitrate unit with UAN mixer which allow for the production of additional chemicals (predominantly agricultural chemicals and fertilizers). The two scenarios may be summarized by considering typical production configurations and example product mixes and quantities. Other production mixes may be selected depending on the outcome of marketing studies. Significant marketable quantities of excess carbon dioxide would be produced as a by-product in both scenarios, but is not shown below because its rate of production is dependent on the combination of processes involved and the chemical mix selected. A wide variety of chemical processes may be involved depending on the product(s) eventually selected for Options 4 and 5.

Figure 2.3-8 Chemical Coproducts



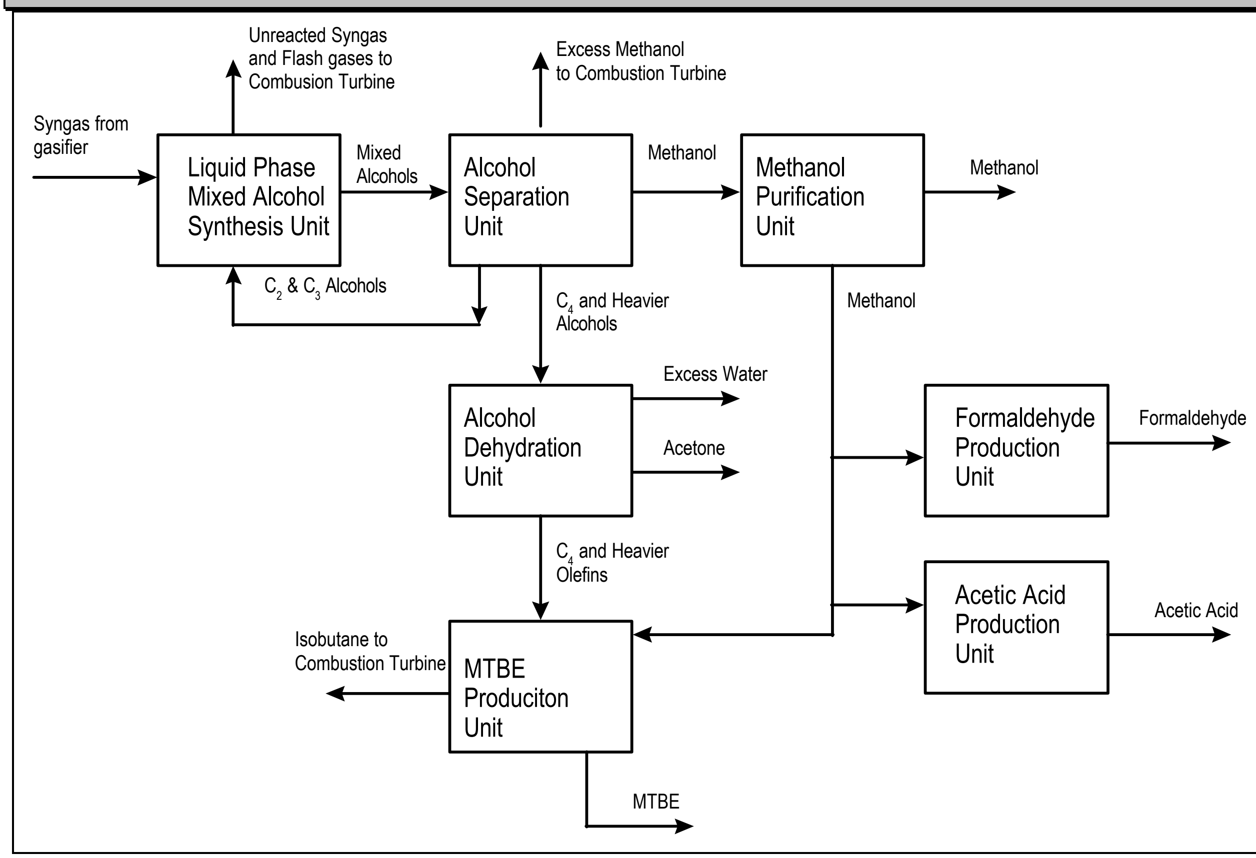
Scenario A

Scenario A results in the production of the following:

- methanol 1,000,000 tons/year
- MTBE (Methyl Tertiary-Butyl Ether) 625,000 tons/year
- formaldehyde 600,000 tons/year
- acetic acid 200,000 tons/year
- CO_2 205,000 tons/year

The production of Scenario A chemicals would involve the successful operation and integration of several process units, as shown in Figure 2.3-9.

Figure 2.3-9 Flow Diagram for Methanol and Derivatives Production

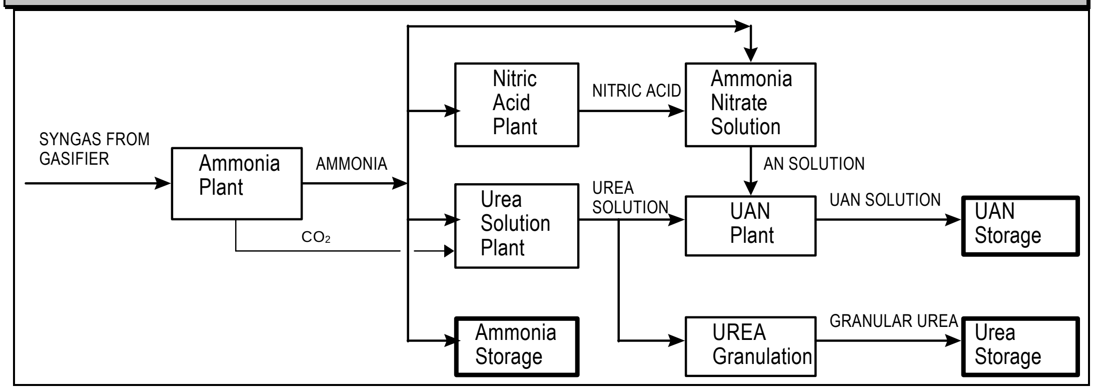


Scenario B

Scenario B results in the production of Scenario A chemicals plus several agricultural chemicals, and would involve the construction and operation of ammonia, nitric acid, urea solutions, ammonia nitrate, UAN solutions blending and urea granulation plants (Figure 2.3-10).

• methanol	740,000 tons/year
• MTBE	462,000 tons/year
• formaldehyde	444,000 tons/year
• acetic acid	148,000 tons/year
• granular urea	155,000 tons/year
• urea ammonium nitrate	496,000 tons/year
• ammonia	31,000 tons/year
• CO_2	205,000 tons/year

Figure 2.3-10 Flow Diagram for Agri-chemicals Production



2.3.7.3 Conclusion

Although selection will be based on product market revenues, the product mix of the combination of products of Scenario B provides a broad evaluation of impact and envelopes the emissions characteristics of likely chemicals production. Because the emissions from Scenario A production are routed to the CTs to recover the energy value of these streams, Scenario A has less environmental impact than Scenario B. In addition, Scenario B represents this category well because the Scenario A production chemicals are included in the Scenario B list. Numerous combinations or derivatives of these could be theorized, but the Scenario B product mix is considered to be the most likely mix and would provide a good representative for the environmental impacts evaluations in Chapter 4.

2.3.8 Coal and Limestone Conveying

2.3.8.1 Introduction

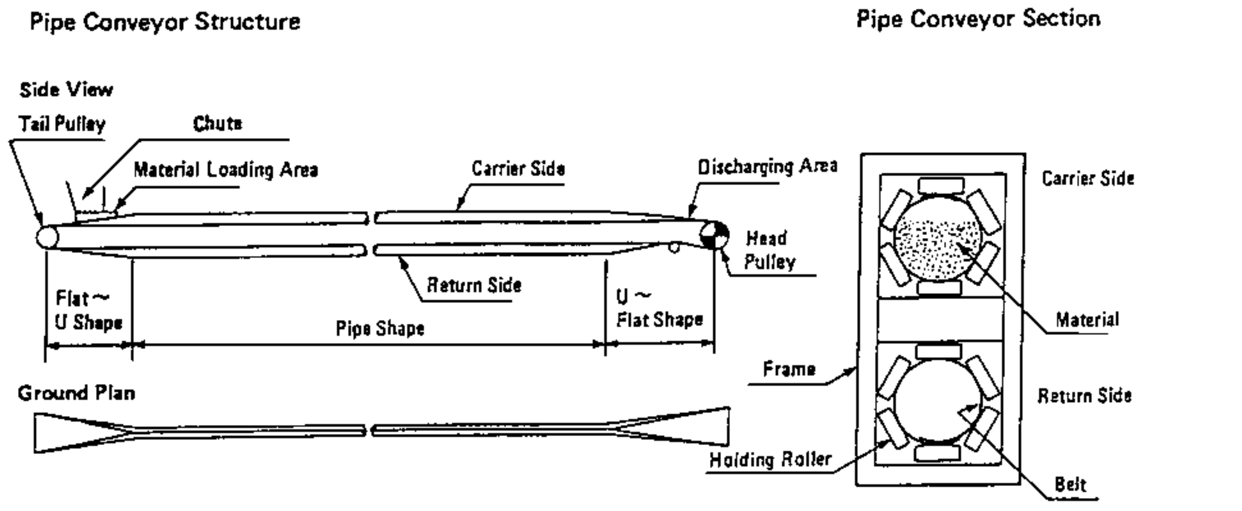
Once onsite, coal and limestone must be moved to the point at which they are used. The loading, transfer, and unloading of materials generally results in the emission of air pollutants to the atmosphere, at a rate dependent on handling rate, number of points, and the effectiveness of control measures.

2.3.8.2 Description and Comparison of Material Conveying Choices

The method most commonly used to transfer materials short distances is the conventional horizontal curve “flat trough” conveyor. A relatively new alternative to the “trough” conveyor method is the pipe conveyor. This method, although more costly, provides the benefit of fewer intermediate transfer points and reduced emissions of air pollutants. In a recent evaluation of methods for conveying coal at Kingston Fossil Plant, the pipe conveyor was chosen as the preferred conveyor technique.[19]

At the loading point, the pipe conveyor would be open in a conventional trough form after which it is formed into a pipe shape for the transport length with materials completely enclosed (Figure 2.3-11). Based on diameter of pipe, the pipe can handle from 1,287 to 278,065 cubic feet per hour. The higher figure requires a 34-inch conveyor diameter. The equivalent trough conveyor would be 84 inches wide to handle the 278,065 cubic feet per hour of material.[19,20] At terminus, the belt opens to discharge the transported material.

Figure 2.3-11 Structure of Pipe Conveyor



The main characteristics of the pipe conveyor are: [20]

- Totally enclosed operations prevent or reduce dust emissions and reduced possibility of contamination by adverse weather conditions,
- Return side of the conveyor prevents spillage or washing of materials because the dirty side of the belt is on the inside of the belt,
- Enclosed concept and the increased friction of the material against movement, steeper inclinations, and sharper turns can be negotiated thus minimizing civil work and allowing greater flexibility in route selection,
- The conveyor is less unsightly because conveyor and support structure is narrower than a conventional conveyor,
- Uses conventional loading and unloading procedures and technologies, and
- No buildup on return idlers since they are only in contact with the clean side of the belt.

A pipe conveyor system has emission characteristics that have minor to no impact on the surrounding environment. The benefits of the pipe concept are understood and appreciated by regulating agencies. Increase in noise levels is expected to be only 2.4 dBA at 75 feet from the pipe. Air emissions are expected to be primarily from the unloading of the coal barges and will be controlled by sprays. The nature of the pipe should prevent any runoff of material from the conveyor to the ground and then to the river. The nature of the return pipe prevents dropping of material to the ground that could be carried to the river during rains. Groundwater concerns primarily exist from the construction activities and should be less than that expected from conventional conveyor construction because fewer components are needed for the conveyor itself and the only junctions required are at the beginning and end. Routine containment practices during construction will minimize impacts. Visual impact will be minimized by

Bellefonte's site terrain which will limit line-of-site visibility from offsite points. Because this type of transport allows for considerable curvature of the conveyor, the route could follow the valley to hide the conveyor from view. In any case the conveyor would be contained in a much smaller space than a conventional unit.

The second alternative is a conventional horizontal curve (i.e. trough type) conveyor. The primary advantage of this conveyor system is its lower cost. The horizontal curve conveyor has the following features:

- Routing will be selected based on the longer horizontal radii required for this type of conveyor,
- A wind/rain type cover would be required over the full length of the conveyor, and
- Crossing over water or roads will require full enclosure.

Pollutant control technologies such as spray systems and bag houses can eliminate the environmental differences between the two alternatives. However, the cost of those measures along with the additional junction houses, electrical power requirements and transfer point maintenance, which would be required due to the terrain of the Bellefonte site, may make the pipe conveyor cost competitive.

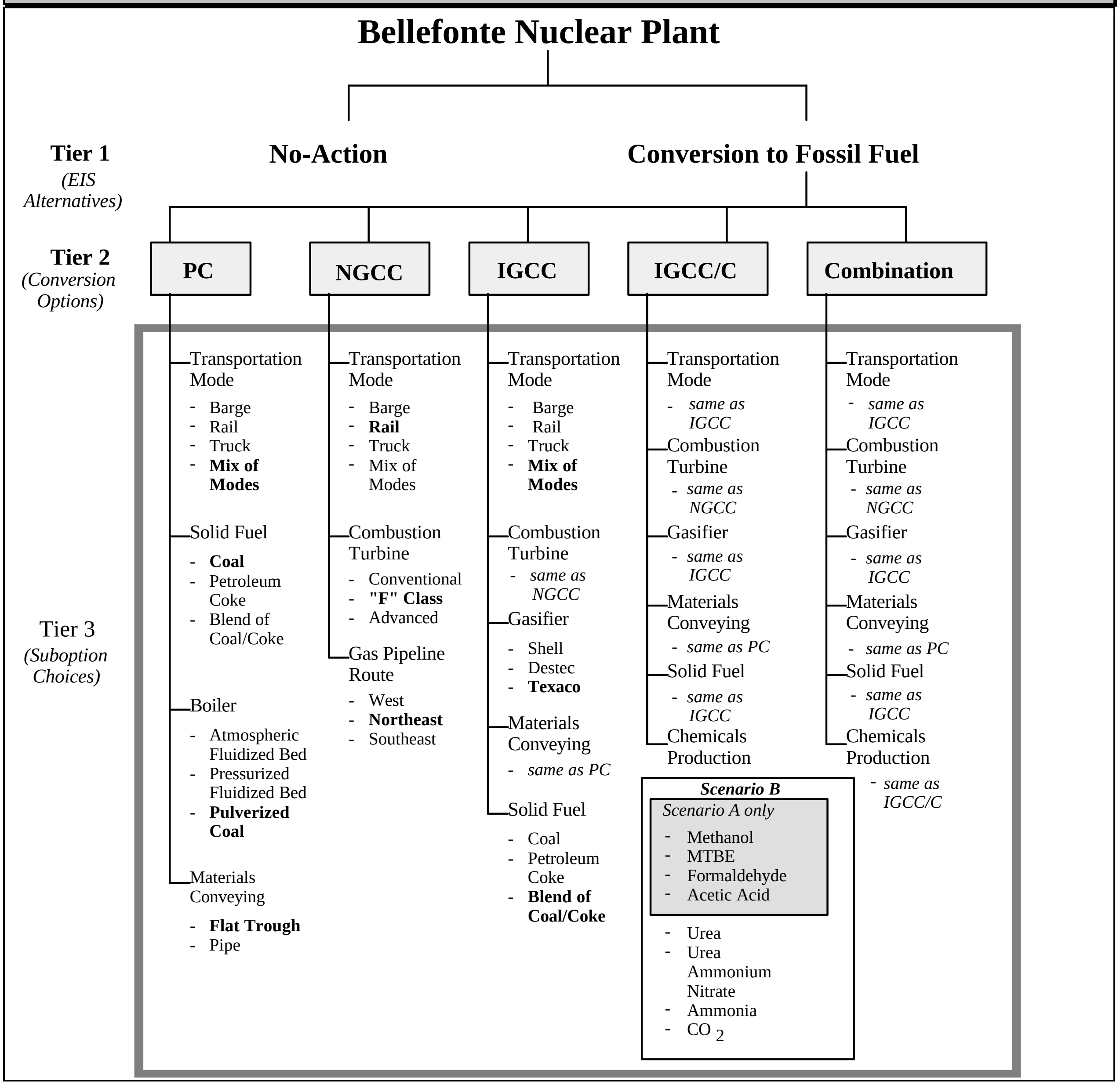
2.3.8.3 Conclusion

TVA has not yet selected a design of coal or limestone conveying. However, the use of the trough conveyor method will be assumed for the purpose of evaluating the Bellefonte conversion options involving coal and limestone use.

2.3.9 Summary of Suboption Choices

Process, control and design choices selected for evaluation in this FEIS as part of one or more proposed conversion options are shown in Figure 2.3.9-1. Presented along with each selection (bold type) are the other possible choices contained within the "envelope" provided by evaluation of the chosen technology. NGCC is TVA's preferred conversion option.

Figure 2.3.9-1 Summary of Option and Suboption Choices



2.4 Summary Comparison of the Environmental Consequences of the Five Bellefonte Conversion Options

The environmental consequences of the five conversion options are compared in this section. These findings are based on the more detailed analytical results presented in Chapter 4, Environmental Consequences of the Proposed Conversion Options. A tabular compilation of impacts is presented in a format designed to allow direct resource by resource comparison of the five options. Also included is a synopsis of the analytical results and findings found in Chapter 4. NGCC is TVA's preferred option.

2.4.1 Summary Comparison of the Five Bellefonte Conversion Options

Tables 2.4.1-1 and 2.4.1-2 compare impacts for each conversion option for construction and operation, respectively. Impacts are assigned a relative impact severity, using a range of pluses and minuses, as compared with the No-Action Alternative. Impact duration is described as either temporary (lasting only a few months or the period of construction) or permanent (life of the plant). Impacts are described as being positive or negative at three levels: light, moderate, or important.

This format is designed to allow the direct comparison of options but suffers from a subjective bias introduced by the consolidation of evaluation results in an unweighted framework. An example of this is the air quality impact category which forces the derivation of a single category assignment from considerations of the impacts from criteria air pollutants, hazardous air pollutants, acid rain, global warming, visibility and odors. Chapter 4 presents detailed results for a more thorough understanding of the scientific basis for impacts and ratings.

Note that impacts are presented for each of the five conversion options AND for the incremental impacts associated with a possible connected action: the construction and operation of a natural gas pipeline. Since pipeline construction would not be undertaken if supplies are brought to the Bellefonte area for reasons unrelated to Bellefonte, it was believed unfair to group these impacts with the two affected options, NGCC and Combination. By presenting pipeline impacts in this way, the reader can either consider these incremental effects or not, depending on the gas supply situation at the time a decision is made regarding a conversion option.

Table 2.4-1 Summary of Construction-Related Impacts for Each of the Five Bellefonte Conversion Options Compared to the No-Action Alternative

	CONVERSION OPTION					
IMPACT CATEGORY	1 PC	2 NGCC	Natural Gas Pipeline	3 IGCC	4 IGCC/C	5 Combination
Physical Resources						
Air Quality	T –	T –	T –	T –	T –	T –
Geologic Setting	P –	N	P –	P –	P –	P –
Soils	P –	N	T – –	P –	P –	P –
Solid Nonhazardous Wastes	T –	T –	T –	T –	T –	T –
Hazardous Wastes	T –	T –	T –	T –	T –	T –
Surface Water						
Availability	N	N	T –	N	N	N
Quality	T – – –	T –	T – –	T –	T –	T –
Floodplains/Floodways	N	N	N	N	N	N
Groundwater						
Availability	N	N	N	N	N	N
Quality	N	N	T –	N	N	N
Biological Resources						
Terrestrial Ecology	P –	P –	T –	P –	P –	P –
Aquatic Ecology	T –	N	N	T –	T – –	T – –
Wetlands	P –	N	T –	P –	P –	P –
Man-Made Environment						
Socioeconomics	T ++	T +	T +	T ++	T ++	T +++
Transportation	T – –	T –	T –	T – –	T – –	T – –
Land Use	P –	N	P –	P –	P –	P –
Aesthetics & Recreation	P – –	P –	T –	P – – –	P – – –	P – – –
Cultural Resources	N	N	N	N	N	N
Noise Impacts	T –	T –	T –	T –	T –	T –
Safety and Health	T	T	T	T	T	T

Key to impact description symbols:

N means no change or negligible impacts
+ or - means light positive or negative
++ or -- means moderate positive or negative
+++ or --- means important positive or negative
T means temporary (short-term)
P means permanent (lifetime of plant)

Note: For a particular impact area (i.e. air quality, socioeconomic, etc.), the degree of impacts are expressed only relative to the No-Action Alternative. No measure of the importance between impact areas has been applied.

Table 2.4-2 Summary of Operation-Related Impacts for Each of the Five Bellefonte Conversion Options Compared to the No-Action Alternative

	CONVERSION OPTION					
IMPACT CATEGORY	1 PC	2 NGCC	Natural Gas Pipeline	3 IGCC	4 IGCC/C	5 Combination
Physical Resources						
Air Quality	P – –	P –	N	P – –	P – – –	P – – –
Geologic Setting	N	N	N	N	N	N
Soils	N	N	N	N	N	N
Solid Nonhazardous Wastes	P –	N	N	P –	P –	P –
Hazardous Wastes	P –	P –	N	P –	P –	P –
Surface Water						
Availability	N	N	N	N	N	N
Quality	P – – –	P –	N	P – –	P – –	P – –
Floodplains/Floodways	N	N	N	N	N	N
Groundwater						
Availability	N	N	N	N	N	N
Quality	P –	N	N	P –	P –	P –
Biological Resources						
Terrestrial Ecology	N	N	P –	N	N	N
Aquatic Ecology	P – –	N	N	P – –	P –	P –
Wetlands	N	N	N	N	N	N
Man-Made Environment						
Socioeconomics	P +	P +	N	P ++	P ++	P +++
Transportation	P – –	P –	N	P – –	P – –	P – –
Land Use	N	N	P –	N	N	N
Aesthetics & Recreation	P – –	P –	P –	P – – –	P – – –	P – – –
Cultural Resources	N	N	N	N	N	N
Noise Impacts	P –	P –	N	P – –	P – –	P – –
Safety & Health	T –	T –	T –	T –	T –	T –

Key to impact description symbols:

N means no change or negligible impacts
+ or - means light positive or negative
++ or -- means moderate positive or negative
+++ or --- means important positive or negative
T means temporary (short-term)
P means permanent (lifetime of plant)

Note: For a particular impact area (i.e. air quality, socioeconomic, etc.), the degree of impacts are expressed only relative to the No-Action Alternative. No measure of the importance between impact areas has been applied.

2.4.2 Impact Summaries by Resource Area

2.4.2.1 Air Quality

Transient emissions of gaseous and particulate air pollutants will occur throughout the construction phase of any Bellefonte conversion option or variant. The impacts of these emissions on local and regional air quality will be minimal and directly dependent upon the amount of necessary new construction. Since the Bellefonte site was previously prepared for the construction of a 2,400 MW nuclear generation facility, anticipated construction-related air quality impacts will be less than for a new site. Accordingly, the overall air quality impact of construction activities for any of the proposed conversion options or variants will not be significant.

The power generation phase of all proposed options or variants will result in the emission of regulatorily significant quantities of a number of air pollutants including, most importantly, sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM10), and carbon monoxide (CO). The FEIS addresses a number of specific air quality issues in detail including potential impacts on ambient air quality standards, prevention of significant deterioration, plume blight, hazardous air pollutants, odors, cooling tower drift, cumulative impacts, air quality related values, regional haze, acidic deposition, and climate change. Where appropriate, EPA-approved dispersion models are used to assist in the assessment of these issues.

Although no ambient air quality standards would be exceeded by any option or variant, some, such as the as-configured PC Option and PFBC variant, for example, will have difficulty demonstrating compliance with short-term Prevention of Significant Deterioration (PSD) Class I and Class II increments for SO_2. In contrast, the lower overall emissions rates from the NGCC and IGCC/C Options appear substantially more innocuous from an air quality perspective.

Important issues identified in this document that will be further addressed upon selection of a conversion option or variant (during permitting) include operational contributions to:

- Class I and/or Class II PSD increments for SO_2 and PM10,
- Plume blight and regional haze in Class I areas, and

- Local and regional production of secondary air pollutants (particularly with respect to recently promulgated standards for ozone and PM2.5).

Notwithstanding the continuing importance of these issues, it should be recognized that a range of additional design and emissions control options are available to bring any of these options or variants into environmental compliance and that the construction and operating permitting process requires substantive demonstration of compliance with both source-related requirements and ambient air quality standard and increment regulations. Finally, to the extent that the operation of the constructed facility allows the less frequent use or retirement of older, less well controlled generating resources, there would be a net decline in regional pollution emissions and a corresponding improvement in regional air quality and air quality related values.

The air quality impact of the chemical operation phase for the IGCC/C and Combination Options and their variants will also be of environmental significance. However, since the preliminary design of the chemical operations calls for the combustion of purge/off-gas streams with the syngas or duct firing prior to the HRSG, emissions from chemical production will be negligible. As for generation, chemical operations will be required to demonstrate compliance with environmental laws and regulations and, if needed, additional design and emissions control options may be applied.

The impact ratings reflect the expectation that technology configurations actually constructed would include emission controls sufficient to ensure compliance with regulations and PSD increments. The important negative permanent ratings assigned to Options 4 and 5 are related to the potential air quality issues inherent in the operation of a chemical plant.

2.4.2.2 Geologic Setting

The lightly negative impacts for construction of all five options are based on the need to provide bedrock testing and grouting to reflect the typically karst terrain in this area of North Alabama.

Operation results in no negative impacts to geologic stability.

2.4.2.3 Soils

Soils of agricultural value within the footprint of each conversion option will be unavailable for future use. The lost agricultural productivity of each option is variable, depending on how much of the affected land was disturbed by previous construction/industrial activity, and how much land will be impacted by new construction/industrial activity. The preferred NGCC Option was assigned a negligible impact because of its relatively small footprint, which occurs on land already permanently impacted by present industrial facilities. The other options were assigned a lightly negative permanent impact rating because of proposed additional construction and industrial needs, such as for fuel, by-product, and waste storage/disposal. All conversion options, however, will have a negligible impact on county agricultural productivity. Soils impacts for construction of the natural gas pipeline, an effect incremental to the NGCC and Combination Options, were classified as moderate because of the disturbance to the topsoil along its route.

Operation would result in no additional land use, and no impacts would occur after construction is complete.

2.4.2.4 Solid Nonhazardous Wastes

Solid nonhazardous wastes generated during construction would be disposed off site at state-permitted landfills. The light temporary impacts shown for each conversion option are indicative of the small pressure that might be placed on off site landfill capacities during construction only.

The combustion by-product materials generated by coal utilization, Options 1, 3, 4, and 5, would be marketed to the highest extent possible. The materials that cannot be marketed, which include off-specification ash, slag, and gypsum generated during unit startups, etc., would have to be disposed in an acceptable way. For this FEIS, it has been assumed that all waste would be disposed in appropriately designed areas on the Bellefonte property. The disposal of these materials is not regulated by ADEM; however, any disposal area will conform to good engineering practice which requires that a buffer zone of low permeability soil or a liner separate the disposed solids from groundwater. The lightly negative permanent ratings for the operation of the coal-consuming options (Options 1, 3, 4, and 5) are associated with the expected generation of some off-specification solids which cannot find a market and thus requires disposal for the life of the plant. Noncombustion wastes generated during operation of all five conversion options will be taken to nearby state-permitted municipal landfills.

2.4.2.5 Hazardous Waste

The lightly negative temporary impacts during construction assigned to all options reflect the expected generation of some low-volume wastes which prove to be characteristically hazardous, thus requiring special handling, reporting, and disposal at appropriately permitted disposal facilities. These wastes would be transported to the TVA Hazardous Waste Management Facility in Muscle Shoals, Alabama, for disposal elsewhere.

Larger quantities of hazardous wastes may be produced during operation also. These wastes will be handled like the hazardous wastes from the construction phase. This resulted in the assignment of lightly permanent negative ratings to all options to reflect this minimal impact extending for the life of the plant.

2.4.2.6 Surface Water

Neither construction nor operation of the five conversion options will pose any problems from a surface water availability standpoint. The proximity and volume flow of the Tennessee River provides a ready source of raw water of sufficient quantity to meet foreseeable needs, including the operation of both natural draft cooling towers. No environmental impacts are expected.

Construction activities for the five conversion options, considering the Best Management Practices (BMPs) required for TVA construction projects, are not expected to result in any surface water quality problems. All construction activities which disturb more than five acres will require a special construction activities runoff permit. The construction storm water runoff for the PC Option will result in increased monitoring and controlling to prevent soil erosion into surface streams, thus the assignment of a higher negative temporary impact.

The impacts during operations are related to the handling, storing, and hauling activities of all materials around the site. The PC Option is highly negative mainly due to the storing of coal in the coal pile; the additional hauling of fly ash and bottom ash; and the increased acreage needed on site for storing the fly ash and bottom ash, and the wet stacking of gypsum. Erosion control structures and measures will be used by TVA to limit the impact from all five options.

Several types of limitations are typically placed on point-source waste water discharges to surface waters at the Bellefonte site, including water quality-based limits and technology-based limits for various types of sources. Typically, waste water generated as a result of power production and industrial/manufacturing operations is treated to the level needed to meet these limits before discharge. No problems are expected in the removal of pollutants to the levels required to comply with regulations, although treatability studies have not yet been completed for comingled streams, especially those for the options with chemical production (Options 4 and 5). The use of the existing cooling towers, assumed for all conversion options, may raise an issue related to the discharge of heated blowdown discharge. For several days during the course of a typical summer, the instream ambient temperature of the Tennessee River exceeds the maximum temperature allowed for discharged effluent. This situation creates an anomaly since the temperature of the extracted water would be higher than that allowed for any discharge. The approach planned for Bellefonte is to obtain a 316(a) variance for temporary releases of heated effluent during such periods. This potential problem is the reason for the moderately negative overall ratings. If a variance cannot be obtained, TVA may be required to lower the temperature of discharge water before its release to the Tennessee River, which would increase costs.

2.4.2.7 Floodplains/Floodways

For all of the conversion options, facilities would be sited to provide a reasonable level of protection from flooding. All facilities related to the production of power would be located outside the limits of the 500-year floodplain, elevation 603.1 feet above mean sea level. The only facilities located within the limits of the floodplain would be repetitive actions: the flyash and bottom ash storage area, and the gypsum storage area. Alternatives to locating the flyash and bottom ash, and gypsum storage areas within the floodplain were evaluated and documented to support a determination of “no practicable alternative” to the proposed floodplain siting. Construction of the storage areas would not adversely impact flood elevations and containment dikes would be constructed with top elevations above the 500-year flood to reduce the possibility of flooding of these areas. The project would comply with the requirements of Executive Order 11988 (Floodplain Management).

There would be no negative impacts associated with this resource area for any conversion option after construction.

2.4.2.8 Groundwater

No groundwater would be used during either construction or operation of the five conversion options; therefore, there would be no impacts to groundwater availability.

Construction of conversion facilities is expected to have no detectable impact on the quality of groundwater. For operation, a small risk of contamination is associated with each conversion option except NGCC because of the increased array of feedstocks, products, by-products, wastes, etc., to be handled, processed, and/or stored on site. Under normal circumstances, groundwater quality would be protected by use of BMPs, liners, containment vessels, and other measures. Spills and accidental releases would be decontaminated and mitigated in accordance with TVA procedures (Spill Prevention Control and Countermeasure Plan) and ADEM regulations. However, a remote possibility exists for the failure of a storage area liner or containment system during a catastrophic event or an earthquake. For these reasons, a lightly negative permanent effect has been assigned to all conversion options except NGCC, the preferred option, which involves little or no risk of groundwater contamination.

2.4.2.9 Terrestrial Ecology

Because of the small footprints and quality of the terrestrial habitat that would be disturbed by conversion of Bellefonte, impacts for this category would be insignificant. No rare plants or unique or uncommon plant communities will be affected. Much of the affected area has been previously disturbed by construction activities, therefore, no important woodlands or grasslands would be affected by construction. Animal species found in the affected area are regionally abundant. No protected species are found on the Bellefonte site. The lightly negative, but permanent, impacts of construction are related to the small habitat losses expected.

Operation will have no additional impacts on terrestrial biological resources.

2.4.2.10 Aquatic Ecology

Effects to aquatic resources are temporary during construction. Most effects would be the result of stormwater runoff and leaching from disturbed or contaminated areas, construction of a barge terminal, coal unloader facility and the lowering of the existing cooling tower blowdown diffuser pipes five feet to allow barge movement. The dredging and barge terminal construction activities would result in near field impacts on resident aquatic communities as a result of increased turbidity dislocation of mussels, fish, and other water life. Protected species have not been found in the affected portion of the Tennessee River. BMPs will be developed to avoid primary spawning seasons and to otherwise minimize impacts. The assignment of moderately negative ratings for Options 4 and 5 are related to the construction of an expanded barge terminal and loading facility for coproducts. Light temporary impacts are expected for the PFBC and IGCC Options, while no impact is expected for NGCC, the preferred option, which avoids the construction of a barge terminal.

Impacts during operation are related to the intake of raw water (entrainment and impingement of aquatic life), possible spills of raw material and products during barge loading/unloading, possible accidental introduction of fuels and products into surface water, and permitted waste water discharges. Although no significant long-term, irreversible impacts are expected to aquatic communities in this stretch of the Tennessee River, small impacts will occur for Options 1, 3, 4, and 5 (no aquatic effects are expected for the NGCC Option, the preferred option), during the course of normal operation and during spills or upsets. The ratings are related to the degree of impacts associated with the amount of water used, extent of barge loading/unloading activities, the number of fuels, chemicals and by-products involved in each option, and the relative impacts of toxic and thermal pollutants. The PC and IGCC Options were assigned a moderately negative permanent impact, whereas the IGCC/C and Combination Options were assigned lightly negative impacts, primarily on the basis of reduced coal use.

2.4.2.11 Wetlands

Options 1, 3, 4, and 5 will require the elimination of 24 acres (9.8 hectares) of aquatic bed and forested wetland islands for the construction of barge handling facilities to handle coal. This negative impact will be permanent for the life of the facility, and can be compensated through the Section 404 of the Clean Water Act mitigation process. The NGCC Option, the preferred option, will not impact any wetlands.

The associated gas pipeline corridor may impact limited areas of wetlands, but those impacts will be temporary and insignificant. The lightly negative permanent impact ratings for Options 1, 3, 4, and 5 are associated with the loss of the 20 acres of wetlands.

No additional loss of wetlands would occur during operation of the converted Bellefonte.

2.4.2.12 Socioeconomics

The socioeconomic impacts for construction are primarily positive because of jobs creation and the multiplying benefit to the local economy. Ratings are directly proportional to the number of workers needed during construction for each of the five conversion options. Some negative impacts were noted for demands on housing and social services, but these were more than overcome by the increased taxes available to local governments and the influx of construction-related dollars. The rating for the Combination Option was judged to be important with an estimated peak employment of 3,447 and with 15,759 person years of employment over ten years, as compared with peak employment of 550 and with 3,008 person years over eight years associated with NGCC, the preferred option, which received a lightly positive rating.

Impacts during operation were similarly treated, except they were long term. It is expected that of the permanent work force who would move into the area (about half the work force), close to 90% would buy or rent houses and 90% would bring their families. Employment at the plant, depending on the conversion option, would result in annual wages ranging from $8.8 to over $28 million dollars annually. Impacts on social services, such as fire departments and schools are expected to be small.

2.4.2.13 Transportation

Additional traffic will be generated during the construction phase of the project. This additional traffic will be most noticed during shift changes. The capacity levels of the local highways will be negatively affected. Impacts would be most acute on Bellefonte Road and Jackson State Route 33 which lead to U.S. Highway 72. Traffic on U.S. Highway 72 would be minimally affected, but some loss of service capability, i.e., lower operating speeds and momentary stoppages, would occur on the roads leading to U.S. Highway 72. Highway impacts can be cost effectively mitigated through staggered work hours and carpooling. Impacts on railroads and river transport systems are expected to be minimal during construction. Construction of new rail access and layby tracks and upgrading of existing tracks leading to Bellefonte would be needed to support the non-NGCC Options. Moderately negative impact ratings were assigned all to conversion options except NGCC, which was lightly negative.

The impact on the local road network during operation of the converted plant would be reduced since the daily permanent work force is somewhat lower. Use of rail and river transport is expected to increase significantly, except for NGCC, because of the need to transport feedstock and products to and from the site. An increase of about 10,600 rail car units per year was projected to serve the IGCC/C and Combination Options. The existing rail system in North Alabama is not expected to experience any congestion from this additional demand. The design coal for all coal-consuming options involves the import of Illinois No. 6 coal by barge. For the IGCC-based options, a coal blend with petroleum coke is the design basis which may involve transport of supplies from the Gulf Coast area, also by barge. Additional barge traffic is estimated to be 6,073 barges annually for the PC Option. This activity places additional demand on lockages through the four dams on the Tennessee River downstream of Bellefonte. Using existing lock capacities, it was projected that the additional barges could be easily accommodated except at Kentucky Dam which currently experiences large delays. Alternatives for importing fuel include rail and barge combinations using various coal transfer terminals located on the Tennessee River but these alternatives were not evaluated in detail. The NGCC Option, the preferred option, received a lightly negative impact for this category primarily for its impacts to roadway use due to workforce commuting. Moderately negative impact ratings were assigned to other options. These impact ratings are predominately related to impacts to road, rail and barge impacts. All impacts are considered to be permanent.

2.4.2.14 Land Use

Construction would result in the consumption of a small amount of acreage currently used or available for hay production. Land requirements range from 46 acres for the NGCC Option to 225 acres for the Combination Option. However, land use impacts would on the whole be insignificant for all conversion options.

Additional impacts on land use are expected for operation under current plant operating assumptions. These include the disposal of unmarketable combustion residue. The largest impact on land use is for the PC Option, which is projected (assuming zero marketing success) to require approximately 300 acres for 20 years of full operation.

2.4.2.15 Aesthetic and Recreation

Construction activities are typically viewed as transient disturbance of the environment from an aesthetic and recreation standpoint. However, several aspects of each of the conversion options will involve a lasting visual reminder of changes at the Bellefonte site. These include the new mooring cells, barge terminals, and coal transfer facilities along a 4,500-foot stretch of the Tennessee River constructed to serve the non-NGCC Options and construction of combustion flue gas stacks ranging in number from two to twelve and in height from 200 to 580 feet. A fuel oil storage tank is associated with two of the five options. These facilities will be noticeable to the casual observer from long distances in any direction and from a considerable stretch of U. S. Highway 72. Lightly negative permanent ratings were assigned to NGCC, TVA's preferred option, because of the avoidance of barge facilities and fuel tanks. Permanent moderately negative ratings were assigned to PC, while the options involving IGCC were given important negative ratings, partly because of the additional structures involved.

Operation of all conversion options would result in the emission of air pollutants and noise from combustion turbines (except for PC) and the cooling tower. The flare stack (not used for NGCC or PC) would probably be easily heard at the plant boundary. Depending on conditions, the flame from the flare stack would be visible for large distances, especially at night. Plumes from combustion stacks could be visible on some occasions, but opacity is expected to be minimal because of the advanced air pollutant control technologies to be used. Also, a negative impact along Jackson County Road 33 would be realized from the resultant truck traffic associated with the transportation of some raw materials to the plant and by-products to markets. Important negative permanent impacts are expected from Conversion Options 3, 4, and 5, while the PC Option impacts were rated as moderate. The NGCC Option was given a rating of lightly negative.

2.4.2.16 Cultural Resources

Previous surveys of the Bellefonte site identified five archaeological sites. However, none of these sites are within the area affected by the construction of any of the five conversion options and therefore there should be no impacts. All structures associated with the original town site of Bellefonte eligible for placement on the National Register of Historic Places were removed prior to the conversion project. Consequently, there are no impacts to structures with potential historical significance for construction.

Operation of a converted Bellefonte plant will not impact cultural resources.

2.4.2.17 Noise Impacts

Routine construction activities associated with all five conversion options will generate noise that is predicted to have no impact except a minor increase in background sound levels for Options 2 through 5 at the nearest fence line. For all options, there will be short periods in which steam lines are cleaned out prior to plant operation in which noise levels would be very loud at the nearest fence line and nearest residence. These are unavoidable, short-term, temporary impacts that will be mitigated through notification of employees and nearby residents to avoid the “startle effect” on residents and hearing damage to employees near the power block.

Routine operating conditions, even at full capacity, would not result in important adverse impacts to sensitive off-site receptors from any of the five conversion options. Noise modeling of sources in the power block, at the barge dock, and at the coal pile indicates that during routine operating conditions there will be substantial increases in noise levels at the nearest fence line for all but TVA’s preferred option, (NGCC); however, none of the options result in levels greater than the 65 Ldn threshold of significant adverse impacts. The PC Option was predicted to result in the greatest increase in noise levels.

Three of the five conversion options—IGCC, IGCC/C, and Combination—involve the use of flares. During the times when flaring is occurring (estimated to be no more than one hour per event and no more than 90 events per year) no significant adverse impacts are expected although the flaring would result in a substantial increase in sound levels at all receptors. By scheduling gasification start ups and shut downs for daylight hours, TVA can mitigate the unavoidable impacts of flaring. Finally, there will be noise impacts from truck traffic hauling combustion by-products from the plant. These impacts are greatest for the PC conversion option and are absent from the NGCC Option.

For these reasons, the NGCC Conversion Option is the least impactive overall with the other four options resulting in minor impacts with occasional moderately high levels from flaring and/or truck traffic.

2.4.2.18 Safety and Health

Construction and operation of any large and complex facility involving a wide array of crafts and personnel interaction poses some risk to the safety of workers. Impacts to safety of workers would be minimized by TVA's safety program which requires workplace standards, workplace accident investigation, emergency response programs, individualized training, job safety planning, training, employee involvement, and workplace inspections, monitoring, and audits. Lightly negative temporary impacts were assigned to each conversion option.

Electromagnetic Fields (EMF)

TVA's standard location practice has the effect of minimizing public exposures to transmission line EMF. The transmission line route selection team used a constraint model that placed a 300-foot radius (91.4 meter) buffer around occupied buildings. For schools, a 1200-foot (366 m) buffer was used. The purpose of these buffers was to reduce potential land use conflicts with yard trees, outbuildings and ancillary facilities, and to reduce potential visual impacts and possible EMF-related controversy. Though not absolute location constraints, these buffers weigh heavily in location decisions, influencing selection of route options and alignments. Because EMF diminishes so quickly with distance, the routing of transmission lines using constraint buffers effectively reduces potential public exposure to EMF.

Health Effects from the Fuel Cycle

For the PC, IGCC, and IGCC/C Options, coal would be the primary fuel source. For the acquisition of coal, significant reductions in rates of mining deaths per number of employee hours worked have been achieved over the last few years in the mining industry. A combination of factors has been responsible for the dramatic safety gains in the U. S. mining industry since the turn of the century. The rate of coal mining deaths decreased from about 0.20 fatalities per 200,000 hours worked by miners (or one death per million production hours) in 1970 to about 0.07 fatalities in 1977 and an average of 0.04 fatalities for the 1990-94 period.

Natural gas would be the primary fuel for the NGCC and Combination Options. Natural gas extraction is technologically simpler and less labor intensive than coal mining, consequently, health effects are fewer and less pronounced.

Impacts Due to Accidents

The accident scenarios evaluated in Section 4.2.18.3 are considered to be rare occurrences. The approach used in this section is to identify reasonably foreseeable accident scenarios and, using guidance provided by pertinent regulations which affect the operation of facilities like those described herein, develop information which would provide residents living near Bellefonte a better understanding of possible health risks. As a federal agency, TVA is not subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) or the Occupational Safety and Health Act. However, TVA is committed to complying with regulations to protect public health and worker safety. As a matter of policy and consistent with Executive Order 12856, TVA complies with EPCRA to the extent other utilities do. TVA must internally comply with Occupational Safety and Health Administration substantive requirements as these are incorporated in its occupational health and safety manual. All facilities would be designed and constructed to prevent hazards from impacting the environment and public health. In addition, TVA would develop and implement safety programs with the primary goals of minimizing potential for accidents and protection of the public and environment.

2.5 References

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3 .0 AFFECTED ENVIRONMENT

This chapter provides baseline information for understanding the environmental impacts and consequences of the proposed conversion options presented in Chapter 4.0. The existing environment and conditions are described in detail for the resources listed below for the areas affected by the No-Action and Preferred Alternatives and for the environment affected by the natural gas pipeline.

- Air quality
- Geologic setting
- Site soils
- Solid waste
- Hazardous waste
- Surface water
- Floodplains
- Groundwater
- Terrestrial ecology
- Aquatic ecology
- Wetlands
- Socioeconomics
- Transportation
- Land uses
- Aesthetics and recreation
- Cultural resources
- Noise levels and conditions

3.1 Environment Affected by the No-Action and Preferred Alternatives

3.1.1 Air Quality

The following sections describe the existing environmental conditions relevant to air quality at the proposed Bellefonte conversion site and in the surrounding area. These include climate and meteorology, ambient air quality, and existing emissions sources.

3.1.1.1 Climate and Meteorology

This section describes climate and meteorology parameters with an emphasis on wind patterns and associated terrain impacts, climatic statistics, and potential severe weather impacts at the site.

Prominent valley-ridge topographical features dominate the site area and are generally aligned from northeast to southwest. Since the Bellefonte site is located in this terrain along the Tennessee River, local wind patterns are dominated by down valley (north through northeast) and up valley (south through southwest) wind directions (radii represent the direction from which the wind is blowing). This is illustrated in the "wind roses" presented in Figures 3.1.1-1 and -2. These wind roses are based on five years of data (1978-1982) collected from a 110-meter tower that was subsequently removed from the site. Wind direction percent frequencies are given by the ends of the bar graphs. For example, the frequency of winds blowing from the northeast in Figure 3.1-1 is about 14.5%. Wind speed frequencies for different ranges of wind speeds in each direction are depicted according to the key at the right of the wind rose. For example, the frequency of wind speeds in the 3.5-5.4 mph range for the northeast wind direction in Figure 3.1-1 is about 5%. Above the level of the valley-ridge influence, the pattern becomes more regional in character with more uniform directional distribution that has slightly predominant southeasterly, southwesterly, and northerly winds. [1]

Figure 3.1.1-1 10-Meter Wind Rose for Bellefonte

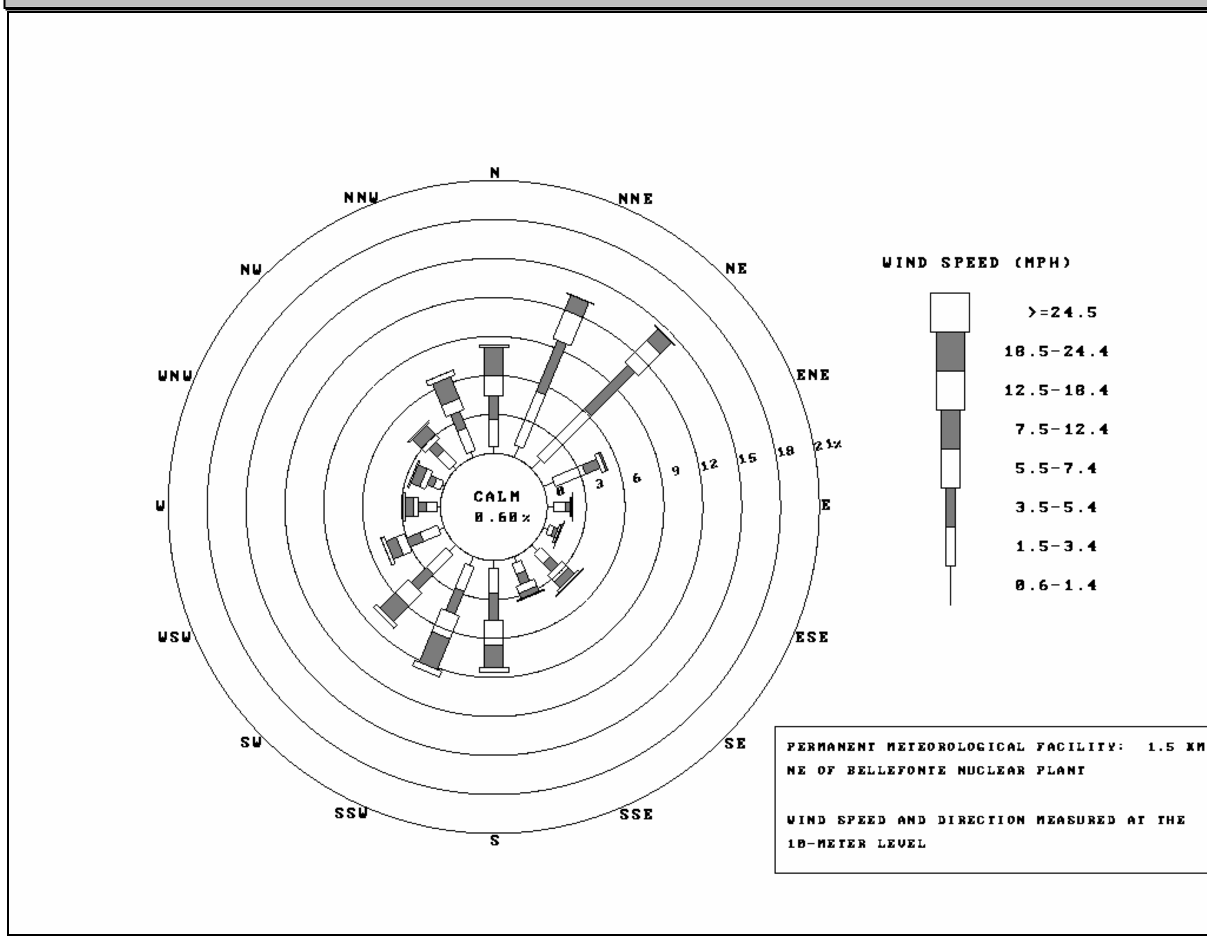
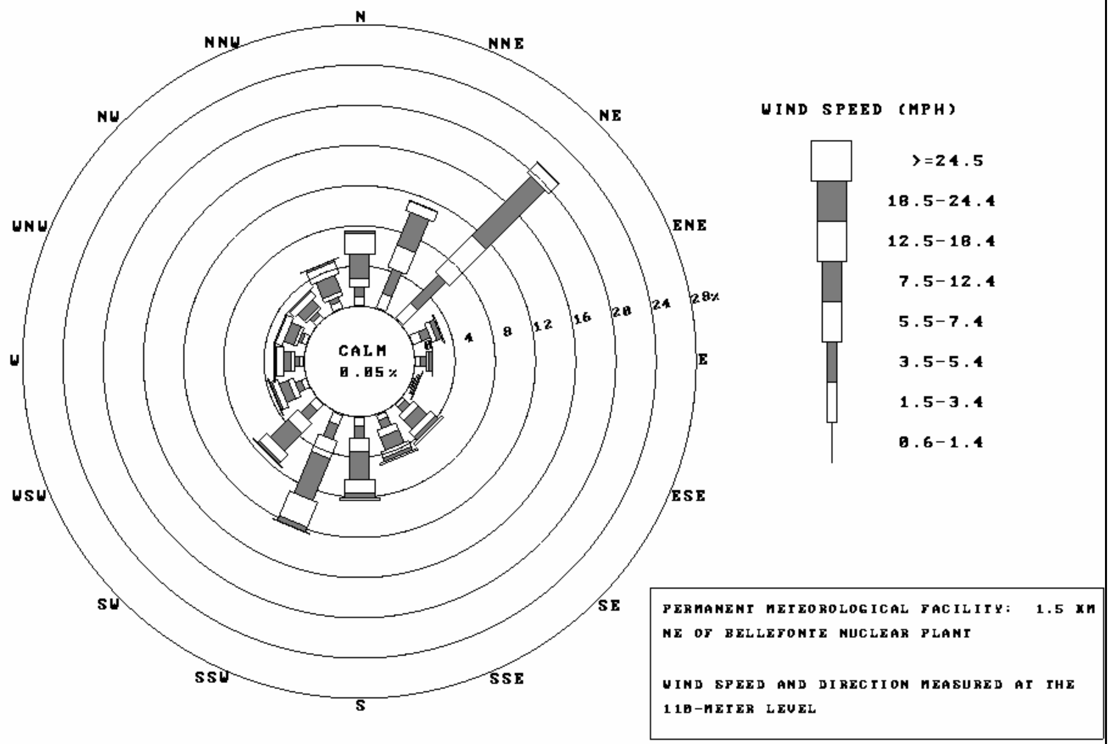


Figure 3.1.1-2 110-Meter Wind Rose for Bellefonte



Climate statistics for the site area are outlined in Table 3.1.1-1. [2-11] The National Weather Service cooperative weather station at Scottsboro is the closest source of long term observations, but is limited to temperature and precipitation data. Snowfall observations have been made at Scottsboro but have not been consistent for reliable averages. The maximum 24-hour snowfall in the records since 1960 is 12.0 inches, which coincides with the March 1993 snowstorm resulting in Chattanooga's record 20-inch snowfall. Dense fog days for Huntsville and Chattanooga differ significantly. Estimates for fog days, extracted from maps, are shown in the third column of fog days data, but there is no site area data. Wind speeds at the Bellefonte site are lower than at either the Huntsville or Chattanooga airports but are closer to the Chattanooga averages. The Huntsville airport is in open terrain while Chattanooga is in the lower end of the Great Valley of the Tennessee River in eastern Tennessee. A low wind speed sensor threshold for onsite measurements and more protection from strong cross-valley winds may explain the lower average wind speeds at the site. The stability class frequencies are the percent of time that unstable (strongest mixing), neutral (good mixing), and stable (poor mixing) atmospheric mixing conditions are observed. The values in Table 3.1.1-1 shown are not necessarily what would be contained in a current modeling data base, but they give a good indication of the approximate distribution at the site.

Severe weather that may affect the site includes:

- Heavy general rainstorms,
- Thunderstorms that can be accompanied by:
  - heavy downpours
  - strong winds
  - hail, lightning
  - tornadoes
- Snowstorms, and ice storms.

The most serious of these would be a tornado. However, the probability of tornado occurrence at any point within a circle with radius of 30 nautical miles (34.5 statute miles) centered at the plant site is 1.15 x 10^{-4}.[8] This is equivalent to once each 8,700 years. For straight winds, the fastest wind at 30 feet above ground expected once in a 100 year period is about 90 miles per hour.[12]

Severe weather could affect the operation and structural integrity of the plant. Plant design would take into consideration the magnitude and frequency of severe weather at Bellefonte.

Table 3.1.1-1 Statistics Representing Existing Climate for the Bellefonte Site

Month	Temperature (degrees Fahrenheit) Scottsboro[2] 1972-94 Averages max	min	mean	1961-90Normal Mean	Precip. (inches) Scottsboro[2] 1961-90 Normal	Snowfall (inches) Huntsville[4] 1968-94	Chattanooga[5] 1931-94	Thunderstorm Days Huntsville[4] 1968-94	Chattanooga[5] 1931-94	Dense Fog Days (visibility <= 1/4 miles) Huntsville[4] 1968-94	Chattanooga[5] 1931-94	Hardwick[7]
Jan	49.4	27.4	38.6	37.6	5.15	1.4	1.8	1.1	1.1	2.6	3.0	3
Feb	54.8	30.8	42.8	41.9	5.14	0.7	1.2	2.1	1.9	1.4	1.6	1
Mar	64.2	38.4	51.5	50.7	6.60	0.4	0.7	4.3	3.7	1.2	1.7	1
Apr	72.4	45.0	58.9	59.2	4.77	trace	0.1	4.7	4.7	0.8	1.5	1
May	80.2	54.5	67.2	67.4	4.89	0	trace	7.1	7.2	1.1	2.3	2
Jun	86.9	62.4	74.7	74.6	4.12	0	0	8.5	9.4	1.3	2.0	2
Jul	90.5	66.7	78.6	77.9	4.80	0	0	10.3	11.4	1.6	2.0	2
Aug	90.1	64.9	77.5	77.0	3.68	0	0	8.2	9.2	1.9	2.5	1
Sep	84.2	58.8	71.5	71.1	4.71	0	0	4.9	4.1	2.1	3.7	2
Oct	73.3	45.0	59.2	59.4	3.28	trace	trace	2.1	1.3	2.4	5.8	3
Nov	63.5	37.3	50.7	50.1	4.53	trace	trace	2.3	1.3	1.8	3.9	3
Dec	53.6	30.4	42.0	41.5	5.80	0.1	0.6	1.1	0.6	1.3	3.2	1
Annual	71.9	46.8	59.4	59.0	57.47	2.8	4.3	56.9	55.8	19.6	33.3	22

Month	Average Relative Humidity (%) at 4 times of the Day (CST) Huntsville[4] Hour 00	06	12	18	Chattanooga[5] Hour 00	06	12	18	Average Wind Speed (mph) Huntsville[4] (25 ft) 1968-94	Chattanooga[5] (20/30 ft) 1941-94	Bellefonte[8] (35 ft) 11/78-10/81	Surface-Based Temperature Inversion Frequency (%)[a] Site Tower[8] (11/78-10/81)
Jan	78	82	64	68	79	82	62	67	9.3	6.9	5.5	23
Feb	75	81	59	61	77	81	57	60	9.7	7.3	5.9	20.9
Mar	73	81	56	57	77	81	53	55	10.1	7.8	6.5	21.2
Apr	75	83	52	52	78	82	49	51	9.3	7.3	5.9	27.6
May	83	87	56	60	87	86	53	57	8.1	5.9	4.8	27.1
Jun	85	88	56	61	88	87	55	60	7.0	5.3	4.5	26.8
Jul	87	90	59	65	88	89	57	63	6.3	5.0	4.2	25.3
Aug	87	91	58	66	89	91	57	65	5.9	4.6	3.6	26.3
Sep	87	91	59	68	89	91	56	67	6.8	4.9	4.2	24.7
Oct	83	87	55	65	88	90	53	67	7.5	4.9	4.4	31.1
Nov	79	84	58	65	83	85	56	66	8.6	6.0	4.9	31.9
Dec	78	82	63	69	81	83	62	69	9.3	6.4	5.2	28.8
Annual	81	86	58	63	84	86	56	62	8.2	6.0	5.0	26.3

TABLE 3.1.1-1. Statistics Representing Existing Climate for the Bellefonte Site (Cont'd)

	Temperature Scottsboro[2] (°F)	**Precipitation** Scottsboro[2] (inches)	**Snowfall** Huntsville[4] (inches)	**Snowfall** Chattanooga[5] (inches)
Highest monthly maximum	96.7 (Jul 80)	14.73 (Dec 90)	9.6 (Jan 88)[b]	20.0 (Mar 93)
Lowest monthly minimum	15.4 (Jan 77)	0.36 (Oct 91)		
Highest	107 (Jul 17, 80)[c]			
Lowest	-8 (Jan 21, 85)[d]			
24 Hour Maximums		6.80 (Dec 90)[e]	9.6 (Jan 88)[b]	20.0 (Mar 93)

Mixing Height Averages[9] (meters)		**Number of Atmospheric Stagnation Cases** (>=4 days) in 35 Years 1936-70[10]		**Stability Class Frequencies**[f]			
Winter				A. Chattanooga 1967-71 STAR Program[11]			
morning	500	Dec	2		U	N	S
afternoon	1,100	Jan	1	Winter	11	58	31
Spring		Feb	0	Spring	23	39	38
morning	510	Winter	3	Summer	34	25	41
afternoon	1,800	Mar	0	Fall	19	39	42
Summer		Apr	3	Annual	22	40	38
morning	430	May	9	B. Site Tower 11/78-10/81 NRC R.G. 1.23 Temperature Diff. Method[8]			
afternoon	1,900	Spring	12		U	N	S
Fall		Jun	8	Annual	8	48	41
morning	350	Jul	4				
afternoon	1,500	Aug	7				
Annual		Summer	19				
morning	450	Sep	12				
afternoon	1,600	Oct	17				
		Nov	16				
		Fall	35				
		Annual	69				

a - Between 10 and 108 meter levels on tower
b - Maximums Prior to 1968 in Huntsville area : 21.4 in and 17.1 in (Dec 63)[6]
c - Highest Prior to 1961: 109°F (Jul 13, 30)[3]
d - Lowest Prior to 1961: -16°F (Feb 14, 05)[3]
e - 1972-94 Period
f - U - unstable, N - neutral, S - stable

3.1.1.2 Ambient Air Quality

Ambient air quality in the surrounding area is generally good. This was documented from February 1, 1990, through January 31, 1991, at an ambient air monitoring station on Sand Mountain, about 3.8 km east of the plant site. The station was operated to meet quality assurance requirements contained in 40 CFR Part 58 for Prevention of Significant Deterioration (PSD) evaluations. [14] Six criteria pollutants were measured at the station:

- Sulfur dioxide (SO_2),
- Particulate matter (PM10),
- Carbon monoxide (CO),
- Ozone (O_3),
- Nitrogen dioxide (NO_2), and
- Lead (Pb).

Results are in Table 3.1.1-2. Criteria pollutants are those pollutants for which EPA has set National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. Primary standards protect human health and secondary standards protect public welfare. Alabama Ambient Air Quality Standards are the same as the NAAQS for all criteria pollutants (Table 3.1.1-3). During the preparation of this environmental impact statement, significant revisions to the ozone and particulate matter NAAQS were promulgated by EPA on July 18 and adopted on September 16, 1997. The revised standards are included in Tables 3.1.1-2 and 3.1.1-3.

Even though the level and form of the revised ozone and particulate matter standards are known, the implementation schedules pertaining to these standards remain uncertain. The U.S. EPA has proposed the following implementation schedules:

- Ozone - Following the effective date of the revised ozone standard (September 16, 1997), states will have three years (until September 2000) to determine attainment status and to issue State Implementation Plans (SIPs) for areas in attainment. States will have an additional three years (until September 2003) to submit SIPs for nonattainment areas, and it is anticipated that compliance with this standard will be achieved between September 2007 and September 2012. The current one-hour standard of 0.12 ppm will continue to remain in effect for nonattainment areas until EPA determines that the standard has been met.
- Particulate Matter - Following the effective date of the revised particulate matter standard on September 16, 1997, states must establish monitoring plans by July 1998, initiate monitoring

by September 1998, and have all monitors in place by September 2000. Although this schedule could allow determination of attainment status for some areas as early as September 2001, EPA has announced that it will wait until after its next five-year review of the particulate matter standard (July 2002) before designating attainment status or implementing any new control requirements. States will be required to submit SIPs in the 2005 to 2008 time-frame in order to achieve attainment by September 2017. In attainment areas, the current PM10 standard will continue to apply until a SIP for the PM2.5 standard is approved by EPA.

No relevant assessment could be made of likely future attainment status for ozone and particulate matter since the Bellefonte PSD monitoring data were insufficient to assess the revised standards which require three consecutive years of monitoring data and, in the case of the particulate matter standard, new sampling instrumentation.

Table 3.1.1-2 Summary of Ambient Air Quality Data For Bellefonte PSD Station

Pollutant	Highest Concentration	Second Highest Concentration	Number of Times Standard Exceeded	Percentage of Standard of Highest Concentration
Sulfur Dioxide (ppm)				
Annual arithmetic mean	0.005	-	0	17
24-hour average	0.023	0.020	0	16
3-hour average	0.080	0.069	0	16
Ozone (ppm)				
8-hour average	0.098	0.098	NA [a]	122 [a]
1-hour average	0.104	0.100	NA [a]	87 [a]
Nitrogen Dioxide (ppm)				
Annual arithmetic mean	0.005	-	0	10
Carbon Monoxide (ppm)				
8-hour Average	1.559	1.487	0	17
1-hour Average	2.840	1.930	0	8
Particulate Matter				
PM10 (ug/m^3)				
Annual arithmetic mean	24	-	0	48
24-hour average	46	45	0	31
24-hour 99th percentile	46	45	NA [a]	31
PM2.5 (ug/m^3)				
Annual arithmetic mean	no data	no data	no data	no data
24-hour 98th percentile	no data	no data	no data	no data
Lead (ug/m^3)				
Quarterly arithmetic mean	< 0.03	< 0.03	0	< 2

[a] - Data insufficient to determine the number of times standard exceeded. Attainment of these standards is based on 3 years of data.

Table 3.1.1-2 shows that concentrations of the six criteria pollutants did not exceed the levels of or violate applicable standards at the monitoring site. In fact, maximum concentrations of all criteria pollutants were significantly below the levels of ambient standards except ozone, which is a secondary pollutant. A secondary pollutant is one which is formed in the atmosphere from chemical constituents, either naturally occurring or emitted from man-made sources in a different chemical or physical form. The two most abundantly emitted primary criteria pollutants within 50 km of the site are SO_2 and PM10. Maximum ambient concentrations levels of SO_2 and PM10 were below levels of applicable standards. The entire Northeast Alabama area is currently in attainment of applicable ambient air quality standards for each of the six criteria pollutants.

Table 3.1.1-3 Alabama and National Ambient Air Quality Standards

Pollutant	Primary Standard (ug/m^3)	Primary Standard (ppm)	Secondary Standard (ug/m^3)	Secondary Standard (ppm)
Sulfur Dioxide				
Annual arithmetic mean	80	0.03	-	-
Maximum 24-hour average[a]	365	0.14	-	-
Maximum 3-hour average [a]	-	-	1300	0.5
Ozone				
Maximum 1-hour average[b]	235	0.12	235	0.12
Average 3-year, 4th- highest 8-hour average	157	0.08	157	0.08
Nitrogen Dioxide				
Annual arithmetic mean	100	0.05	100	0.05
Carbon Monoxide				
Maximum 8-hour average[a]	10,000	9	10,000	9
Maximum 1-hour average[a]	40,000	35	40,000	35
Particulate Matter				
PM10				
Annual arithmetic mean	50	-	50	-
Maximum 24-hour average[c]	150	-	150	-
Average 3-year 99th percentile of 24-hour concentrations	150	-	150	-
PM2.5				
Average 3-year annual arithmetic mean	15	-	15	-
Average 3-year 98th percentile of 24-hour concentrations	65	-	65	-
Lead				
Maximum arithmetic mean[d]	1.5	-	-	-

[a] - Not to be exceeded more than once a year.
[b] - The standard is attained when the expected days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than 1.
[c] - The standard is attained when the expected days per calendar year with a 24-hour concentration above 150 ug/m^3 is equal to or less than 1.
[d] - Averaged over a calendar quarter.

Although the EPA schedule for attainment status designation is several years off, the potential impacts of the revised ozone and particulate matter standards on Bellefonte and the surrounding area are substantial. An assessment of historical ozone and particulate matter monitoring data across the Tennessee Valley region indicates considerable nonattainment potential for both these standards. The impact of the revised ozone and particulate matter standards will be to place additional regulatory scrutiny on large NO_x and SO_2 emissions sources.

3.1.1.3 Existing Air Emission Sources

Current Bellefonte Nuclear Plant Emissions

Bellefonte Nuclear Plant on June 24, 1996, was determined to be a minor source under Title V of the Clean Air Act Amendments of 1990. [15] The determination was issued by the Alabama Department of Environmental Management (ADEM) after reviewing TVA's emission estimates for sources located at Bellefonte. The emissions estimates, based on average operating hours and usage levels for 1994, are shown in Table 3.1.1-4.

Table 3.1.1-4 Air Pollutant Emissions for Bellefonte Nuclear Plant, Pounds Per Year

Source	PM	SO_2	NO_X	CO	VOC[a]	HAP[b]
Diesel Generators 1-4	1.12	8.08	49.6	12.9	1.6	0.03
Diesel Fire Pumps 1-4	24.6	23	350	75.6	29.2	0.31
Auxiliary Boilers 1-2	105	3740	1056	264	10.6	5.16
Lube Oil System	380	—	—	—	—	—
Fuel Oil Tanks	—	—	—	—	—	—
Totals	512	3780	1456	352	133	5.48

[a] - Volatile organic compounds
[b] - Hazardous air pollutant

Other Air Pollutant Sources Near Bellefonte

Bellefonte is located in a predominately rural area with few industrial air pollutant sources in the immediate vicinity. Table 3.1.1-5 presents summarized information from the 1985 National Precipitation Assessment Program (NAPAP) point-source emissions data file for all sources located within 50 km of the site. [16] These data have been supplemented with recent TVA staff estimates of actual emissions for

Widows Creek and should be generally representative of current emission levels. A certified inventory will be obtained from ADEM for use in preparing the PSD construction permit application.

The nearest industrial emissions (other than particulate matter) are over 20 km from the site. The TVA Widows Creek Fossil Plant, approximately 25 km northeast of the Bellefonte site, is responsible for 91% of the SO_2 and 95% of the NO_x emissions shown in Table 3.1.1-5. Other air pollutant emission sources in the area include transportation, fires, and agriculture. Emissions associated with transportation are primarily due to motor vehicle traffic on U.S. Highway 72, which runs along the northeast boundary of the site. Other transportation emissions are associated with boat traffic, both recreational and commercial, on the Tennessee River which borders the southeast side of the site. Transportation emissions occur throughout the year at about the same level, while emissions from fires and agricultural activity occur either at random or seasonally.

Table 3.1.1-5 Summary Of Emissions For Resources Within 50 km Of The Bellefonte Site

Facility	Emissions (tons/year) of indicated pollutant				
	SO_2	NO_x	VOC	TSP	CO
Revere Copper & Brass Inc., Goose Pond Island	1	4	272	201	0
TVA Widows Creek Fossil Plant, Stevenson, AL[a]	25,403	21,199	345	3,299	1,344
The Mead Corp. Stevenson, Jackson Co., AL	1,907	812	117	356	569
Hoover Inc, Hollywood, AL	0	0	0	303	0
Hudson Wire Co, Trenton, GA	0	0	127	0	0
Galaxy Carpet Corp., Marion Co., TN	3	17	121	16	49
Tennol Inc, Jasper, TN	742	356	54	103	48

[a] - TVA staff estimates 1995 SO_2 and NO_x emissions to be 46,000 and 36,000 tons per year.

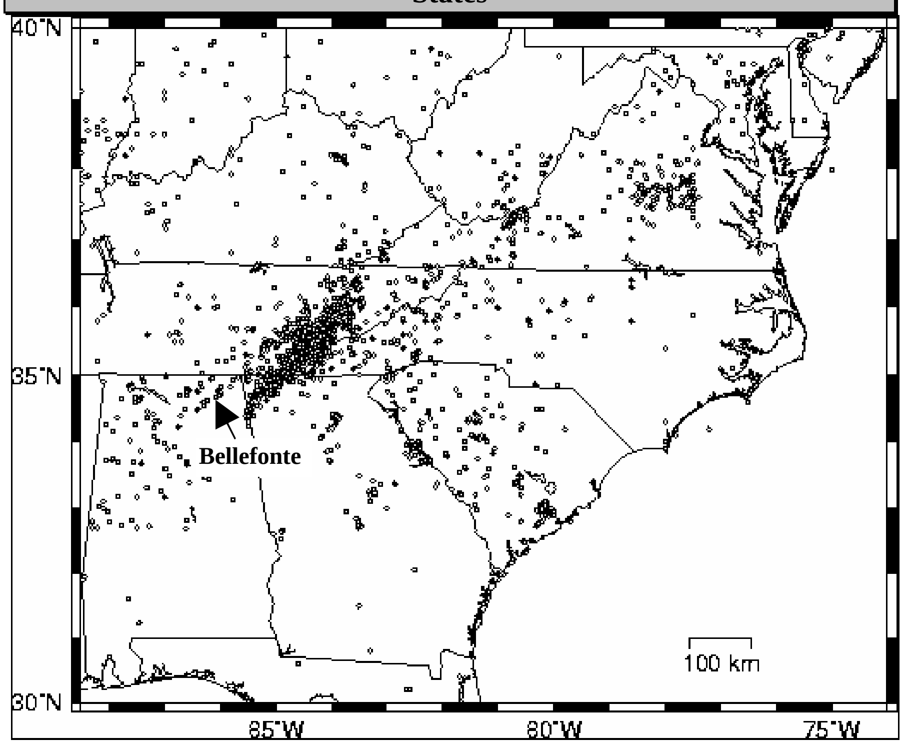
3.1.2 Geologic Setting

Because of past efforts to construct a nuclear plant at Bellefonte, a great deal of information has been generated about the site's geological characteristics and seismic stability. Two excellent sources of information are the 1974 Bellefonte Nuclear Plant EIS and the Final Safety Analysis Report generated to satisfy Nuclear Regulatory Commission requirements. [8,17] The information presented here is greatly summarized in the interest of brevity. More detailed information is contained in Appendix F.

3.1.2.1 Siesmicity and Faulting

Regional seismic monitoring networks were installed in the southern Appalachians beginning in the late 1970s. These networks have produced a much clearer picture of the siesmicity of the region. Figure 3.1.2-1 depicts the locations of earthquakes in the southeastern United States recorded by these networks from 1977 through 1995. [18] Bollinger presents recurrence relationships for southeastern United States earthquakes based on historical and instrumental records. [19]

Figure 3.1.2-1 Earthquake Locations in the Southeastern United States



No recent surface faulting is known near Bellefonte; however, small to occasionally moderate earthquakes continue to occur in the southern Appalachians. Essentially all of these recent earthquakes occur within the basement rocks of the southern Appalachians at depths from 5 to 26 km. Reactivation of zones of existing weaknesses within the basement rocks are believed to be responsible for present day earthquake activity in the region.[20]

Soil Amplification and Ground Deformation

Liquefaction of soils at the Bellefonte site due to earthquake ground motion is believed to be very unlikely. However, the effects of amplification of ground motions through soil columns should be considered in the seismic design of structures not founded on rock. Likewise, the potential for liquefaction beneath any new structure, pipeline or conduit not founded on rock should be evaluated in areas that were not investigated as part of the original Bellefonte Safety Analysis Report.[8]

Seismic Hazard Assessments

A probabilistic seismic hazard study was performed for nuclear plant sites in the central and eastern United States, including Bellefonte, in the 1980's by the Electric Power Research Institute (EPRI).[21] TVA commissioned a regional probabilistic seismic hazard study for dam safety purposes that was completed in 1992.[20] Guntersville Dam was the closest dam to the Bellefonte site for which specific seismic hazard results were reported. This study determined that the peak ground acceleration expected at Guntersville Dam for a 10,000 year return period is 0.23 g.

The ground shaking maps in the 1994 National Earthquake Hazards Reduction Program Recommended Provisions place the Bellefonte site in Seismic Hazard Zone 2.[22] Seismic Zone 2 is considered a "low" seismic hazard zone on a scale that ranges from Seismic Zone 1 (lowest computed hazard) to Seismic Zone 7 (highest hazard).

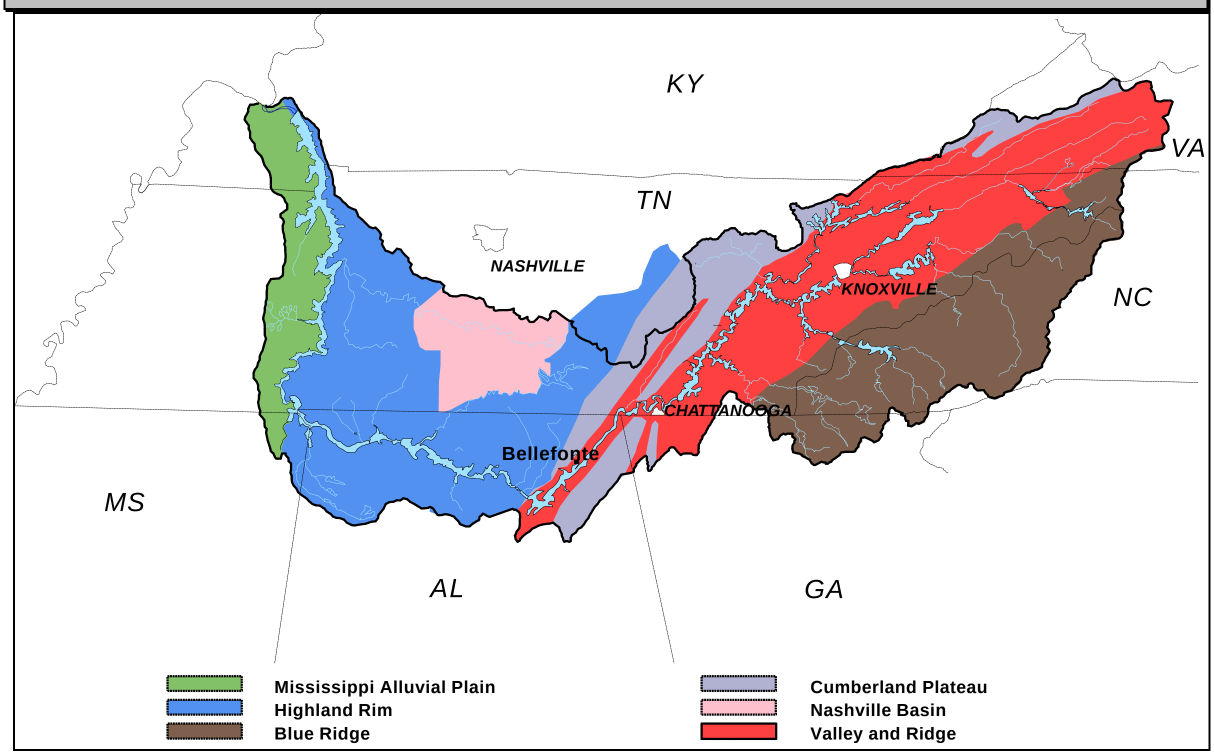
The earthquake hazard to ordinary buildings at Bellefonte can be adequately addressed through use of existing building codes. Special structures that house hazardous processes or sensitive equipment may require additional considerations. Transport of hazardous substances through underground or above ground piping may also require non-routine design to address seismic hazards at the site.

The regional seismic hazard in the vicinity of Bellefonte is relatively low. However, it is imperative that the effects of site soil conditions on the amplitudes of ground shaking and on the possibility for ground deformations be evaluated.

3.1.2.2 Regional Geologic Setting

The plant site is situated in the Browns Valley-Sequatchie Valley segment of the Cumberland Plateau section of the Appalachian Plateaus physiographic province (Figure 3.1.2-2). The controlling geologic structure in this area is the Sequatchie anticline, a long and relatively narrow fold occurring in the Cumberland Plateau as a western outlier of the folded structures of the Valley and Ridge province to the east. The anticline is asymmetrical, with the strata on the northwestern limb dipping steeply while those on the southeastern limb have dips seldom exceeding 20 degrees.

Figure 3.1.2-2 Physiographic Provinces of the Tennessee River Basin



The Browns Valley-Sequatchie Valley extends northeast-southwest for approximately 140 miles, from Crab Orchard, Tennessee, to the vicinity of Blount Springs, Alabama. This valley was formed from erosion of the Sequatchie anticline. Where erosion breached the arch of thick sandstone and exposed the dolomite and limestone, an axial valley was developed. The site lies on the southeast side of the valley that separates Sand Mountain from the Cumberland Plateau. It is known as Browns Valley in Alabama.

3.1.2.3 Local Geologic Setting

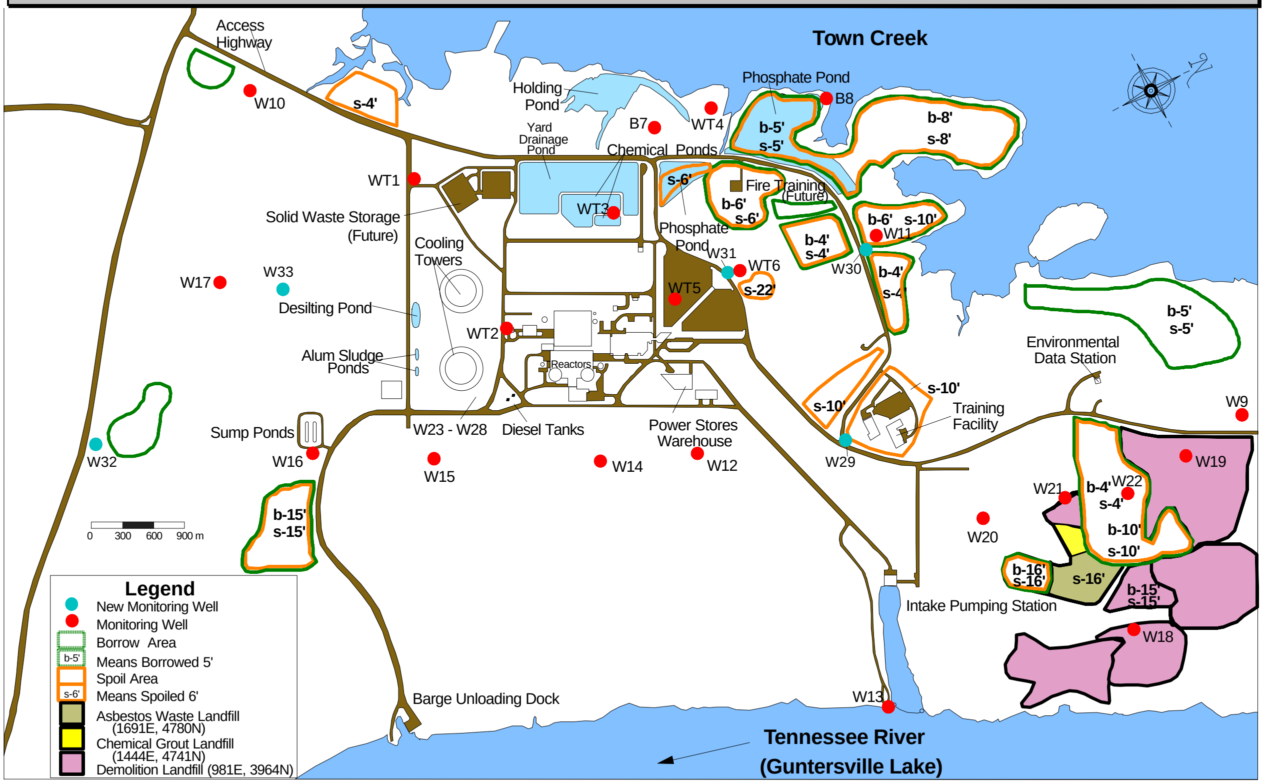
Initial site explorations at Bellefonte began in December 1970, when 52 seismic depth-to-rock determinations were made on a 122-meter grid. Eighty-seven core holes (11.3 to 65.8-meters deep) were then drilled on the seismic grid layout. As more information became available, the grid spacing was reduced to 61 meters and finally to holes 30.5 meters on center under the major structures. A few additional holes were drilled to the north, west, and northeast of the main plant area to investigate conditions at possible intake and discharge structures. Geophysical logs were collected for most boreholes and several were examined with down-hole television equipment. During Bellefonte construction activities, all excavation surfaces, floors, and rock walls were mapped by the project geologist. Dynamic seismic tests were made in and between selected holes to determine the in-situ dynamic characteristics of the foundation rocks in the main plant area.[8]

Subsequent subsurface investigations at the site include:

- Appraisals of sinkhole problems at the sump collection ponds [23,24]
- An investigation of seepage problems at the Bellefonte parking lot [25]
- An evaluation of the impacts from trisodium phosphate land application, and [26]
- Assessments related to subsurface releases of diesel fuel from the above ground storage tanks.[27-29]

Figure 3.1.2-3 shows site overburden disturbances caused by previous activities.

Figure 3.1.2-3 Landfills, Borrow Pits, & Spoil Areas



Site Overburden

The initial soils exploration at the Bellefonte site began in the fall of 1972. Overall results showed that the intake channel area soils were shown to be predominantly lean and moderately plastic clays, with some lean and plastic silts, and scattered clayey and silty sands. Along the Essential Raw Cooling Water (ERCW) pipeline, the soil is reported as mostly fat and lean clays. The overburden depth is described as varying from 0.6 to 7.0 meters along the ERCW pipeline, being deepest nearest the intake channel and decreasing in depth toward the plant.

Groundwater investigations at the site provide additional information related to soil geochemical and hydraulic properties. Soil logs describe the clay soil underlying the site parking lot as a "fat" clay.[25] Fat clays are cohesive and compressible clays of high plasticity.[30] Several grain-size analyses of fat clay samples from other locations at the site show that the fat clay is about 80% silt and clay.[25] Based upon physical inspection of residual soils and reported grain-size analyses, Young and Carpenter estimate the average hydraulic conductivity of fat clays to be about 1 x 10^{-7} cm/s and the porosity to be approximately 0.40 for clays underlying the site parking lot. [25] Physical inspection of residual soils and grain-size analyses were also conducted by Young and Lindquist. [26] They estimated a range for hydraulic conductivity of residual soils of 1 x 10^{-6} to 1 x 10^{-8} centimeters/second (cm/s) and a total porosity of 0.45 for soils in the vicinity of the aboveground diesel fuel storage tanks (locations shown in Figure 3.1.2-3).

Soil sampling was performed during the installation of monitoring wells W12, W14, W18, and W19 at the site (Figure 3.1.2-3). [31] Natural densities, soil classifications, grain-size distributions, specific gravities, and moisture contents were measured for a selected soil sample at each well location and at depths ranging from 0.6 to 3.1 meters. In general, the soils can be described as clayey silts to sandy clayey silts with estimated hydraulic conductivities from 1×10^{-6} to 1×10^{-8} cm/s. [32]

Site Bedrock

The Chickamauga Formation is well described in the Bellefonte Final Safety Analysis Report. [8] The formation is about 425 meters thick, of which the middle 152 meters was penetrated by exploratory borings at the site. In the vicinity of the plant, the stratigraphy of the formation is described as medium bedded, shaly limestone with interbeds of more massive, purer limestone and zones of siltstone or argillite.

A typical problem associated with carbonate terrains is local ground subsidence and sinkhole collapse. This phenomenon was experienced at the site in 1986 and 1987, when sinkhole activity resulted in liner soil piping and pirating of contents from the sump collection ponds located on the southeast corner of the plant site near the intersection of two prominent lineaments. Sinkhole development is generally associated with structural features and lithology. [31-34] The sinkhole collapse at the site was evidently induced by several factors:

- Over-excavation of overburden material (to bedrock or almost to bedrock),
- Inadequate design of the pond liners, fluctuating groundwater/pond levels,
- Increased loading (hydraulic head), and
- Changes in surface drainage patterns at the sump pond area.

Numerous karst researchers have identified the various problems associated with the construction of retention basins in carbonate terrains and methods are available for describing and predicting the occurrence of sinkholes.[35-37]

3.1.3 Site Soils

The soils occurring on the Bellefonte project site are described in the Jackson County, Alabama, soil survey. [38] A total of 58 detailed soil mapping phases representing 24 soil series occur within the Bellefonte project site. Eight soil groupings based on soil series, parent material, landscape position, soil drainage, slope, and other characteristics are shown for the Bellefonte project site (Figure 3.1.3-1). These eight soil areas and the proportion that each comprises are as follows:

1. *Armuchee - Tellico*; silty clay loams; well drained soils formed from reddish shale, sandstone, and limestone parent materials; 5 to 25 % slopes (176 acres, or 10.9% of the site).

2. *Colbert - Talbott - Swaim*; silty clays and silty clay loams; moderately well and well drained shallow soils derived from argillaceous limestone; 2 to 12% slopes (264 acres, or 16.4%).

3. *Dewey - Fullerton - Hermitage*; silt loams, silty clay loams, and cherty silt loams; well-drained soils derived from dolomitic and cherty limestones; 2 to 12% slopes (62 acres, or 3.9%).

4. *Dunning - Melvin - Robertsville - Guthrie - Taft - Tupelo*; silt loams and silty clays; poorly and somewhat poorly drained soils on stream terraces, bottomlands, and upland depressions; 0 to 5% slopes (279 acres, or 17.3%).

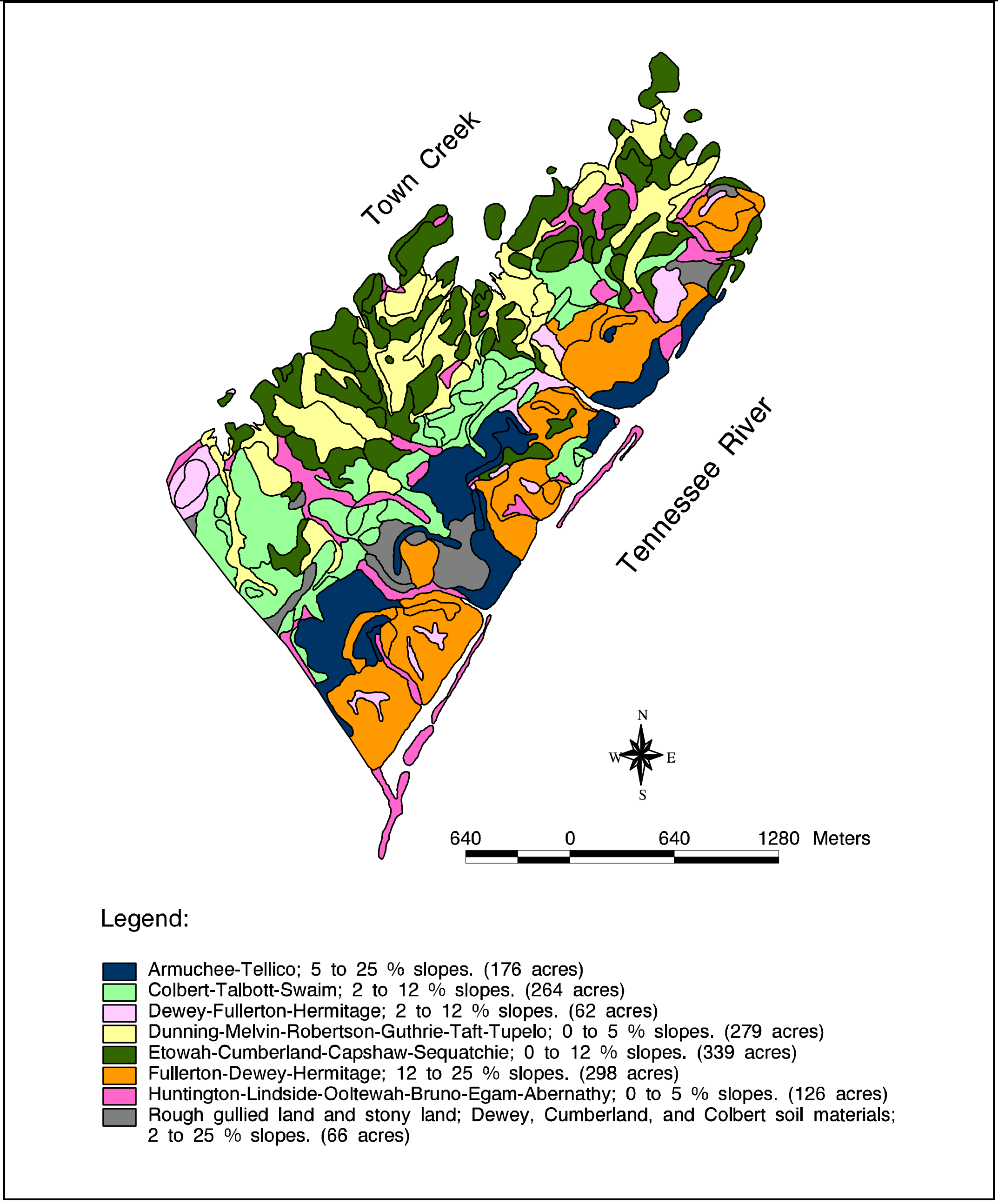
5. *Etowah - Cumberland - Capshaw - Sequatchie*; silt loams and silty clay loams; moderately well and well-drained terrace soils derived from limestone valley alluvial sediments; 0 to 12% slopes (339 acres, or 21.0%).

6. *Fullerton - Dewey - Hermitage*; cherty silt loams and silty clay loams; well-drained soils derived from dolomitic and cherty limestones; 12 to 25%+ slopes (298 acres, or 18.5%).

7. *Huntington - Lindside - Ooltewah - Bruno - Egam - Abernathy*; silt loams, fine sandy loams, and silty clay loams; moderately well and well-drained soils on stream bottoms and local alluvium; 0 to 5% slopes (126 acres, or 7.8%).

8. *Rough gullied land and stony land*: Dewey, Cumberland, and Colbert soil materials; 2 to 25%+ slopes (66 acres, or 4.1%).

Figure 3.1.3-1 Soil Categories for Bellefonte



The most agriculturally suited soils of the Bellefonte project site occur in the western part, paralleling Town Creek. This includes the generally level to rolling, deep, permeable, well and moderately well-drained soils on stream bottoms, terraces, and limestone uplands.

Soil series are:

- Huntington
- Lindside
- Ooltewah
- Bruno
- Egam
- Etowah
- Cumberland
- Capshaw
- Sequatchie
- Dewey
- Fullerton
- Hermitage

Presently, these soils are primarily in pasture/hay crops, forest, and industrial uses. A considerable acreage of poorly drained soils along small streams and in upland depressions also occurs in the western part of the project site. These areas are subject to frequent flooding and include the *Dunning, Melvin, Robertsville, Guthrie, Taft, and Tupelo* soils. Presently these soils are mostly in forest and pasture/hay crop uses. Occurring generally in the central part of the project site are undulating to rolling soils with very plastic, clayey, subsoils and slow percolation. These are the Colbert, Talbott, and Swaim soil series. These soils are relatively shallow to agrillaceous limestone, and are presently in forest, pasture/hay, and industrial uses.

In the dominantly wooded knobby ridges of the eastern part of the project site, paralleling the Tennessee River are predominantly well-drained, often rocky soils derived from cherty limestone, shale, and sandstone. These soil series include *Armuchee, Tellico, Dewey, Fullerton, and Hermitage*, with some inclusions of gullied and severely eroded areas.

3.1.4 Solid Wastes Management and Past Practices

Current operational activities include primarily actions necessary to maintain the vital systems of the plant, such as the turbines, etc., in a state of nondeterioration, while power is not being generated. The onsite staff is about 80 to 100 persons.

The solid waste generated is minimal as expected with the deferred status. Typical sanitary solid waste is routinely put in dumpsters onsite and subsequently disposed of off site by contractor. Asbestos and special wastes are sent to the local sanitary landfill, upon approval by the ADEM. In 1995, Bellefonte generated more than 100 cubic yards of asbestos wastes, such as asbestos insulation board, roofing material, tiles, gaskets, and filters. Special wastes generated by Bellefonte include activated alumina, grease, oil-contaminated rags, oil filters, sandblast grit, cement, and surplus chemicals. Bellefonte special waste disposal for 1995 included 55 drums (each containing 55 gallons) of oil-contaminated materials, grease and surplus chemicals, several hundred pounds of waste cement, and lesser amounts of other wastes.

3.1.5 Hazardous Wastes Management and Past Practices

The Bellefonte site currently qualifies as an EPA Small Quantity Generator, i.e., the site generates more than 100 kgm but less than 100 kgm of hazardous waste in any one calendar month per year. Kinds of hazardous waste generated by Bellefonte include:

- Waste oil
- Waste mercury
- Lead/mercury wastes
- Nickel/cadmium batteries
- Acetic acid wastes
- Hydrazine
- PVC glue
- Tar, and
- Solvents

Additionally, some PCB wastes, which are more appropriately classified as toxic wastes, are also generated. Hazardous wastes are typically shipped to the TVA Hazardous Waste Storage Facility in Muscle Shoals, Alabama, which makes arrangements for disposal at a permitted disposal facility off site.

Historic Site Contamination

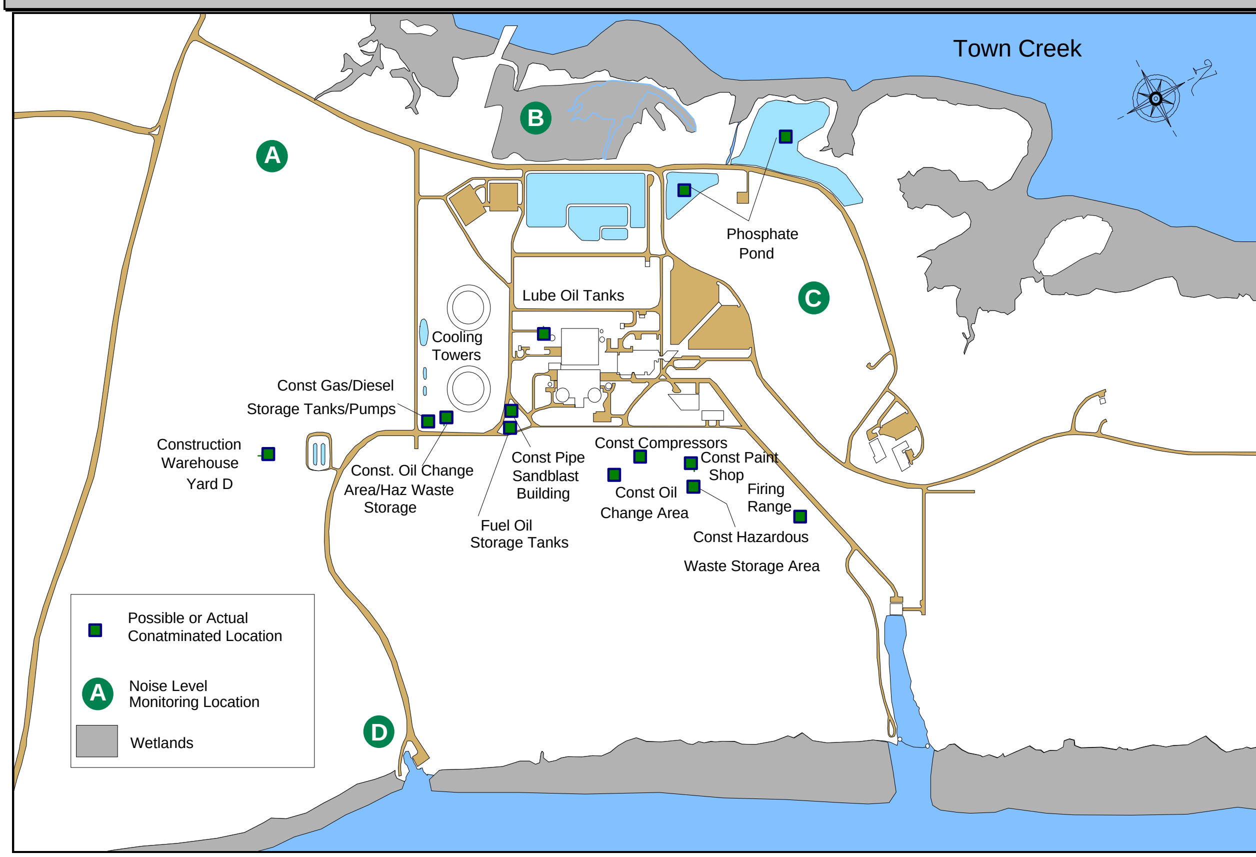
Table 3.1.5-1 presents a listing of existing or possible contaminated locations at Bellefonte resulting from plant activities to date that fall or seem to fall within the projected footprints for the various Bellefonte conversion options. Also included in the table are the current status of the location, recommendations to correct the problem, references to any relevant documentation, and the location relative to the footprint of the Bellefonte facility. The approximate locations of these actually contaminated and possibly contaminated sites falling within the relevant footprints are shown in Figure 3.1.5-1.

Table 3.1.5-1 Soil Contamination/Possible Soil Contamination Bellefonte Nuclear Plant

Location	Contaminants/Possible Contaminants	Comments
Yard Areas[a]	D-Weed-O, Roundup, and Rascal herbicides have been used in various locations for grass/weed control	
Construction Gas/Diesel Station (North of Const. Whse.)[a]	Above ground diesel tank/piping have previously leaked. Area around dispensing pumps and underground piping are also possibly contaminated.	Soil investigation/study required
Yard D of Const. Whse. Yard[a]	Oils, chemicals, and creosoted crossties have been stored in this area.	
Site Fields[a]	Trisodium phosphate pipe flushing wastes land applied	Part of NPDES permit.
Construction fire protection and compressed air buried piping[b]	Piping probably has an asbestos mastic coating.	

[a] - Within Bellefonte Conversion Project footprints
[b] - Possibly within Bellefonte Conversion Project footprints

Figure 3.1.5-1 Locations of Actually and Possibly Contaminated Sites



Areas of concern falling within the relevant footprints include the ones where cumulative effect of small repetitive spills from the routine handling of oils, fuels, paints, and solvents may have produced significant contamination. Such areas would include the Construction Gas/Diesel Dispensing Station. Construction Warehouse Yard D in which oils, chemicals, and creosoted crossties have been stored may also show some evidence of contamination. In particular, the leakage of 1,1,1-trichloroethane from several drums in 1988 in that area may still have some remnants of contamination there, at depth. Construction of fire protection and compressed air buried piping runs through several areas of the existing Bellefonte site, including some of the option footprints. However, it is not clear as to how much of this piping is covered with asbestos mastic coating. Also, trisodium phosphate (TSP) was generated from the preoperational metal cleaning at Bellefonte from 1981 to 1986. [26] The waste was originally disposed of in two evaporation/percolation ponds. Because the ponds did not percolate adequately, in 1984 the treatment was changed to land application of the TSP. Records are not available quantifying disposal of the TSP in the two ponds. However, the concentrations of various constituents in the pond waste water were monitored periodically. A total of 33.3 million gallons of TSP waste were applied over 342 acres at Bellefonte. A total of 26,000 pounds of sodium and 14,000 pounds of phosphorus were applied. Land spreading of TSP waste was conducted primarily east and west of the North Access Road north of the Training Facility.

3.1.6 Surface Water

The Bellefonte plant site is located on a peninsula formed by the Town Creek Embayment on the western shore of Guntersville Lake at Tennessee River Mile (TRM) 391.5; and about seven miles northeast of Scottsboro in Jackson County, Alabama. The drainage area of the Tennessee River above Bellefonte is 23,340 square miles; and at Nickajack Dam, 33 miles upstream, the drainage area is 21,870 square miles. Going downstream 43 miles from the site to Guntersville Dam, the drainage area is 24,450 square miles.

Town Creek begins about 2.5 miles southwest of the plant site and flows northeastward into the Guntersville Lake at TRM 393.5. The drainage area of Town Creek at the site is 5.94 square miles. In addition, two creeks are adjacent to the plant site; Dry Creek to the southwest and Mud Creek to the northeast.

3.1.6.1 Guntersville Lake History and Description

A prime purpose of the TVA water control system is flood control with particular emphasis on protection for Chattanooga, 72.7 miles upstream of Bellefonte. Because of the watershed's configuration, this control is also effective at the plant site (see Section 3.1.7, Floodplains and Flood Risk).

Guntersville Lake has a shoreline length of 949 miles, and a width which ranges from 900 feet to 2.5 miles. It has a total area of 67,900 acres, and a volume of 1,018,000 acre-feet. Town Creek, a 4.2 mile embayment, has six small unnamed tributaries with less than one square mile drainage area. Guntersville Lake is one of nine reservoirs on the Tennessee River. Contributing flows from upstream tributaries are listed in Table 3.1.6-1 with respective drainage area and river miles.

Table 3.1.6-1 Drainage Areas with Contributing Flows to Guntersville Lake

Contributing Flows	Drainage Area (square miles)	Tennessee River Mile (TRM)	Tributaries
Hiawassee	20,370	TRM 499.4	
Holston	3,776	TRM 652.2	Watauga
French Broad	5,124	TRM 652.2	Pigeon, Little Pigeon, Lower Nolichucky
Little Tennessee	2,627	TRM 601.1	
Clinch	4,413	TRM 567.8	
Sequatchie	605	TRM 422.4	

The operation of Guntersville and Nickajack Dams also affects water levels. The normal minimum pool level of Guntersville Lake is at elevation 593 feet above mean sea level (msl), normal full pool is at elevation 595, and top of gates is 595.44. The lake may be drawn to elevation 591 feet msl during flood control operations. The lowest headwater elevation after initial filling was 590.65 feet msl on November 12, 1968. The highest elevation since closure of Guntersville Dam was 596.29 feet msl on March 2, 1944.

Daily flow volumes at the site, are represented by discharge records from the nearest stream gage to the Bellefonte site. This U. S. Geological Service (USGS) gage, located at South Pittsburg, Tennessee, at TRM 418.1, was discontinued in 1987. Momentary flows at the site may vary considerably from daily average flows, depending upon turbine operations for peak power demands at Nickajack and Guntersville Dams. Under normal operating conditions, flow reversals resulting from surges develop in the lake, and for short periods flow at the plant site can be in an upstream direction. Average flows past the Bellefonte site are approximately 3% greater than flows at the South Pittsburg gage. Based upon these discharge records, the average daily streamflow at the plant is 38,800 cubic feet per second (cfs). The maximum daily flow rate was 322,800 cfs on March 18, 1973. The minimum daily streamflow at the plant during the period was 3,000 cfs on November 1 and 15, 1953, and was the result of flow regulating activities by Chickamauga Lake. From records for 1950-1987, average streamflow is estimated to be about 31,600 cfs during the summer (May-October) months and about 48,700 cfs during the winter (November-April) months.

No-flow frequency and duration were analyzed based on hourly Nickajack and Guntersville release records from 1976 to 1995, excluding 1993-1994, which were missing from the record.[39,40] Periods of flow less than one cfs occur at the site 11% of the time, as shown in Figure 3.1.6-1. However, the duration of zero or reverse flows rarely last more than half a day, as shown in Figure 3.1.6-2. There were no occasions when the duration of zero release from Nickajack or Guntersville was 40 hours or more. Analysis of flow data from a stream gage on Guntersville Lake at South Pittsburg (TRM 418.1) from 1968 through 1986 indicated a three-day low flow condition of 9,560 cfs has an average recurrence interval of 20 years (3Q20).[41]

Figure 3.1.6-1 Flow Frequency Curve for Nickajack Dam Releases

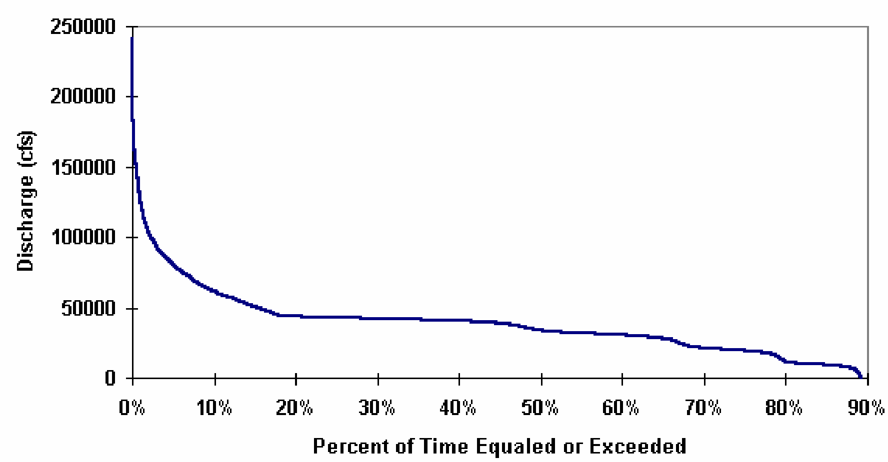
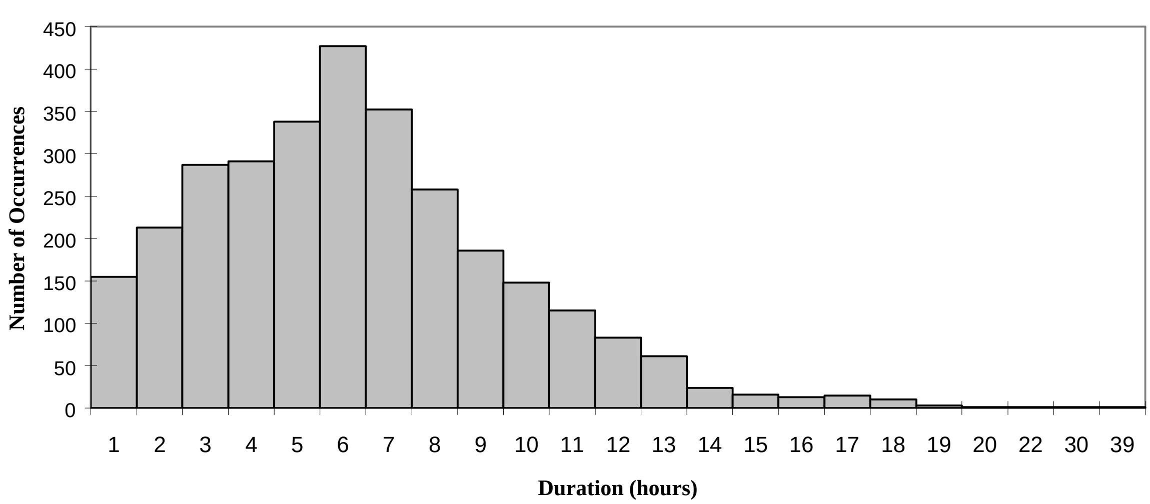


Figure 3.1.6-2 Duration of Zero Flow from Nickajack Dam 1975-1995



Channel velocities at the Bellefonte site average about 0.9 feet per second (fps) under normal winter conditions. Because of lower flows and higher lake elevations in the summer months, channel velocities average about 0.6 fps. Reversals of flow into the Town Creek Embayment occur as a result of water management practices.

3.1.6.2 Surface Water Supply and Demand

A listing of the surface water supply systems withdrawing from the Tennessee River in the vicinity of the Bellefonte site is presented in Table 3.1.6-2. The reach considered covers the 66-mile distance between South Pittsburg, Tennessee, and Guntersville, Alabama. The intakes are listed progressively from upstream to downstream of Bellefonte.

Table 3.1.6-2 Public and Industrial Surface Water Supplies From the Tennessee River Near Bellefonte

Plant Name	Use (million gallon/day)	Location (River mile and bank)	Approximate Distance From Site (miles)	Type of Supply
South Pittsburg	1.10	TRM 418.0 R	26.5	Municipal
Bridgeport	0.71	TRM 413.6 R	22.1	Municipal
TVA Widows Creek Fossil Plant	1079	TRM 407.7 R	16.2	Industrial
Mead Corporation	4.4	TRM 405.2 R	13.7	Industrial
TVA Bellefonte Nuclear Plant	unknown[a]	TRM 391.5 R	0.0	Industrial
Fort Payne	10.00	TRM 387.6 L	4.5	Municipal
Scottsboro Water System	5.00	TRM 385.8 R	5.7	Municipal
		TRM 377.4 R	14.1	Municipal
Section, Alabama Water Board	2.00	TRM 382.0 L	9.5	Municipal
Christian Youth Camp	unknown	TRM 367.9 R	23.6	Municipal
Guntersville State Park	unmetered[b]	TRM 362.2 L	29.3	Irrigation
Albertville	9.00	TRM 361.0 L Short Creek 2.0	30.5	Municipal
Guntersville	2.83	TRM 358.0 L	33.5	Municipal
		TRM 352.6 L	38.9	Municipal
Arab	3.14	TRM 356.0 L	35.5	Municipal

[a] - River water usage currently limited to fire protection needs.
[b] - Water usage is not metered.

The Water Works Board of the City of Fort Payne, Alabama, has constructed a new raw water intake pumping station on the Tennessee River at Mile 387.6 L with a capacity of 10 million gallons per day to supply additional drinking water. An Environmental Assessment was prepared in December 1995 to consider locating the intake downstream of Bellefonte. [42] The intake may be one to four miles downstream of Bellefonte, with a capacity of 10 million gallons per day. [42] The preferred location places the intake at about TRM 387 (Sartain Bend), a second alternative would be at about TRM 390.5 (Sublett Ferry), and a third alternative would be on Jones Creek which joins the lake at about TRM 388.

3.1.6.3 Surface Water Quality

Guntersville Lake

Guntersville Lake is classified for the uses of public water supply, fish and wildlife, and swimming and other whole body water-contact sports. [43] Extensive historical water quality data are available for the Guntersville Lake from TVA monitoring activities dating back to 1963, which is prior to the commissioning of the Nickajack Dam (1966). However, only the more recent data will be used to better represent the current water system.

Water quality data for the Tennessee River in the section near Bellefonte were obtained from the EPA Storage and Retrieval of Parametric Data (STORET) database (Appendix G). [44] The data from seven different sampling sites from TRM 375.2 to TRM 396.8 (shown in Figure 3.1.6-3) for the period 1974 to 1990 were composited for the summary presented below (in Table 3.1.6-3). Data were summarized to determine the range and average of parameter values. Based on average values, the raw water characteristics were typical of a surface water source. Table 3.1.6-4 summarizes data for Primary Drinking Water Contaminants (health concerns) in the raw water as compared to current regulations of ADEM. Mercury was the only primary contaminant that had any sample that exceeded a current maximum contaminant level (MCL) for drinking water. [42]

Figure 3.1.6-3 Water Quality Sampling Locations

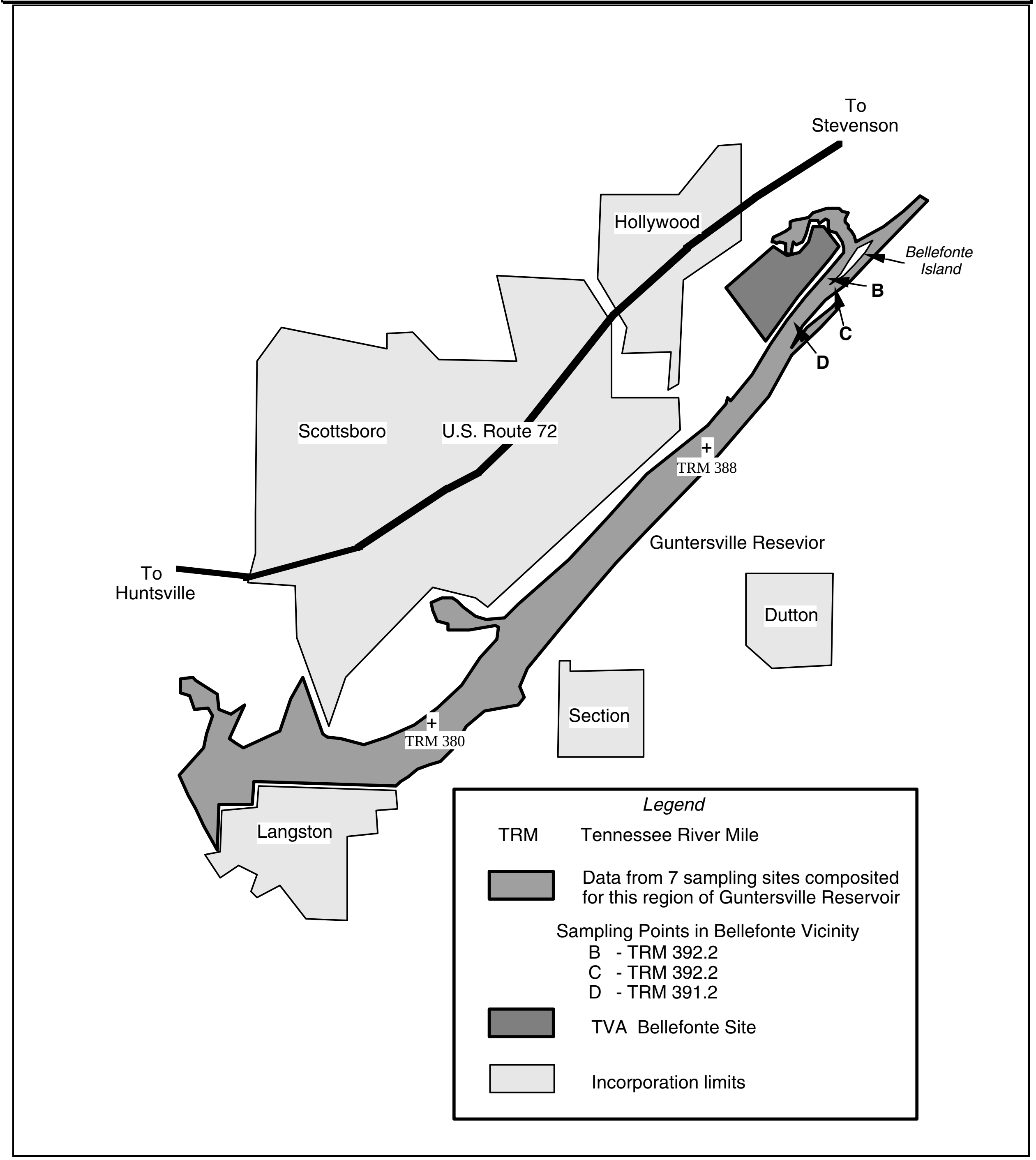


Table 3.1.6-3 Water Quality Characteristics Of Guntersville Lake

Parameter	Lowest Value	Highest Value	Average Value
Temperature (°C)	4.0	31.4	20.3
Conductivity (umhos)	70.0	255.2	157.6
Dissolved Oxygen (mg/L)	1.1	14.8	8.0
pH s.u.	6.2	8.7	7.4
Turbidity (NTU)	1.0	41.0	6.2
Chem. Oxygen Demand (mg/L)	1.0	31.0	6.1
Calcium Hardness (mg/L)	45.0	97.0	70.3
Total Alkalinity (mg/L)	34.0	69.0	51.6
Calcium (mg/L)	13.0	32.0	20.0
Magnesium (mg/L)	2.8	8.5	4.9
Total Coliform (col./100 ml)	10	1,335	309
Fecal Coliform (col./100 ml)	1	200	29

Table 3.1.6-4 Primary Drinking Water Regulations Versus Guntersville Lake Water Quality

Contaminant	MCL[a] (mg/L)	Lowest Value (mg/L)	Highest Value (mg/L)	Average Value (mg/L)
Nitrate (as N)	10.0	0.01	8.8	0.39
Fluoride	4.0	0.05	0.3	0.01
Arsenic	0.05	0.001	0.009	0.0002
Barium	1.0	0.01	0.3	0.05
Cadmium	0.01	0.0001	0.005	0.0005
Chromium	0.05	0.001	0.02	0.003
Lead	0.05	0.001	0.05	0.006
Silver	0.05	0.01	0.01	0.01
Mercury	0.002	0.0002	0.004	0.0009
Asbestos	7 X 10^6 Fibers[b]/L	-	-	-

[a] - Maximum Contaminant Level
[b.]- Longer than 10 micrometers

Dissolved Oxygen

Dissolved oxygen concentrations routinely dropped below 5 milligrams per liter (mg/L) during the summer months at lower depths in the lake. No concentrations less than 4 mg/L were measured during the data collection period. Mild dissolved oxygen stratification occurs occasionally in the main channel areas, and stronger stratification occurs fairly frequently in the shallower overbank and embayment areas.

Hydrogen Ion Activity (pH)

All of the pH measurements were above the minimum Alabama criterion of 6.0. However, pH levels above the maximum Alabama criterion of 8.5 were observed to occur in areas of high biological activity. The dissolved oxygen concentrations in these areas are usually above 100 percent saturation. Guntersville Lake has extensive shallow overbank areas which are conducive to prolific macrophyte and plankton production. These biota have a definite effect on water quality conditions in these areas.

Alkalinity
Total alkalinity ranged between approximately 40 and 60 mg/L during the data collection period. These concentrations are normal and have no unusual significance.

Hardness
Total hardness averaged approximately 65 mg/L, which is considered moderately hard.

Turbidity and Total Suspended Solids
Average turbidity and solids concentrations were normal. Considering the data collection period, these observed concentrations of turbidity and suspended solids could even be considered slightly lower than normal.

Generally speaking, the chemical water quality of Guntersville Lake in the vicinity of Bellefonte is good. Concentrations of primary (health) trace metals were significantly less than concentrations established by the EPA "National Interim Primary Drinking Water Standards" for finished drinking water. Except for iron and manganese, the concentrations of secondary (aesthetically undesirable) constituents were less than concentrations specified by the 1962 Public Health Service "Drinking Water Standards." Iron and manganese concentrations were normal for waters of the Tennessee Valley. Higher than normal dissolved iron and manganese in lakes is due to a stagnant bottom-water layer. During seasonal lake turnover, these minerals are dispersed from the bottom muds. [45] Concentrations of nitrogen and phosphorus were also consistent with those found throughout the Valley.

As published in the TVA RiverPulse, an annual report on the conditions of the Tennessee River and its tributaries, Guntersville Lake remained in good health in 1994. All ratings were either good or fair. The biggest change was an improvement in dissolved oxygen levels from the previous year, especially in the upper end of the lake near Nickajack Dam. This was because there was more rain in early 1994, so summer flows in the Tennessee River system were higher than in 1993.

The rating for the bottom life near Guntersville Dam decreased slightly in 1994, but still was close to the level considered good. The rating for algae in the middle part of the lake also was lower, probably because of the higher flows. There were no fish consumption advisories in the Guntersville-Sequatchie watershed. All recreation areas tested on Guntersville Lake and the canoe access sites on the Sequatchie River met state criteria for water contact. Aquatic plants covered about 9,600 acres of Guntersville Lake in 1994, up from 7,600 acres in 1993 and 6,000 acres in 1992. Plant coverage on Guntersville peaked in

1988 with about 20,000 acres covered, declined for several years, then began increasing again in 1992. Guntersville has more aquatic plants than any other lake in the Tennessee Valley.

The thermal component of the Alabama water quality standards for the Tennessee River Basin consists of two parts: a maximum temperature rise (outside of the mixing zone) of 2.8°C, and a maximum temperature of 30°C. Section 316(a) of the Clean Water Act provides that a discharger may request alternate thermal discharge limitations based on a demonstration which shows that the specific operation in excess of the lower thermal criteria would ensure the protection and propagation of balanced indigenous fish, shellfish, and wildlife communities in and on the receiving body of water.

NPDES Permit number AL0024635, issued by ADEM for Bellefonte Nuclear Plant on October 1, 1992, specified that instream temperature was limited to a daily maximum of 30°C. Water temperature profiles measured at 6 cross sections in Guntersville Lake indicate that the lake becomes slightly stratified downstream of Bellefonte in the spring and summer.[41] Water temperatures upstream of the site are primarily related to release temperatures from Nickajack Dam. Water temperature profiles in fall and winter are nearly uniform, indicating that Guntersville Lake is primarily a flow-through lake with relatively short water retention time.

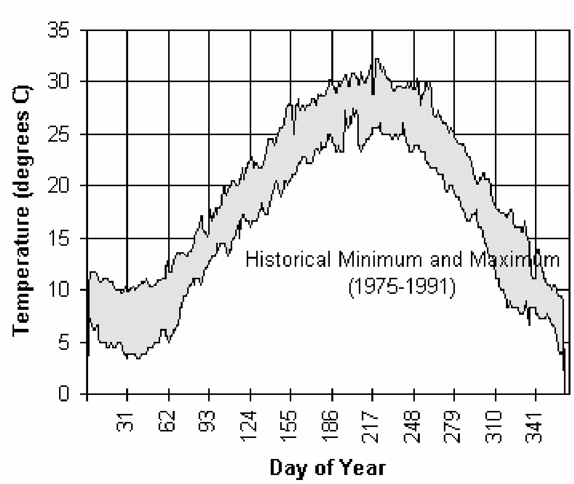
Water temperatures were monitored approximately monthly in 1975, daily from 1976 through 1982, monthly during 1983, and daily 1989 through 1991 in Guntersville Lake at Tennessee River Mile 391.2, located 0.3 miles upstream of Bellefonte. Results are shown in Table 3.1.6-5 and Figure 3.1.6-4.[44,46,47]

Table 3.1.6-5 Guntersville Lake Water Temperatures Near Bellefonte

Month	Temperature (^oC) at TRM 391.2, 1975-1991			
	Minimum	Maximum	Mean	Median
January	1.7	11.8	7.4	7.2
February	3.3	12.2	7.8	8.3
March	5.0	17.1	11.7	11.7
April	12.8	21.7	17.0	16.8
May	16.1	27.8	20.8	20.6
June	20.6	29.4	25.2	25.0
July	20.7	30.9	27.2	27.8
August	21.9	32.2	27.5	27.8
September	19.4	30.3	25.6	25.7
October	13.3	25.6	19.6	19.4
November	1.7	21.9	14.4	14.4
December	5.0	17.8	9.1	8.9

Measurements were made in the center of the cross section, at depths of 0 to 31 feet. Water temperatures were typically lowest in December and January, and highest during July and August. Temperatures ranged from a minimum of 1.7°C on January 21, 1977, to a maximum of 32.2°C on August 7, 1991.

Figure 3.1.6-4 Guntersville Lake Temperatures at Bellefonte (TRM 391.2)



A more extensive data set is available for the Widows Creek Fossil Plant, located on Guntersville Lake, 16 miles upstream of Bellefonte.[46,47] Daily average water temperatures have ranged from a minimum of 1.7°C on December 27, 1989, to a maximum of 31.0°C on August 1995. In the last 10 years, the daily mean intake temperature at Widows Creek has been equal to or greater than 30ºC on 85 days, an average of 8.5 days per year. The duration of each exceedance has averaged 5 days, with a maximum of 14 consecutive days, which occurred in 1995 (Table 3.1.6-6).

Table 3.1.6-6 Occurrences and Duration of Daily Average Intake Temperatures, Widows Creek Fossil Plant (1985 - 1995)

Month	T≥30.5°C			T≥30°C		
	Days per Month	Days of Duration		Days per Month	Days of Duration	
		Avg.	Max.		Avg.	Max.
June	0	0	0	0.	0	0
July	10	1	2	54	4	14
Aug.	12	4	5	31	5	12
Sept.	0	0	0	0	0	0

These data indicate that the Alabama water temperature limit of 30°C is likely to be exceeded downstream of Bellefonte, because water ambient temperatures typically exceed this value in July and August.

Bellefonte Vicinity

Additional water quality data were collected from June 1990 to March 1991 at three stations in the immediate vicinity of Bellefonte. These data represent only a portion of one year. They do not represent a complete annual wet to dry cycle, but do provide additional insight as to the quality of the surface water near site discharge points. Sampling points designated as points B, C, and D are shown in Figure 3.1.6-3.

The 1990-91 measurements, listed in detail in Appendix G as retrieved from EPA's STORET system, are summarized in Tables 3.1.6-7 and 3.1.6-8 for the quality indices used earlier for the composite samples.

Table 3.1.6-7 Water Quality Characteristics Near Bellefonte

Parameter	Point B	Point C	Point D
Temperature (°C)	18.5	18.1	18.9
Conductivity (umho/cm)	174.4	176.9	170.9
Dissolved Oxygen (mg/L)	8.5	8.6	7.8
pH	7.57	7.48	7.26
Turbidity (NTU)	-	-	8.86
Chem. Oxygen Demand (mg/L)	5.5	4.9	6.3
Calcium Hardness (mg/L)	-	-	-
Total Alkalinity (mg/L)	61.1	60.8	52.1
Calcium (mg/L	20.8	20.8	19.5
Manganese (µg/L)	13.4	10.5	17.2
Total Coliform (col./100 ml)	-	-	214
Fecal Coliform (col./100 ml)	38.8	27.1	39.5

Table 3.1.6-8 Primary Drinking Water Regulations Versus Water Quality in the Bellefonte Vicinity

Contaminant	MCL[a] (mg/L)	Point B	Point C	Point D
Nitrate (as N)	10.0	-	-	-
Fluoride	4.0	0.15	0.1	0.17
Arsenic	0.05	0.001	0.001	0.003
Barium	1.0	0.022	0.022	0.060
Cadmium	0.01	0.0001	0.0001	0.0007
Chromium	0.05	0.0015	0.002	0.005
Lead	0.05	0.002	0.002	0.010
Silver	0.05	0.010	0.010	0.010
Mercury	0.002	0.0002	0.0002	0.0002
Asbestos	7 X 10^6 Fibers*/L	-	-	-

[a] - Maximum contaminant level
* Longer than 10 micrometers

3.1.6.4 Existing Sources of Surface Discharge

The Bellefonte Reservation covers approximately 1,600 acres. Surface drainage from the existing plant site is approximately 200 acres which primarily leaves through twelve National Pollutant Discharge

Elimination System (NPDES) permitted discharge points. Three points are active process discharge points which empty into the Tennessee River: Discharge Serial Number (DSN) 003C (Effluent from the cooling tower desilting pond), DSN 005 (Plant intake trash sluice), and DSN 007 (Simulator Training Facility treated sanitary waste water). The nine storm water discharge points drain through natural drainage ways to the Town Creek Embayment and to the Tennessee River. See Figure 3.1.6-5 for the locations of these outfalls. A more detailed drawing of drainage areas and discharge points is contained in Appendix B. In 1992, TVA collected data at these outfalls as part of the NPDES permit renewal process. The analytical results for the storm water and active process discharges are shown in Table 3.1.6-9. For the most part, the metals were just above the detection limits, except for total aluminum, manganese, and iron which were higher. The trace metals, mainly copper and chromium, were also slightly above the detection limits. In comparison, the results of the metals samples for the intake water which were taken at the same time, were above the detectable limits for these same metals. All other priority pollutants for these outfalls tested below the method of detection limits. Table 3.1.6-10 shows the intake sample data for the same period.

Figure 3.1.6-5 Bellefonte Surface Water Discharge Points

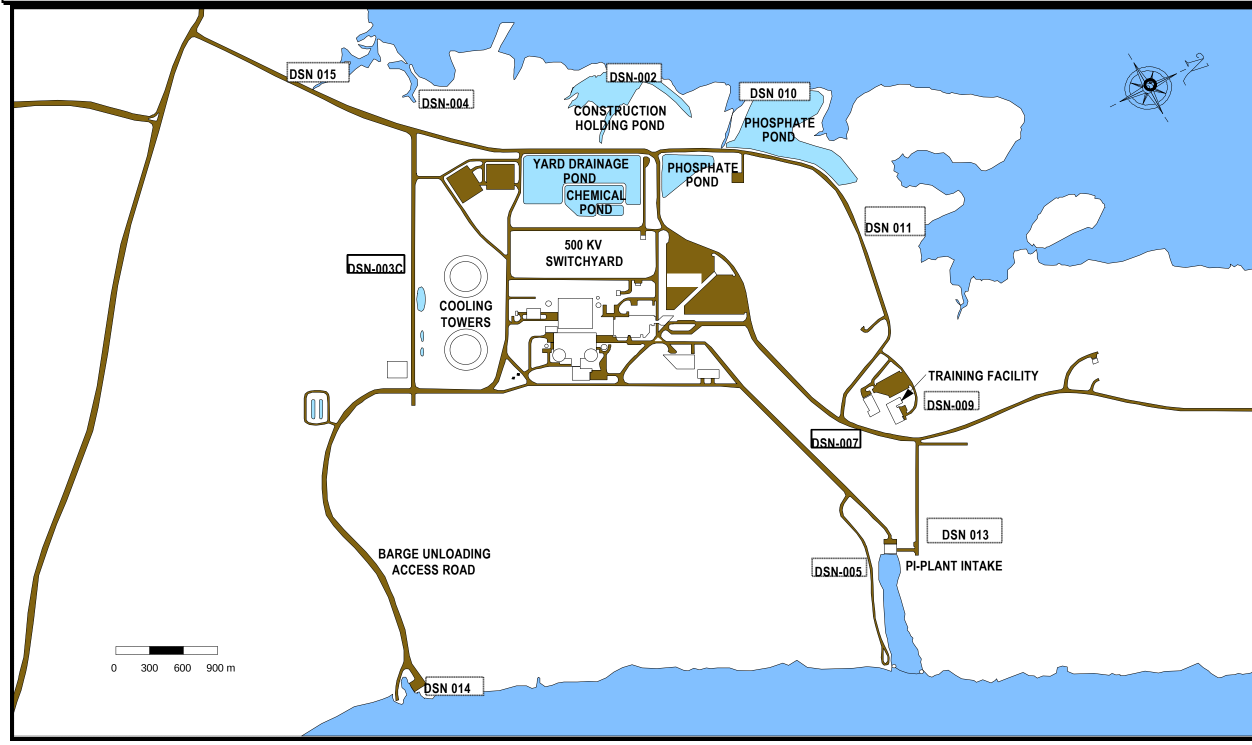


Table 3.1.6-9 Water Quality Data for Storm Water Discharge Points in the Affected Area

Pollutant	DSN 002 Construction Holding Pond		DSN 004 East Culvert Impoundment		DSN 014 South Drainage Basin		DSN 015 Southwest Drainage Basin	
	Grab	Composite	Grab	Composite	Grab	Composite	Grab	Composite
Oil & Grease mg/L	<5	-	<5	-	<5	-		
BOD mg/L	3.1	3.0	1.7	1.7	<1.0	No Flow	<1.0	1.4
COD mg/L	16	14	12	10	13	No Flow	11	22
TSS mg/L	17	16	11	7	55	No Flow	260	29
Nitrogen mg/L	0.44	0.46	0.354	-	0.39	No Flow	0.22	0.54
Nitrate mg/L	<0.01	<0.01	<0.01	<0.01	0.09	No Flow	0.42	0.31
Phosphorus mg/L	0.04	0.06	0.05	0.04	0.18	No Flow	0.22	0.07
pH s.u.	***Min*** 8.4	***Max*** 8.8	***Min*** 8.8	***Max*** 8.8	***Min*** 7.4	***Max*** 7.4	***Min*** 7.6	***Max*** 7.9
Hydrazine mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Iron µg/L	780	700	-	250	-	-	1200	1600
Copper µg/L	20	20	-	-	-	-	<10	<10
Sodium mg/L	2.6	2.5	-	-	-	-	2	1.8
2,4,D µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	No Flow	<0.1	<0.1
Barium, total µg/L	30	10	-	-	-	-	20	40
Titanium, total µg/L	15	14	-	-	-	-	-	-
Sulfate mg/L	37	35	52	50	140	No Flow	30	32
Aluminum, total µg/L	630	640	-	280	-	-	1800	2400
Manganese, total µg/L	62	47	-	39	-	-	35	31
Magnesium mg/L	7.2	7.1	-	7.2	-	-	6.4	5.5
Cadmium µg/L	-	-	-	0.1	-	-	-	-
Lead µg/L	-	-	-	1	-	-	-	-
Fluoride mg/L	0.2	0.3	-		0.2	No Flow	-	-
TRC mg/L	0.3	-	-		-	-	-	-
Color PCU	-	15	10	10	15	No Flow	10	10
Silicon µg/L	1,000	930	-		-	-	4600	5400
Selenium µg/L	-	-	-	2	-	-	-	-
Calcium mg/L	32	35	-	38	-	-	67	56
Antimony µg/L	-	-	-	3	-	-	-	-
Zinc µg/L	-	-	-	-	-	-	<10	<10
Surfactants mg/L	-	-	-	-	-	-	<0.1	<0.1

Table 3.1.6-10 Water Quality Data for Active Process Discharges

Pollutant	DSN 003C Cooling Tower Desiltation Pond Maximum Daily Value	DSN 005 Trash Sluice Maximum Daily Value	DSN 007 Simulator Tng Facility Maximum Daily Value	Intake Average Value
PART A				-
BOD mg/L	<1.0	1.1	6.4	1.5
COD mg/L	10	6.0	14	13
TOC mg/L	2.1	2.0	4.3	2.8
TSS mg/L	2	8	12	5
Ammonia (N) mg/L	0.01	0.08	8.8	0.03
Flow gpm	-	60	0.02	-
Temperature (*winter*) ºC	14.7	13.5	15.4	-
Temperature (*summer*) ºC				-
pH s.u.	***Maximum*** 8.8	***Maximum*** 7.8	***Maximum*** 7.4	***Maximum*** -
PART B				
Bromide mg/L	<0.1	<0.1	<0.1	<0.1
Fecal Coliform N/100ml	-	-	430	-
Fluoride mg/L	<0.1	<0.1	<0.1	<0.1
Nitrate-Nitrite mg/L	0.16	0.57	36	1.9
Nitrogen, Total Organic (N) mg/L	0.16	0.27	9.5	0.31
Oil & Grease mg/L	8	5	<5	<5
Phosphorus mg/L	0.01	0.06	1.6	0.06
Sulfate (SO4) mg/L	21	19	230	22
Sulfide (S) mg/L	<0.02	<0.02	<0.02	<0.02
Sulfite (SO3) mg/L	<0.5	<0.5	<0.5	<0.5
Surfactants mg/L	<0.1	0.12	<0.1	<0.1
Aluminum, total µg/L	600	400	270	340
Barium, totalµg/L	20	30	50	30
Boron, total µg/L	<50	<50	<50	<50
Cobalt, total µg/L	<1	<1	<1	<1
Iron, total µg/L	<10	430	330	380
Magnesium, total mg/L	3.8	6.0	33	6.0
Molybdenum, total µg/L	<20	<20	20	<20
Manganese, totalµg/L	28	370	69	<5
Tin, total µg/L	<50	<50	<50	<50
Titanium, total µg/L	<5	<5	<5	<5
Metals, Cyanide, and Total Phenols				
Antimony µg/L	<7	<7	<7	<7
Arsenic, totalµg/L	<1	<1	4	<1
Berylliumµg/L	<1	<1	<1	<1
Cadmium µg/L	<0.1	<0.1	0.2	0.6
Chromiumµg/L	1	1	3	2
Copper, totalµg/L	60	60	40	30
Lead, totalµg/L	<1	<1	<1	<1
Mercury, totalµg/L	<0.2	<0.2	<0.2	<0.2
Nickel, totalµg/L	<1	2	8	<1
Selenium, totalµg/L	<1	<1	4	<1
Silver, total	-	-	-	-
Thallium, totalµg/L	<50	<50	<50	<50
Zinc, total µg/L	<10	<10	<10	<10
Cyanide, total mg/L	<0.02	<0.02	<0.02	<0.02
Phenols, total µg/L	9	48	13	24

The existing Bellefonte site consists of eight drainage grid areas (Table 3.1.6-11).

Table 3.1.6-11 Site Drainage Area

Site Location	Total Surface Area (Acres)	% Impervious Surface
Area 1	120	57%
Area 2	42	18%
Area 3	315	10%
Area 4	465	3%
Area 5	283	6%
Area 6	130	0%
Area 7	179	23%
Area 8	60	96%
Overall Site Totals	**1594**	**15%**

A description of each affected area follows:

Area 1 - Not affected by construction of any new facilities.

Area 2 - Not affected by construction of any new facilities.

Area 3 - This area is defined by the North Access Highway to the east and Town Creek to the west. The abandoned phosphate pond lays in the western portion of this area and is monitored for storm water runoff (DSN 010). This pond is currently not in use. The eastern half of the main parking lot is drained by nine storm sewer drain inlets and is routed in a northerly direction to a wooded area. The wooded area then drains north through natural ditches that empty into Town Creek through a monitored storm water outfall (DSN 011). The Simulator Training Facility is located near the eastern boundary. Storm water collects in storm drain inlets, and flows to the west of the building to a grassy area which leads to intermittent drainage ditches to Town Creek (DSN 009). The HVAC once through cooling water and fire protection system flush water flows northwesterly and discharges into Town Creek (DSN 008). The Environmental Data Station is located in a grassy field area further north of the Simulator Training Facility. Some of this area has not been disturbed during previous construction activities at the site. New storm water monitoring points may have to be added. Herbicides and fertilizers are used as required on grassed areas around the Simulator Training Facility and the Environmental Data Station. Land spreading of trisodium phosphate occurred in this area in the 80's.

Area 4 - The area consists of both grassy fields and wooded areas and is defined by the North Access Highway to the west and the Tennessee River to the north and east. The simulator sand filter effluent (DSN 007) is discharged through a 12-inch pipe which drains east beside the access road to the plant intake. The flow then enters a storm drain inlet structure which empties at the east face of the intake structure into the intake channel. Some of the land received trisodium phosphate several years ago as part of the land spreading project. In addition the firing range, borrow pits and spoil areas, and waste landfills are located in this area. The storm water runoff drains through roadside ditches and natural ditches east to the Tennessee River.

Area 5 - The area is defined by roadways to the west, natural drainage area to the south, Tennessee River to the east, and natural drainage area to the north. The construction storage area ground cover consists of gravel and grassy areas. Herbicides are applied when needed. The drainage in this area flows west to the precipitation ditch. The precipitation ditch is lined with riprap and grass. The area drainage flows south through grassed ditches to the Tennessee River.

Area 6 - Not affected by construction of any new facilities.

Area 7 - The equipment laydown area is located on the northern boundary. This area drains several roadside ditches that flow into a central ditch which goes through a wooded area (DSN 015). Herbicides are used as required in the former equipment laydown area. The Storage and Insulation Warehouses are located in the northeast corner of this drainage area. The ground cover is primarily crushed stone and gravel. This area is drained by roadside ditches under the south access road and then to Town Creek Embayment.

Area 8 - This area is defined by a railroad loop north. The main access road lies to the west and the construction roadway to the east and south. The primary ground cover is crushed stone and gravel. This area is drained by several roadside ditches that flow into a central ditch westward through the construction parking area. The central ditch carries drainage under the south access road in three 30-inch pipes to the east culvert impoundment through a 92.5 degree V-notched weir and drains into Town Creek. The main construction warehouse is in the eastern edge of the drainage area. The ground cover consists of crushed stone. The warehouse has a loading dock where materials normally will not come in contact with storm water runoff. Runoff from this area flows through several roadside ditches and then to the central ditch. The construction gas and diesel aboveground storage tanks are in the north east corner of the area. The storm water runoff in this area is drained by roadside ditches which flows to intermittent ditches and overland to the Tennessee River. The construction laydown area is drained by a series of grassed roadway ditches which drains into the main ditch. This ground cover consists of crushed gravel and grass. Herbicides are used as required in the former construction laydown area.

3.1.7 Floodplains and Flood Risk

Bellefonte is located on a peninsula formed by the Town Creek Embayment and the Tennessee River on Guntersville Lake in Jackson County, Alabama. The proposed project area could be flooded from both the Tennessee River and Town Creek. The area impacted by the construction of any of the conversion options extends from about Tennessee River mile 390.4 to mile 392.3, and from about Town Creek mile 2.1 to mile 3.3.

The 100-year floodplain for the Tennessee River varies from elevation 600.5 feet above mean sea level at river mile 390.4 to elevation 601.1 at river mile 392.3. The TVA Flood Risk Profile (FRP) elevations on the Tennessee River vary from elevation 601.8 at river mile 390.4 to elevation 602.6 at river mile 392.3. For Town Creek, the 100-year floodplain is the area lying below elevation 601.4. The FRP elevation is 603.1. The FRP is used to control flood damageable development for TVA projects. At this location, the FRP elevations are equal to the 500-year flood elevations. A figure depicting the 500-year flood elevations for Bellefonte is contained in Appendix B.

Jackson County, Alabama has adopted the 100-year flood as the basis for its floodplain regulations, and all development would be consistent with these regulations. There are no floodways published for this area.

3.1.8 Groundwater

3.1.8.1 Groundwater Occurrence

All water at the site is derived from precipitation or is imported by pipeline from the Tennessee River. Additional groundwater recharge may occur from leaking water and waste water pipelines, process pipelines, and impoundments. All water eventually leaves the site as streamflow and runoff, is removed by pumping, or is consumed by evapotranspiration. Except for barren landscape features, paved and roofed areas, the land surface is permeable. Water that is not removed by runoff, evapotranspiration, or the site drainage system moves laterally through the subsurface to the Town Creek Embayment and the Tennessee River. It appears that all groundwater is discharged to surface waters and none is known to leave the site as underflow. Appendix H contains more detailed information about groundwater levels and movement at Bellefonte.

Groundwater Levels

A total of 35 groundwater monitoring wells have been installed at the site since 1973. The well locations are shown in Figures 3.1.2-3 and 3.1.8-1 with pertinent construction data provided in Table 3.1.8-1. Groundwater movement is generally toward the Town Creek Embayment. During certain times of the year, movement may occur toward the river from the east side of the main parking (roughly along the ERCW pipeline route) and possibly from the southeast corner of the site (near the sump collection ponds). Groundwater levels normally reach maximum elevations during the months of January through March. During September and October water levels are usually at a minimum. The water table generally ranges from 0 to 22 feet below land surface at the plant site.

Figure 3.1.8-1 Groundwater Wells and Elevations Near Diesel Tanks

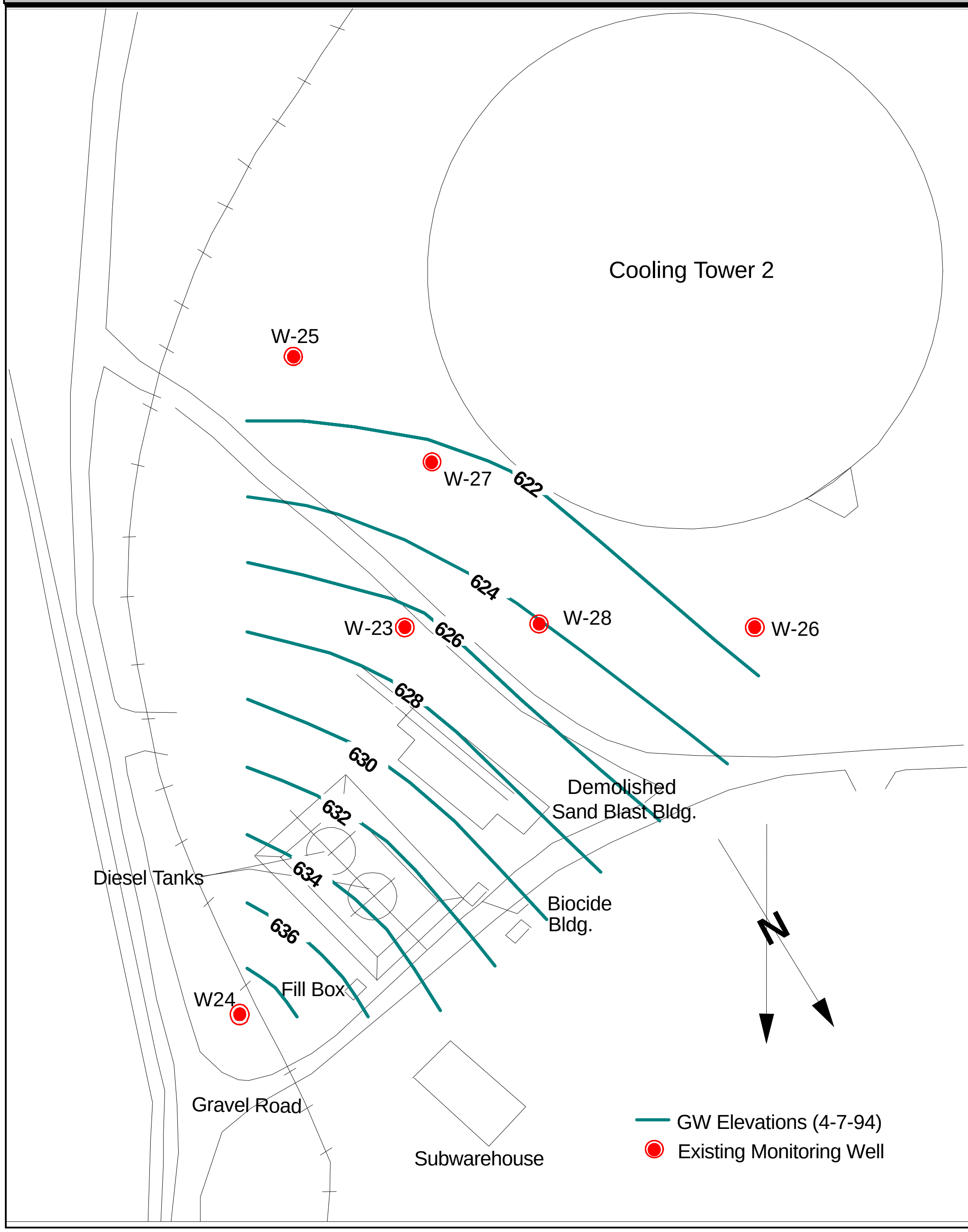


Table 3.1.8-1 Site Groundwater Monitoring Wells

Well ID	Date Installed	Depth Range (m)	Soil or Bedrock	Purpose	Reference
WT1 - WT6	1973	13.9	Bedrock	Background Water Quality and Water Level Data	TVA (1976)
B7 & B8	1981	6.5 - 7.4	Bedrock	Monitor Groundwater Quality Near TSP[a] Ponds	Lindquist (1990)
W9 - W11	1984	0.9 - 1.3	Soil	Monitor Groundwater Quality Near TSP[a] Land Applications	Lindquist (1990)
BNP01 - BNP03, BNP06 & BNP07	1987	0.4 - 0.5	Soil	Monitor Groundwater Quality Near Diesel Tanks	Young and Lindquist (1988)
W12 - W19	1990	0.9 - 3.3	Both	Background Water Quality and Water Level Data	Julian (1990)
W21 - W22, B & C	1992	3.8 - 4.4	Bedrock Soil	Monitor Groundwater Quality Near Landfill	Browman (1994)
W23 - W26	1993	0.9 - 1.4	Bedrock	Monitor Groundwater Quality Near Diesel Fuel Tanks	Julian (1993)
W27 & W28	1994	1.4	Both	Monitor Groundwater Quality Near Diesel Fuel Tanks	Julian (1994)
W29 - W43	1996		Both	Aquifer Characterization	Julian (1996)

[a] Trisodium Phosphate

3.1.8.2 Groundwater Quality

Background groundwater sampling has been conducted at the site since 1978. Initial background sampling consisted of analyses for radionuclides in groundwater from wells WT1 through WT6. Subsequent background sampling for inorganics has included samples from 13 wells scattered across the site. Groundwater sampling has also been conducted for organics and indicator parameters associated with known/potential subsurface releases at the site.

During the period from 1977 through 1983, monthly groundwater samples were collected from six onsite bedrock wells WT1 - WT6 (Figure 3.1.2-2) to establish background radionuclide levels at the site. [48] All samples were analyzed for gamma-emitting radionuclides and quarterly composites were analyzed for tritium. The results are compiled in Table 3.1.8-2. It should be noted that the well locations exhibiting the highest annual mean radionuclide concentrations were both temporally and spatially variable.

Table 3.1.8-2 Composite Results of Radioactivity in Background Groundwater Samples from Wells WT1 - WT6 for the Period 1977 Through 1983

Parameter	Min (pCi/L)	Max (pCi/L)	Fraction of Detectable Measurements
Fe-59	4.80	5.40	2/44
K-40	24.03	68.88	32/145
Bi-214	8.34	131.85	98/145
Pb-212	2.30	13.52	44/144
Pb-214	8.33	119.74	77/145
Tl-208	4.14	6.14	33/138
Ac-228	----	----	0/22
Tritium	111.19	111.24	4/153

Table 3.1.8-3 provides results of background groundwater sampling for inorganics (sampling frequency and periods are variable between wells). With the exception of dissolved nickel, samples were not filtered during collection and results represent total concentrations. As shown in the table, very few constituents exceed EPA’s Maximum Contaminant Levels (MCLs) for Primary and Secondary Drinking Water Standards. Metals that appear consistently at levels greater than the MCLs are iron, manganese, and aluminum. However, the seemingly elevated concentrations of these metals are likely related to very fine-grained (colloidal) particles from indigenous clay captured during groundwater sampling and this bias is a mere reflection of natural mineralogy.

Table 3.1.8-3 Inorganics in Background Groundwater Samples for the Period 1981 Through 1991

Parameter	Units	# of Wells Sampled or Well ID	# Obs	Min	Max	Primary[a] MCL	Secondary MCL	Well(s) Exceeding MCL
Temperature	Centigrade	13	143	10.00	24.30	------	------	
Alkalinity	mg/L	11	39	16.00	431.00	------	------	
ORP	mV	11	39	94.00	450.00	------	------	
Conductivity	umho	13	188	32.00	874.00	------	------	
pH	SU	13	195	5.50	8.00	------	6.5-8.5	B7, B8, W10, W11
DO	mg/L	11	39	0.30	7.50	------	------	
Hardness	mg/L	13	52	1.00	552.00	------	------	
TDS	mg/L	13	188	24.00	570.00	------	500	Well 17
Ag,TOT	ug/L	W9, W10 & W11	30	10.00	10.00	------	100	
Al,TOT	ug/L	13	53	50.00	15000.00	------	50 to 200[b]	All Wells Sampled
As,TOT	ug/L	11	38	1.00	1.00	50	------	
B,TOT	ug/L	11	36	4.00	4.00	------	------	
Ba,TOT	ug/L	11	39	1.00	130.00	2000	------	
Be,TOT	ug/L	W9, W10, & W11	7	4.00	4.00	4	------	
Ca,TOT	mg/L	13	72	0.02	170.00	------	------	
Cd,TOT	ug/L	11	83	0.00	22.00	5	------	W9, W10, W11
Chloride,TOT	mg/L	13	77	1.00	9.00	------	250	
Cn,TOT	mg/L	W9, W10, & W11	6	0.02	0.02	0.2	------	
Co,TOT	ug/L	W9, W10, & W11	7	1.00	1.00	------	------	
Cr,TOT	ug/L	11	59	0.00	12.00	100	------	
Cu,TOT	ug/L	13	92	1.00	43.00	1300[c]	1000	
Fe,TOT	ug/L	13	78	5.00	15000.00	------	300	All except B8
Hg,TOT	ug/L	W9, W10, & W11	3	0.20	0.30	2	------	
K,TOT	mg/L	11	66	0.22	16.00	------	------	
Li,TOT	ug/L	11	51	10.00	30.00	------	------	
Mg,TOT	mg/L	13	58	0.60	45.00	------	------	
Mn	ug/L	13	54	5.00	750.00	------	50	All except 16
Mo,TOT	ug/L	11	36	20.00	20.00	------	------	
Na,TOT	mg/L	13	175	0.10	53.00	------	------	
Ni,DISS	ug/L	11	30	1.00	32.00	------	------	
Ni,TOT	ug/L	B7,B8,WT4,W9, W10, W11	65	1.00	280.00	100	------	Well W10
NH_3+NH_4,TOT	mg/L	B7 & B8	80	0.01	0.59	------	------	
NO_2+NO_3,TOT	mg/L	13	114	0.01	17.00	10	------	Well B8
Pb,TOT	ug/L	11	41	1.00	20.00	50[c,d]	------	
Phos,TOT	mg/L	13	137	0.01	0.51	------	------	
PO_4,TOT	mg/L	11	15	0.01	0.17	------	------	
Sb,TOT	ug/L	11	63	1.00	5.00	6	------	

Table 3.1.8-3 Inorganics in Background Groundwater Samples for the Period 1981 Through 1991 (Cont'd)

Parameter	Units	# of Wells Sampled or Well ID	# Obs	Min	Max	Primary[a] MCL	Secondary MCL	Well(s) Exceeding MCL
Se,TOT	ug/L	11	29	1.00	2.00	50	------	
Si,TOT	ug/L	11	36	2,800.00	22,000.00	------	------	
SO_4,TOT	mg/L	13	122	1.00	97.00	500 (proposed)	250	
Sr,TOT	ug/L	11	35	50.00	2,600.00	------	------	
Tl,TOTAL	ug/L	W9, W10, & W11	9	50.00	270.00	2	------	
V,TOT	ug/L	11	41	10.00	10.00	------	------	
Zn,TOT	ug/L	13	81	5.00	230.00	------	5,000	

[I]Wells B7, B8, WT4, W9, W10, W11, 12, 13, 14, 15, 16, 17, and 19
[II]Wells WT4, W9, W10, W11, 12, 13, 14, 15, 16, 17, and 19
[a]Sources: Federal Register, Vol. 55, No. 143, July 25, 1990
Federal Register, Vol. 56, No. 20, January 30, 1991
Federal Register, Vol. 57, No. 138, July 17, 1992
Federal Register, Vol. 59, No. 243, December 20, 1994
[b]Limit is to be determined by states
[c]EPA established action levels (ALs) rather than MCLs; effective December 7, 1992
[d]MCL used by states; EPA AL = 15 mg/L

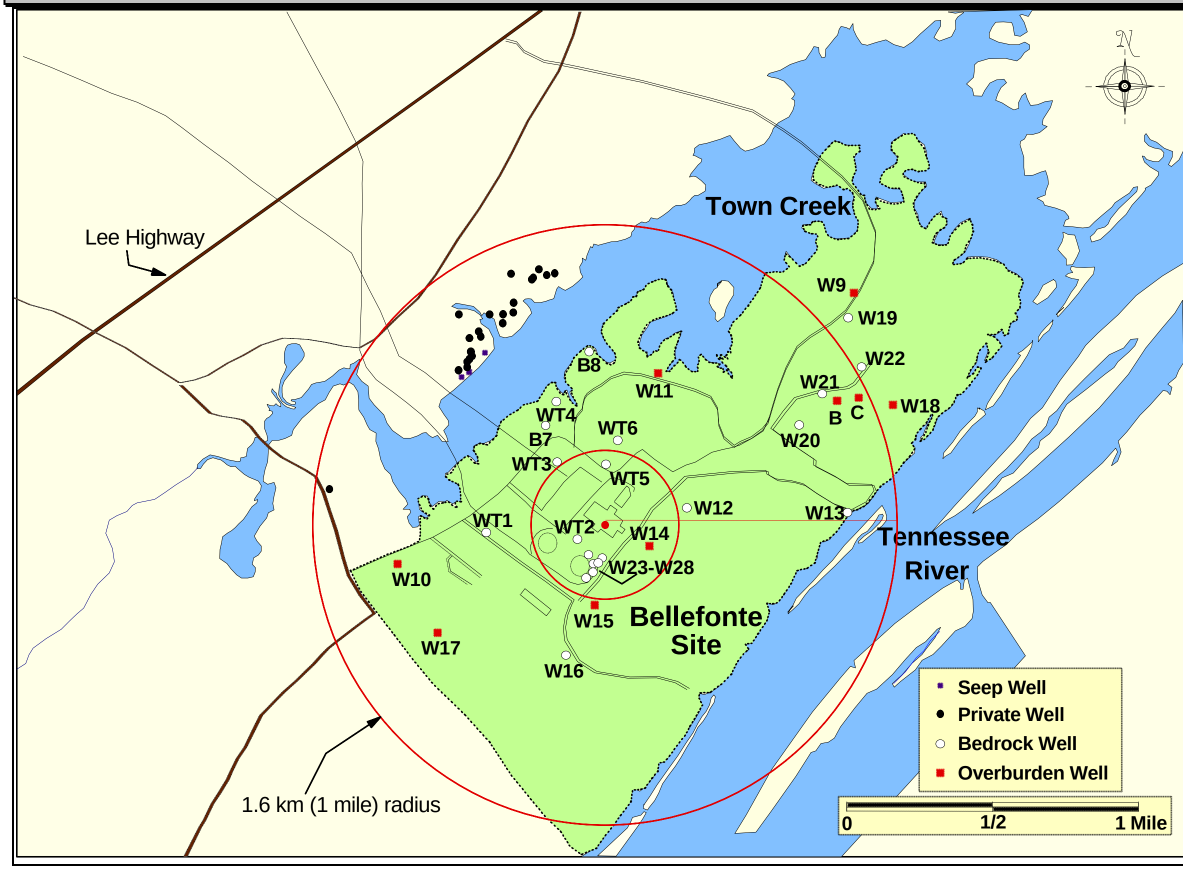
3.1.8.3 Groundwater Use

The water-bearing properties of the Chickamauga Formation are variable but it is considered a reasonably good aquifer at certain locations. The absence of large springs in this Ordovician limestone area is a conspicuous and characteristic groundwater feature. The few small springs that occur are local seeps that yield less than a few gallons a minute. Many drilled and dug wells in this formation yield domestic, industrial, and municipal water supplies. Water supply wells for the neighboring cities of Stevenson and Scottsboro, Alabama reside within the Chickamauga Formation. [8,29] The city of Hollywood, Alabama, (4 km northwest of the site) utilizes two deep wells and the combined estimated pumping rate is about 110,000 gallons per day.

Groundwater supplies within a one-mile radius of the site were obtained during a 1990 groundwater investigation of the site. [49] As shown in Figure 3.1.8-2, all groundwater supply wells near the plant site are located on the opposite side of Town Creek Embayment which serves as a hydraulic boundary along the western border of the site. All of the off-site wells shown in Figure 3.1.8-6 serve as domestic groundwater supplies and/or as secondary sources of water for garden irrigation, washing automobiles, and other miscellaneous uses. Drilled wells range in depth from about 18 to

61 meters and average 30 meters deep. The few seep wells shown in Figure 3.1.8-2 are one to two meters deep.

Figure 3.1.8-2 Groundwater Supply Wells Within 1.6 km Radius of the Site



3.1.9 Terrestrial Ecology

3.1.9.1 Vegetation

The project area is located within the Mixed Mesophytic Forest Region. [50,51] This region is characterized by numerous tree species sharing the canopy as opposed to forests being dominated by one or a few species. Tree species sharing dominance in this region include:

- American beech,
- Tuliptree,
- Basswood,
- Sugar maple,
- Red maple,
- Yellow buckeye,
- Red oak,
- White oak,
- Black gum,
- Black walnut, and
- Several species of hickory.

Previous land use changes at Bellefonte (other than the partial construction of the nuclear plant) are typical of those occurring throughout the region. Historically, valleys and lower ridge slopes were cleared for agricultural uses. Row crops and pastures are typically restricted to the broad valley floor. The ridges and knolls are mostly forested, although repeated timber harvests have occurred. Site vegetation has thus been continuously disturbed by decades of timbering and agriculture. The history of land uses, especially the numerous agricultural activities, has produced a patchwork mosaic of plant communities, representing various succession stages. Because of the repeated pattern of disturbance, there is a high percentage of weedy species, both native and exotic, occurring on the site.

Onsite vegetative communities can be allocated to one of five general categories:

- Mixed hardwoods,
- Lawns and grassy fields,
- Scrub-shrub thickets (including fencerows),
- Bottom land/riparian hardwoods, and
- Pine hardwood forests.

Approximately 20% of the site has no vegetative cover but has instead parking lots, roads, buildings, cooling towers, and other structures associated with the partially constructed nuclear facility.

Mixed hardwood communities cover approximately 40% of the project site, and are found most commonly on the ridges and knobs. In such communities, typical tree species include:

- White oak,
- Northern red oak,
- Chestnut oak,
- Sugar maple,
- Pignut hickory,
- Mockernut hickory,
- Shagbark hickory,
- Black cherry,
- Persimmon,
- White ash,
- Hackberry, and
- Basswood.

Shrub, herb, and vine species common in these forests include:

- Sweetshrub,
- Mock-orange,
- Wild geranium,
- Milkweed,
- Crossvine,
- Toothwort,
- Mayapple,
- Phlox,
- Poison ivy,
- Virginia creeper, and
- Greenbrier.

Lawns and grassy fields occupy approximately 10% of the site, where lawns are typically associated with areas surrounding existing buildings and parking lots. Grass fields are fields that were previously maintained for pasture or mowed for hay. However, hay is not presently being harvested from Bellefonte land, with areas simply being maintained as open space. Plant species found in such areas include:

- Bermuda grass,
- Fescue,
- Broom sedge,
- Orchard grass,
- Various other Grass species,
- Dandelion,
- Buttercup,
- False wild-strawberry,
- Plantain, and
- Blackberry.

Scrub-shrub communities occur in areas that were previously managed as open land but have now been left undisturbed for the past 2-25 years. Typically these are areas that were used for agricultural purposes or sites where timber had been removed. Such areas undergo succession and develop from a mostly grasses stage, through perennial herbs, to saplings and thick understory. Early successional communities are dominated by such species as:

- Broom sedge,
- Lespedeza,
- Japanese honeysuckle,
- Ragweed,
- Buttercup,
- Goldenrod,
- Blackberry,
- Sumac,
- Virgin's bower, and
- Various other grasses and asters.

Older sites will generally include:

- Pine,
- Various oaks,
- Sumac,
- Blackberry,
- Winged elm,
- Persimmon, and
- Black locust.

Approximately 15% of the Bellefonte site has this vegetation type.

Bottomland hardwood & riparian forests are associated with streams and the shoreline margins of Guntersville lake. Such forests typically are various mixtures of:

- Box elder,
- Red maple,
- Sweetgum,
- Hackberry,
- Sycamore,
- Cherrybark oak,
- Willow oak,
- Water oak,
- River birch, and
- Cottonwood.

These forests occupy approximately 5% of the site.

Pine-hardwood forests occur on approximately 10% of the project area. These communities are predominantly:

- Loblolly pine mixed with short leaf pine,
- Red maple,
- Persimmon,
- Elm, and
- Various oaks.

Common understory components are:

- Japanese honeysuckle,
- Blackberry,
- Poison ivy, and
- Sumac.

3.1.9.2 Wildlife

In the immediate vicinity of the proposed facility, most project land has been converted to parking lots, roads, and structures associated with the construction of Bellefonte Nuclear Plant. Consequently, there is little habitat for wildlife. However, the remaining land on the site provides a variety of habitats suitable for many terrestrial wildlife species. These habitats are described in the previous section, Vegetation.

Mixed-hardwood and pine-hardwood communities provide habitats for white-tailed deer, gray squirrels, and flying squirrels. Fallen timber and woody debris provide cover for woodland voles, southeastern shrews, and eastern chipmunks. Common birds in these habitats include red-bellied woodpeckers, blue jays, American crows, and Carolina wrens. Several neotropical migrant songbirds such as the summer tanager, wood thrush, red-eyed vireo, and Kentucky warbler nest in these habitats; these and other migrants are also present during the spring and fall. Reptiles and amphibians commonly found in these forested habitats include ring-necked snakes, ground skinks, slimy salamanders, and Fowler’s toads.

Lawn and grassy fields are used as nesting and foraging areas by many species of birds. Common ground nesting species include meadowlarks and field sparrows. Occasionally, wild turkeys are observed foraging in such habitats. Common mammals include eastern cottontail rabbits, woodchuck, hispid cotton rats, prairie voles, and least shrews. Reptiles and amphibians commonly found in these habitats include gray rat snakes, eastern garter snakes, and American toads.

Scrub-shrub communities are one of the most abundant habitat types occurring on the site. Such communities not only provide important nesting and foraging areas, but they also are used for travel corridors by quail, fox, and small mammals. In the highly fragmented landscapes of the Tennessee Valley, scrub-shrub thickets provide a very important habitat component. In these habitats, common birds include gray catbirds, rufous-sided towhees, and mockingbirds. Frequently encountered mammals include southeastern shrews, eastern cottontail rabbits, and gray squirrels.

Bottomland hardwoods and riparian forest are located along streams and Guntersville Lake shoreline and are important habitats for numerous animal species. These forests provide suitable habitat for beaver, mink, muskrat, belted kingfishers, and green herons. In such communities, tree hollows provide nesting sites for wood ducks, gray squirrels, screech owls, and prothonotary warblers. Additionally, trees located along the shoreline of Guntersville Lake are used as perching/loafing sites for great blue herons, great egrets, osprey, and occasionally bald eagles. Several species of amphibian and reptile are commonly found in forested riparian communities. These include rough green snakes, midland water snakes, bullfrogs, gray treefrogs, northern cricket frogs, and American toads.

3.1.9.3 Terrestrial Endangered and Threatened Species

No state- or federally-listed plant species are known to occur on or in close proximity to the site. At least one federally-listed animal does occur regularly on the site, and other state- or federally-listed species likely occasionally utilize areas of suitable habitat on the site or in the site vicinity (Table 3.1.9-1).

Gray bats, *Myotis grisescens,* listed as endangered by the U. S. Fish and Wildlife Service, roost in caves year-round. Gray bats typically consume emerging insects while foraging over aquatic habitats. Because of the proximity (within 15 km) of several caves known to support summer colonies of this species, it is likely that gray bats forage over shallow sloughs in the general area of the Bellefonte site.

Table 3.1.9-1 List of Federally And State Listed Species Potentially at Bellefonte

Common name	Scientific name	Status	Habitat
Gray Bat	*Myotis grisescens*	Endangered [a]	Riparian Zones
Indiana Bat	*Myotis sodalis*	Endangered [a]	Wooded Areas
Meadow Jumping Mouse	*Zapus hudsonius*	SPOC	Abandoned Pasture,Shrub
Bald Eagle	*Haliaeetus leucocephalus*	Threatened [a]	Riparian Zones
Osprey	*Pandion haliaetus*	Threatened [a]	Riparian Zones
Cooper's Hawk	*Accipiter cooperii*	SPOC [b]	Wooded Areas
Willow Flycatcher	*Empidonax traillii*	STUN [c]	Abandoned Pasture, Shrub, Riparian Zones
Warbling Vireo	*Vireo gilvus*	STUN [c]	Wooded Areas
Box Turtle	*Terrapene carolina*	SPOC [b]	All Habitats

[a] - Indicates Federally and State listed
[b] - SPOC = Species of concern in Alabama
[c] - STUN = Status undetermined in Alabama

Indiana bats, *Myotis sodalis*, also listed as endangered, roost in hollow trees during summer months and hibernate in caves during the winter. These bats typically forage in wooded areas adjacent to streams and other water courses. Because Indiana bats have been observed hibernating in nearby caves, it is likely that they forage within forested riparian areas remaining on the Bellefonte site during summer months.

Meadow jumping mice, *Zapus hudsonius*, utilize lawn and grassy field habitats, often adjacent to scrub-shrub communities. Though not common in northern Alabama, this species may use the extensive areas of abandoned pastureland occurring in the Bellefonte area.

In recent years, migrant-wintering and nesting bald eagle, *Haliaeetus leucocephalus*, populations have increased on Guntersville Lake. Bald eagles also use the wooded shoreline of the Bellefonte site along the mainstem of the Tennessee River and the intake canal for perching and foraging during the winter.

Population levels of osprey, *Pandion haliaetus*, have also been increasing on Guntersville Lake, and several nests have been observed in the vicinity of Coon and Crow Creeks. This species would also use shoreline habitats fronting the Bellefonte site for loafing/foraging sites.

Cooper's hawks, *Accipiter cooperii,* usually nest in slightly fragmented deciduous forest. This predatory bird typically feeds on avian prey. Because of the secretive nature of this species, it is difficult to obtain accurate population estimates. However, suitable nesting habitat does occur at the Bellefonte site.

Willow flycatchers, *Empidonax traillii,* typically nest in willow thickets within riparian communities, however, they will also utilize abandoned pastureland and hedgerows. This species is rare in Alabama; however, due to the abundance of riparian and fragmented habitats located on the site, this bird may nest at Bellefonte.

Warbling vireos, *Vireo gilvus,* select suitable nest sites within forest edge and riparian habitats. Little is known about the distribution of this species in Alabama. Suitable habitat is, however, common at Bellefonte, and this species may use the site.

Box turtles, *Terrapene carolina,* are usually found in association with hardwood forest, however, this species may be found in most of the remaining natural habitats at Bellefonte. This species has experienced recent population declines in the State of Alabama.

3.1.10 Aquatic Ecology

Bellefonte is located on a peninsula bounded to the north and east by Town Creek Embayment and to the south by the Tennessee River (Guntersville Lake). Town Creek Embayment, the mainstream Tennessee River channel, and shallow protected overbanks adjacent to the river channel comprise the variety of aquatic habitats in the immediate vicinity of the project and beyond. A low-lying floodplain between the site and the old Tennessee River channel was flooded by the impoundment of Guntersville Lake in 1939. This area now exists as narrow backwater sloughs and embayments which are protected from wave and current action of the main river by strip islands and bars formed by the higher portions of the old river bank.

These backwater areas support a diverse assemblage of aquatic flora and fauna. Beyond the strip islands and bars, the original mainstream channel of the Tennessee River also contains a diverse aquatic community, though more affected by river flows, reflecting to a greater degree the transport of aquatic organisms (especially plankton) past the plant site. The Town Creek Embayment which flows into Guntersville Lake at TRM 393.4, is more isolated from river currents than the shallow overbank aquatic habitat along the river proper. Both littoral habitats are closely associated with rooted aquatic plants (macrophytes) and provide a very productive habitat and nursery area for aquatic species.

Downstream from the project site, Guntersville Lake becomes gradually more broad and deep. The zone of transition between riverine (lotic) and pooled (lentic) conditions, based on deposition of silt/clay and increased (phytoplankton) chlorophyll, is approximately TRM 375, or 16 river miles downstream from the project site. The exact point of transition depends upon river elevation (stage) and flow and will vary upstream or downstream with changes of those two variables.

Various biological assessments have been conducted near the plant site and beyond. Fisheries data have been collected since 1949, when TVA began conducting cove rotenone sampling in Guntersville Lake to determine the standing stock of game, prey, and commercial fish species. These assessments include the following:

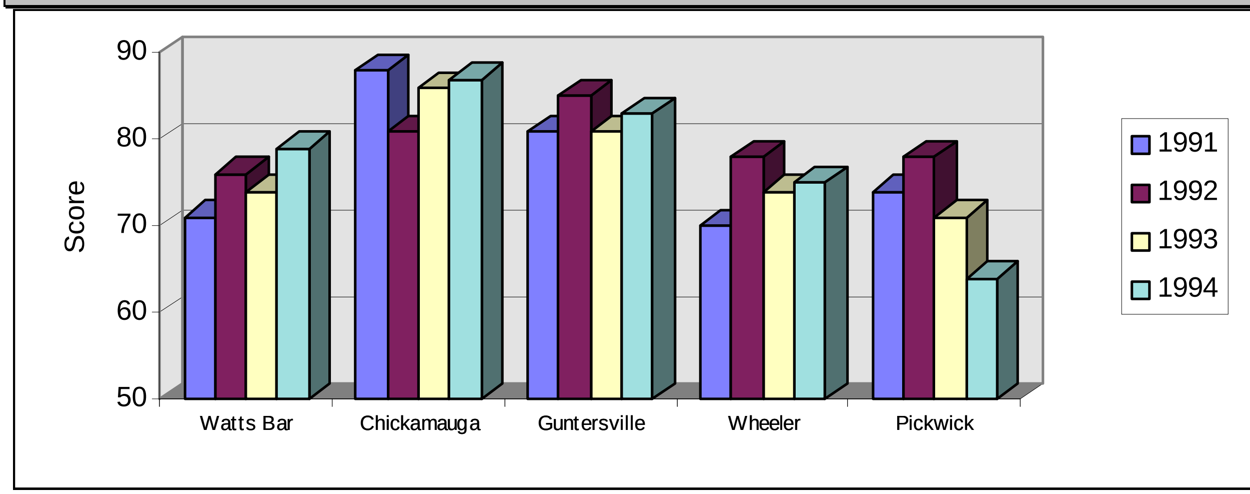
- Cove rotenone samples were collected annually through 1961; however, variations in the sampling procedures limit the value of these early historical data.
- In 1971, rotenone sampling procedures used in Tennessee Valley lakes were standardized and sampling was initiated again in Guntersville Lake. Except for four years (1973, 1978, 1987, and 1989), rotenone sampling was conducted annually through 1993 as a component in TVA's lake assessment and the monitoring program for Bellefonte.
- In addition to cove rotenone sampling, other sampling that included collection of fishery data on nursery areas and movement of young (eggs and fish larvae--1974 through 1983) and occurrence and movement of adults (gill netting and electrofishing--1981 through 1984) was initiated in 1974 as part of a preoperational monitoring program for the Bellefonte project.

The preoperational assessment of the fishery community in Guntersville Lake in the vicinity of the Bellefonte site was reported by TVA in 1985.[52] A 1983 TVA report assessing the effects of the proposed Murphy Hill Coal Gasification Project on Guntersville Lake presented additional data on the fish community in 1981 and 1982.[53] Recent fishery data from Guntersville Lake (1985 through 1995) have been collected as components in the joint agency (TVA/U. S. Army Corps of Engineers) aquatic plant management project and TVA's lake vital signs monitoring.[54-69] In addition to cove rotenone sampling, the various studies have included data describing the fishery community collected from popnetting (1990), gillnetting (1989-1994), hydroacoustics and trawling (1990-1991), and electrofishing (1988-1991). Procedures used in collecting fishery data are in TVA's Biological Resources Procedures Manual.[70]

Two of the studies referenced above for the fish community and several other studies also evaluated other aquatic communities, including phytoplankton, zooplankton, periphyton, aquatic marcophytes, and benthic macroinvertebrates.[52,53,71,73] The Bellefonte construction effects monitoring assessment and the Bellefonte preoperational study, though dated, provide the most comprehensive description of aquatic communities and their habitats near Bellefonte.[55,71] Based on the Bellefonte preoperational assessment, which evaluated plankton and other communities monthly, February-October, 1974-1983, phytoplankton are quite variable among stations, months, and years such that spatial and temporal trends are seldom obvious. However, there has been a trend indicated for greatest total phytoplankton abundance and Cyanophyta (blue-green algae) dominance during parts of the year at shallow overbank habitats and at downstream sampling locations. Such a trend would be expected based on increased hydraulic retention time as the transition is made from lotic to lentic conditions. Aquatic community types near the project site are somewhat varied from aquatic communities in other mainstem TVA lakes due largely to abundance of aquatic macrophytes.

More recent Guntersville Lake studies have focused primarily on fish and benthic macroinvertebrates and not on other community types which are very dynamic, variable, and/or transient with regard to conditions near Bellefonte. Notably, the ecological health assessments of TVA lakes conducted since 1990 have included assessments of fish, benthic macroinvertebrates, chlorophyll-a, sediment quality, and dissolved oxygen. These studies have been used to compare the health of each lake based on data collected from inflow, transition, and forebay lake zones.[58,61,64,67,69] These data indicate that Guntersville Lake is one of the better lakes compared with others upstream and downstream (Figure 3.1.10-1). Comparisons were not made with Nickajack and Wilson lakes because no transition zone exists for those lakes. Lake health scores were made for the period 1991-1994 using 1994 scoring criteria.[69]

Figure 3.1.10-1 Overall Lake Health Scores Comparing Guntersville with Other Tennessee River Lakes



The following detailed description of the affected environment is provided for the fish and macroinvertebrate communities which are the more permanent community types at the site with the greatest potential for being impacted by the project. Historical data for these two communities are summarized below with emphasis on the more recent community assessments conducted in support of the lake ecological health studies. Also provided is a brief description of nonnative (introduced) species and their effects on the existing environment. More detailed information is contained in Appendix I.

3.1.10.1 Fish

Guntersville Lake supports a diverse endemic fish community including both a sport and commercial fishery. A total of 82 species of fish have been collected in TVA field investigations in Guntersville Lake (Table 3.1.10-1).

- 61 were collected in both recent (1984-1994) and historical (1949-1984) field investigations.
- 13 species only occurred in samples prior to 1985.
- Eight species have been added since 1985.
- Except for grass carp (an introduced species), all species unique to either the historical or recent field investigations were infrequently collected and often limited to one or only a few individuals.

The diversity of species within each major fish group (game, rough, and forage) was similar in the historical and recent studies when similar gear types were used (Figure 3.1.10-2). Differences observed were attributed to variations in longevity and intensity of studies, habitats sampled, procedures, and specific gear types.

Figure 3.1.10-2 Number Of Fish Species Collected With Each Gear Type In Guntersville Lake

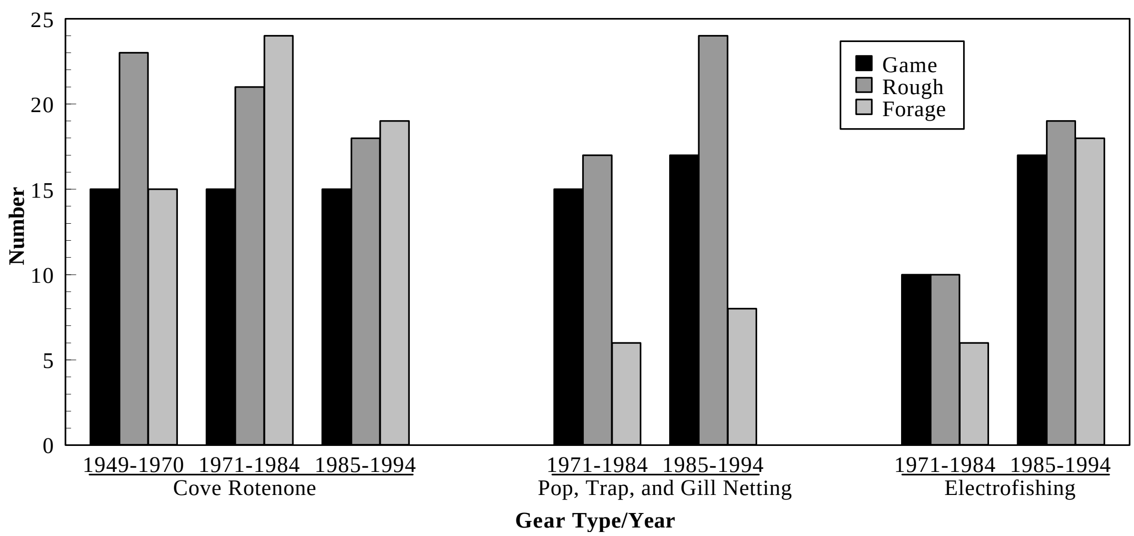


Table 3.1.10-1 Common And Scientific Names Of Fish Collected In Guntersville Lake, 1949-1994

Common Name	Scientific Name	Common Name	Scientific Name
Forage		**Rough**	
Alewife[a]	*Alosa pseudoharengus*	Chestnut lamprey[a]	*Ichthyomyzon castaneus*
Gizzard shad	*Dorosoma cepedianum*	Paddlefish[b]	*Polyodon spathula*
Threadfin shad	*Dorosoma petenense*	Spotted gar	*Lepisosteus oculatus*
Central stoneroller	*Campostoma anomalum*	Longnose gar	*Lepisosteus osseus*
Bigeye chub[b]	*Notropis amblops*	Shortnose gar	*Lepisosteus platostomus*
Silver shub	*Macrhybopsis storeriana*	Bowfin	*Amia calva*
Golden shiner	*Notemigonus crysoleucas*	American eel[b]	*Anguilla rostrata*
Emerald shiner	*Notropis atherniodes*	Skipjack herring	*Alosa chrysochloris*
Ghost shiner	*Notropis buchanani*	Mooneye	*Hiodon tergisus*
Whitetail shiner[b]	*Cyprinella galactura*	Goldfish	*Carassius auratus*
Spotfin shiner	*Cyprinella spiloptera*	Common carp	*Cyprinus carpio*
Blacktail shiner[b]	*Cyprinella venusta*	Grass carp[a]	*Ctenopharyngodon idella*
Mimic shiner	*Notropis volucellus*	River carpsucker	*Carpiodes carpio*
Steelcolor shiner	*Cyprinella whipplei*	Quillback	*Carpiodes cyprinus*
Pugnose minnow	*Opsopoeodus emiliae*	Highfin carpsucker[b]	*Carpiodes velifer*
Suckermouth minnow[b]	*Phenacobius mirabilis*	Northern hog sucker[b]	*Hypentelium nigricans*
Bluntnose minnow	*Pimephales notatus*	Smallmouth buffalo	*Ictiobus bubalus*
Fathead minnow	*Pimephales promelas*	Bigmouth buffalo	*Ictiobus cyprinellus*
Bullhead minnow	*Pimephales vigilax*	Black buffalo	*Ictiobus niger*
Creek chub[b]	*Semotilus atromaculatus*	Spotted sucker	*Minytrema melanops*
Blackstripe topminnow	*Fundulus notatus*	Silver redhorse[a]	*Moxostoma anisurum*
Blackspotted topminnow	*Fundulus olivaceus*	River redhorse[a]	*Moxostoma carinatum*
Western mosquitofish	*Gambusia affinis*	Black redhorse[a]	*Moxostoma duquesnei*
Orangespotted sunfish	*Lepomis humilis*	Golden redhorse	*Moxostoma erythrurum*
Dusky darter[a]	*Percina sciera*	Shorthead redhorse	*Moxostoma macrolepidotum*
Bluntnose darter[b]	*Etheostoma chlorosomum*	Blue catfish	*Ictalurus furcatus*
Fantail darter[b]	*Etheostoma flabellare*	Black bullhead	*Ameiurus malas*
Striptail darter	*Etheostoma kennicotti*	Yellow bullhead	*Ameiurus natalis*
Redline darter[b]	*Etheostoma rufilineatum*	Brown bullhead	*Ameiurus nebulosus*
Logperch	*Percina caprodes*	Channel catfish	*Ictalurus punctatus*
Brook silverside	*Labidesthes sicculus*	Flathead catfish	*Pylodictis olivaris*
		Freshwater drum	*Aplodinotus grunniens*
Game			
White bass	*Morone chrysops*	Redeye bass[a]	*Micropterus coosae*
Yellow bass	*Morone mississippiensis*	Smallmouth bass	*Micropterus dolomieu*
Striped bass	*Morone saxatilis*	Spotted bass	*Micropterus punctulatus*
Rock bass	*Ambloplites rupestris*	Largemouth bass	*Micropterus salmoides*
Warmouth	*Lepomis gulosus*	White crappie	*Pomoxis annularis*
Redbreast sunfish	*Lepomis auritus*	Black crappie	*Pomoxis nigromaculatus*
Green sunfish	*Lepomis cyanellus*	Yellow perch	*Perca flavescens*
Bluegill	*Lepomis macrochirus*	Sauger	*Stizostedion canadense*
Redear sunfish	*Lepomis microlophus*	Walleye[b]	*Stizostedion vitreum*
Longear sunfish	*Lepomis megalotis*		

[a] - Occurrence reported only in recent fish data from Guntersville Lake, 1985-1994.
[b] - Occurrence reported only in early historical fish data from Guntersville Lake, 1949-1984

Based on cove rotenone sampling, standing stock estimates (number and biomass per hectare) for Guntersville Lake from 1985 through 1993 was 22,267 fish/ha and 371 kg/ha. These results were similar to the 1971-1984 average of 19,962 fish/ha and 297 kg/ha. Since mid-1970s, game species became typically the dominant fish group in terms of numbers followed by forage and rough (Figure 3.1.10-3). Historically, forage and rough fish contributed more to biomass; however, the contribution of game fish to the total biomass also has increased since the mid 1970s (Figure 3.1.10-4). Biomass estimates for rough fish showed the most significant annual fluctuations. Rough fish were typically larger individuals (more body weight) and were typically collected in fewer numbers than the other fish groups; therefore, slight variations in the number of individuals collected would more significantly impact total biomass. Dominant species from each fish group in recent cove rotenone sampling (1985-1993) were:

game -- bluegill, redear sunfish, warmouth, yellow bass;
rough -- freshwater drum, yellow bullhead, spotted gar, skipjack herring, and grass carp;
forage -- gizzard shad and threadfin shad.

Figure 3.1.10-3 Mean Number Of Fish Per Hectare In Guntersville Lake, Cove Rotenone Samples

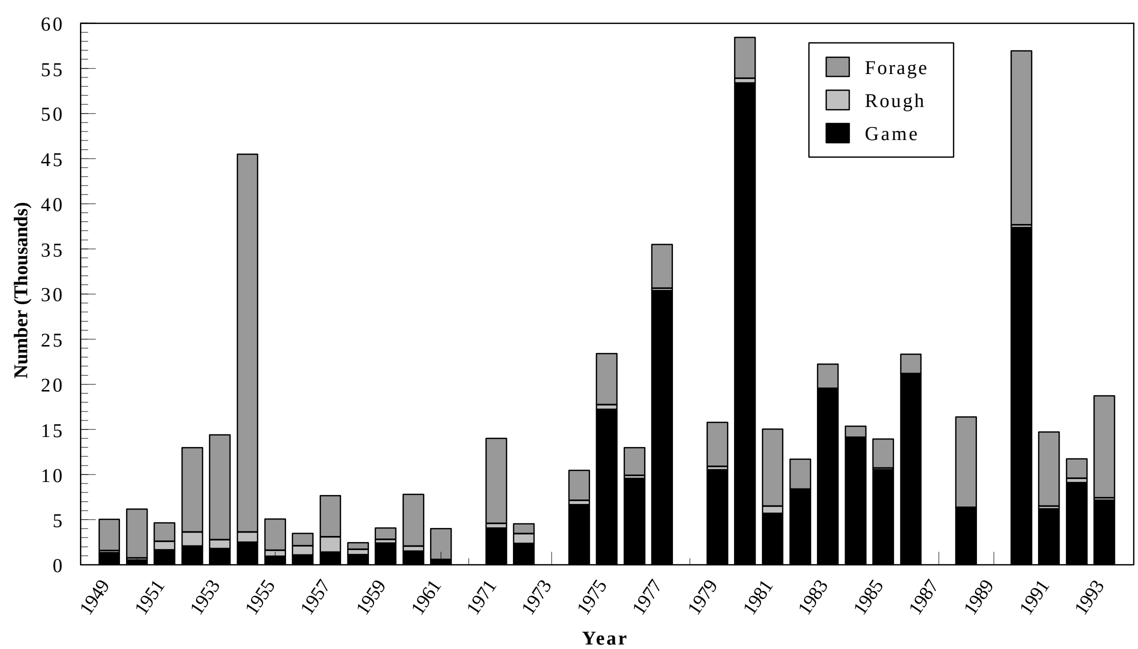
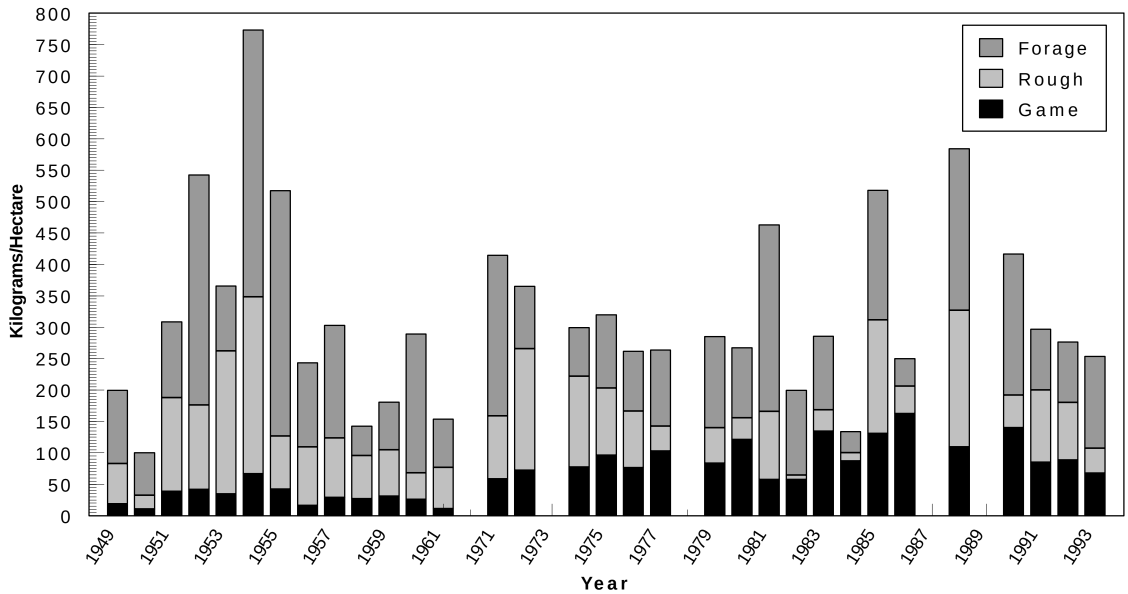


Figure 3.1.10-4 Mean Biomass In Guntersville Lake Rotenone Samples



Bluegill and redear sunfish were the most abundant game species with estimated numbers of yellow bass and yellow perch increasing in 1990 through 1993. Freshwater drum was the dominant rough species followed by yellow bullhead. Other rough species contributing significantly to either total numbers or biomass in one or more of the annual estimates but lacking consistency in all samples were:

- Smallmouth buffalo,
- Skipjack herring,
- Spotted gar,
- Common carp, and
- Grass carp.

Gizzard and threadfin shad were the dominant forage species. Gizzard shad was a dominant species in both numbers and biomass and threadfin shad (being smaller adults) were more important in terms of numbers. Although listed as game fish, lepomids are probably more significant contributors to the forage base in Guntersville than is typical in other mainstem Tennessee River lakes. In shallow highly vegetated lakes such as Guntersville, small sunfish (primarily lepomids) provide a greater percentage of the forage base for the predatory species; whereas, shad usually are the significant forage species in deeper more open water areas.[56]

Electrofishing and netting samples were collected to provide additional data on near-shore fish populations, and hydroacoustics and trawling were used in open water. Shad, lepomids, and minnows were the dominant taxa in near-shore habitats, and shad were dominant in the open water.

- **1981-1984:** field investigations - dominant species in gill net and electrofishing samples were gizzard shad, yellow bass, emerald shiner, and bluegill. [52]
- **1988:** electrofishing surveys - several species of sunfish comprised 70% of total catch. [56]
- **1990:** vital sign (lake ecological health) monitoring - threadfin shad was dominant in the open water hydroacoustic surveys and bluegill was dominant near shore in the electrofishing and gill net samples. Other dominant near shore species in 1990 were gizzard shad and emerald shiner.[58]
- **1991:** gillnets and electrofishing - gizzard shad was the dominant species comprising 23% of total number collected followed by bluegill (13%), threadfin shad (9%), spotfin shiner (7%), emerald shiner (6%), redear sunfish (5%), and largemouth bass (3%). [61]
- **1992:** **e**merald shiners comprised 80% of total catch; other important species were gizzard shad (7%), bluegill (3%), and 1% each from largemouth and spotted bass, redear sunfish, yellow bass, and channel catfish. [64]
- **1993:** electrofishing samples - dominant species were emerald shiner, gizzard shad, bluegill, and brook silverside; whereas, gill nets were dominated by skipjack herring, gizzard shad, bluegill, yellow bass, and spotted bass. [67]
- **1994:** vital signs monitoring - dominant species were gizzard shad, emerald shiner, bluegill. spotted bass, largemouth bass, and yellow bass. [68]

Guntersville Lake supports both sport and commercial fisheries. Guntersville has gained acclaim as one of the most desirable bass tournament locations in Alabama and, consequently, largemouth bass is the target species of most anglers. [56] Recent field investigations in Guntersville Lake were designed to evaluate effects of aquatic macrophytes on the fish community and determine the optimum vegetative cover for the sport fishery. Optimum aquatic macrophyte cover for bass populations in Guntersville Lake appears to be 11 to 15%. [57] Commercial species are catfish (blue, channel, and flathead), buffalo, and paddlefish. [56]

The fish community in Guntersville Lake is comparable to other mainstem lakes having high densities of aquatic macrophytes. In Guntersville Lake, shad is dominant in open water and either shad or lepomids are dominant in near-shore habitats depending on the density of aquatic macrophytes. The shift in numbers of fish/ha occurring in the mid-1970s where game fish became dominant (Figure 3.1.10-5) coincides with the onset of nonnative aquatic macrophytes in Guntersville Lake and illustrates the impact of aquatic macrophytes on the fishery community. Recent studies show lepomids more dominant in highly vegetated areas, and shad are dominant in areas lacking aquatic macrophytes. In other mainstem lakes lacking extensive aquatic macrophyte coverage, shad becomes more dominant with percent composition of lepomids decreasing. [56,57]

The most recent assessments of the fish community in Guntersville Lake are derived from shoreline electrofishing and gill netting samples and are based on the "Reservoir Fish Assemblage Index" (RFAI) from lake inflow (upstream from the plant site), transition (downstream from the project site), and forebay (farfield from the project site) zones. The RFAI is based on 12 metrics which include assessments of species richness and composition, trophic composition, reproductive composition, abundance, and fish health. Individual matrix descriptions and their significance are described in detail in the 1994 lake health assessment report. [69]

Fish community health scores were similar for the inflow, transition, and forebay zones in Guntersville Lake in 1992, but varied other years. Ratings from the inflow, transition, and forebay zones were "good," "fair," and "poor," respectively, in 1994 (Figure 3.1.10-5). The transition zone (moved downstream from the Plant site in 1992) scored lower than in other nearby mainstem lakes in 1992-94 (Figure 3.1.10-6). Reflected in the lower ("fair") transition zone scores were low numbers of sucker species, high percent of tolerant species in near-shore electrofishing samples, a high dominance by a single species, and a high percentage of omnivores in near-shore electrofishing samples.

Figure 3.1.10-5 Lake Fish Health Scores Comparing Inflow (TRM 420-24), Transition (TRM 372.5), and Forebay (TRM 350) Communities

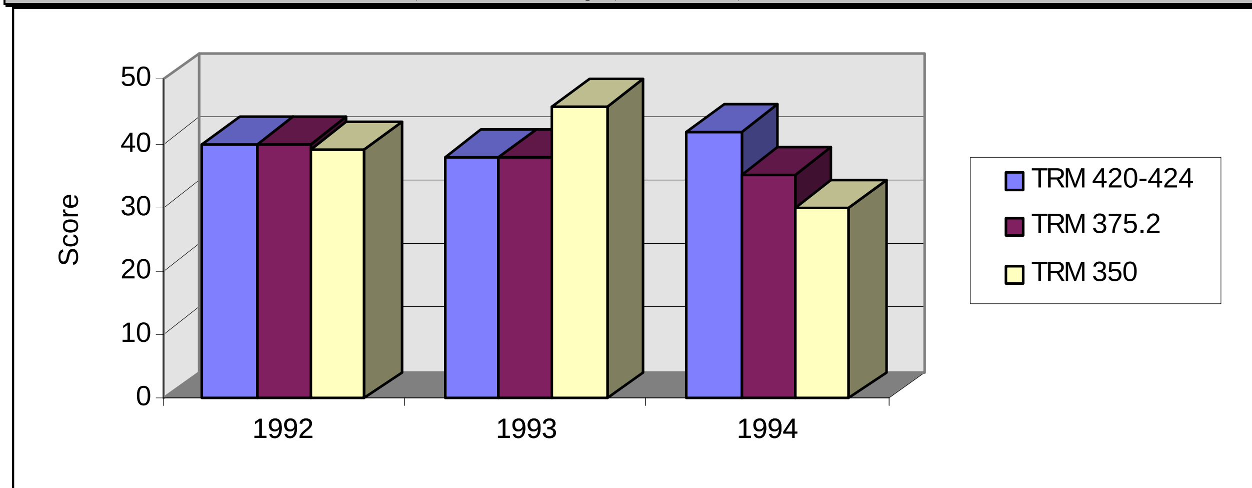
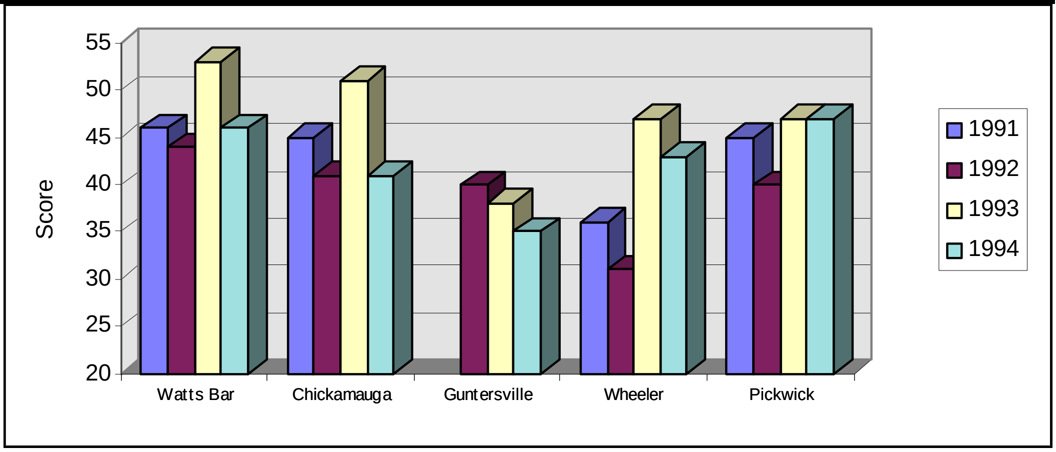


Figure 3.1.10-6 Ecological Health Scores Comparing Transition Zone Fish Communities for Guntersville and Other Tennessee River Mainstem Lakes



The overall ecological health of Guntersville was rated "good" in the 1994 vital signs monitoring; however, fish indices rated "fair" ("poor" in the forebay zone due to low abundance, no sucker species collected, and high anomalies).[69]

Two species of special interest to activities near the project site are paddlefish and sauger. Larval fish collections (1974-1983) documented the area between Nickajack Dam and Bellefonte as a nursery location for both species.[52] Adult paddlefish were infrequently collected in Guntersville field investigations prior to 1985 and have not been collected by TVA since 1985. Sauger is a migratory cool water species that often spawns in the more riverine areas below dams. Theoretically, sauger would be the most likely species affected by elevated discharge temperatures and has been the focus of studies at Browns Ferry (Wheeler Lake), Sequoyah (Chickamauga Lake), and Watts Bar (Chickamauga Lake) Nuclear Plants. Field investigations have shown that plant operations had no discernible effect on movement or reproduction of sauger.[73,74]

3.1.10.2 Benthic Organisms

Benthic macroinvertebrates collected from littoral (overbank) and open water (Tennessee River Channel) habitats in the vicinity of Bellefonte during the period 1974-83 consisted of 138 taxa, 113 from littoral areas and 110 from the river channel.[52] The two habitat types had 86 taxa in common.

1974 - 1979 The macroinvertebrate community in the channel was dominated by the asiatic clam, *Corbicula fluminea*, and aquatic worms (*Oligochaeta*)

1982 A major shift in dominance was evident where the burrowing mayfly, *Hexagenia sp*., became the most numerous organism at all three stations (TRM 396.8, upstream from Bellefonte, and TRMs 391.2 and 388.0, adjacent to and downstream from the site, respectively).

1978 - 1983 The trend observed in the channel was reversed on the overbank habitats during the period

1978-1983 *Corbicula* increased in dominance and *Hexagenia* decreased.

Over the study period a general increase in macroinvertebrate taxa and abundance occurred. Macroinvertebrate abundance in the channel generally increased from upstream to downstream. Lists of taxa and population levels over the period 1974-83 are presented in the Bellefonte preoperational report. [52] The macroinvertebrate community composition near Bellefonte was similar to that further downstream in the vicinity of the Murphy Hill site (TRM 368.5-371.5), as 87% of the taxa identified were common to both sites.

More recent assessments of Guntersville Lake benthic macroinvertebrate communities have been made for the period 1990-95 (1995 data are not yet available for this community description). These data were collected annually, late winter/early spring, as part of TVA's Valley-wide ecological health assessment and represent 10 evenly spaced samples transecting each lake at each location (inflow, transition, forebay). [67] Eight metrics were used for the macroinvertebrate community assessment to score and rank (1 = "poor", 3 = "fair", 5 = "good") each station based on community health. The station representing the lake transition zone (TRM 375.2) is approximately 16 river miles downstream from Bellefonte. TRM 396.8, sampled in 1990 and 1991, then moved to TRM 375.2, indicated channel macroinvertebrate densities near Bellefonte at a level similar to the early years (1974-79) of preoperational monitoring at Bellefonte. [52,69]

Macroinvertebrate community health scores for the three lake zones were similar in 1992; however, the transition zone scores were higher (rated "excellent") than inflow and forebay scores (rated "good") during 1993 and 1994 (Figure 3.1.10-7). Guntersville transition zone scores in 1992 and 1993 exceeded transition zone scores in Chickamauga Lake and were appreciably better than transition zone scores in other lakes upstream and downstream (Watts Bar, Wheeler, Pickwick), although all scores in the named lakes exhibited a "good"-to-"excellent" health rating (Figure 3.1.10-8). Higher transition zone macroinvertebrate health ratings for Guntersville Lake (and also annual variations in population numbers) likely are in part a reflection of the extensive colonization of littoral habitats by aquatic macrophytes. Macroinvertebrate taxa and abundance for each station and year are in Appendix I. Appendix I also lists results of the health evaluation with a description of each metric in the footnote. In 1994, sediment quality was rated good at the transition zone based on assessment of toxicity and chemical contaminant levels. The forebay rated slightly lower due to contaminant levels of arsenic and zinc.[69] Bioavailability is not addressed in the chemical contaminant data.

Figure 3.1.10-7 Lake Benthic Macroinvertebrate Health Scores Comparing Inflow (TRM 420), Transition (TRM 375.2), and Forebay (TRM 350) Communities

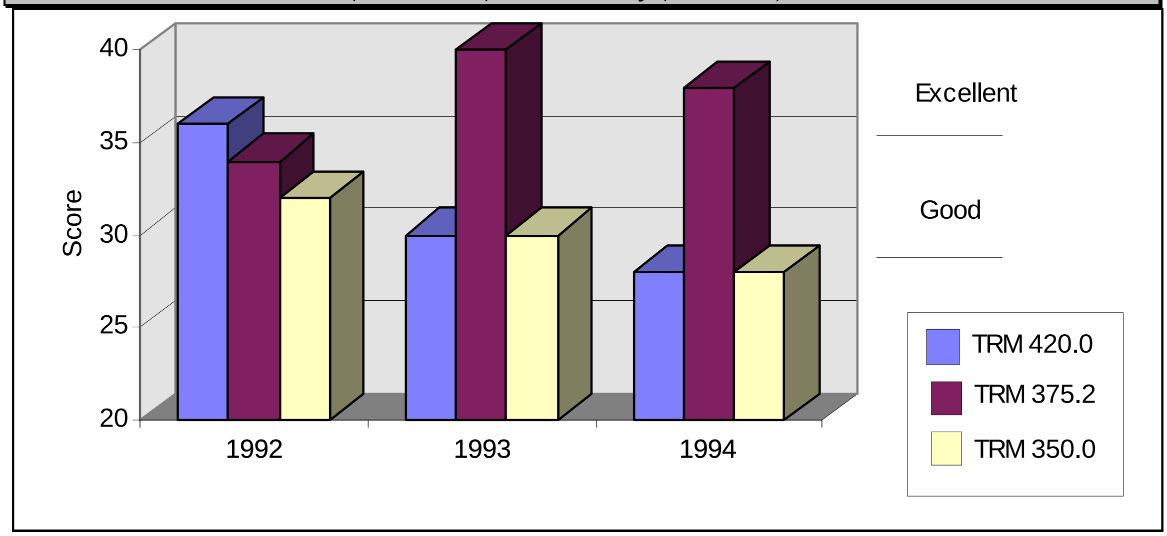
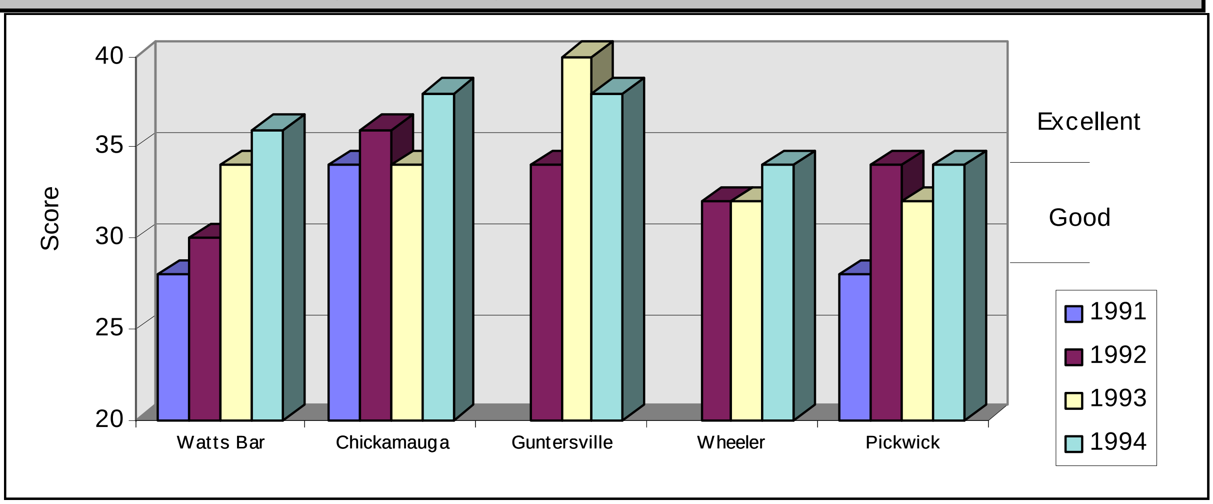


Figure 3.1.10-8 Ecological Health Scores Comparing Transition Zone Benthic Macroinvertebrate Communities for Guntersville and Other Tennessee River Mainstem Lakes



The most permanent (long lived) members of the benthic macroinvertebrate community are the freshwater mussels (Unionidae). These organisms, which require a fish host to complete their life cycle, were at one time a dominant and diverse part of the benthic community of the Tennessee River; however, major declines in numbers and diversity of these organisms have occurred during the past 30 years.[75,76] These organisms have been collected infrequently from Ponar/Peterson grab samples during past (1974-83) and recent monitoring (Appendix I).[52] Because of the ecological and commercial value of these organisms and because there is some potential for the occurrence of endangered and threatened species near Bellefonte, a more intensive investigation was made in August 1995. Fourteen 50 m transects were surveyed from near shore out into the river channel. Divers collected all mussels encountered within approximately one-half meter along either side of the transect line, so that the area surveyed along each transect represented approximately 50 m^2. These mussels were identified and counted before being returned to the river. A total of 238 mussels, representing 14 species, was encountered during the survey (Appendix I). The greatest abundance for a single transect (eight species, 65 mussels, approximately 1.3/m^2) was at TRM 391.1, just downstream from the Bellefonte underwater diffuser. The three most abundant mussels, *Megalonaias nervosa*, *Potamilus alatus*, and *Pleurobema cordatum*, made up 84% of the total. While some mussel species found along Bellefonte are harvested by the commercial mussel industry (e.g., *Megalonaias nervosa*), the low average density found here (approximately 0.3/m^2) indicates this area does not support a valuable commercial mussel resource.

3.1.10.3 Aquatic Endangered and Threatened Species

As indicated in Section 3.1.10.1, the reach of the Tennessee River which would become Guntersville Lake was inhabited by a wide variety of fish, freshwater mussels, and other aquatic species before the dam was built. Several of those species are now extinct and others have been listed or suggested for protection as federal endangered or threatened wildlife because each has declined over most of its historic range. In general, the species which declined the most when the river was impounded were those, like many freshwater mussels, which were adapted to life in a flowing-water habitat.

In recent years, no aquatic species on the federal or State of Alabama lists of endangered or threatened wildlife have been found in the Tennessee River near Bellefonte. Results of recent fish community assessments and the 1995 TVA mussel survey in this part of Guntersville Lake (presented in Section 3.1.10.1) do not include any records of listed or candidate endangered or threatened species. This part of the lake is unsuitable for many flowing-water species.

The upstream end of Guntersville Lake, from approximately Long Island upstream to Nickajack Dam (TRM 415 to 429, 15 to 30 river miles upstream from Bellefonte), is known to support populations of five listed or suggested endangered or threatened aquatic species. Species included on the federal lists of endangered and threatened wildlife are protected under the Endangered Species Act but species suggested for possible listing are included here only for information purposes. Pertinent information on each of these species is presented in the following paragraphs.

The snail darter, *Percina tanasi*, is now listed as a federal threatened species. Results of 1981 survey work by the U. S. Fish and Wildlife Service and TVA indicate that snail darters occur in the lower Sequatchie River and, to a lesser degree, in the main stem Tennessee River near the mouth of the Sequatchie. All known snail darter populations occur only in streams with direct access to the main stem Tennessee River. Juvenile snail darters are thought to use habitats in the river during their first year of life, then move to gravel habitats in the smaller stream to spawn. In upper Guntersville Lake, adult and juvenile snail darters could occur on clean-swept gravel substrates from Nickajack Dam downstream as far as Long Island.

The pink mucket, *Lampsilis abrupta*, (a federal endangered species) is the only protected or suggested candidate freshwater mussel recently found alive in upper Guntersville Lake. Two live pink muckets were found in a 1981 survey at the upper end of Long Island (TRM 417) and empty pink mucket shells of unknown age were found during a 1991 survey at TRM 418. These records indicate this endangered mussel persists in suitable clean-swept gravel substrates in upper Guntersville Lake but only as an extremely uncommon member of the sparse mussel community. No live or dead shells of the pink mucket were found during the 1995 mussel survey adjacent to Bellefonte.

Anthony’s riversnail, *Athearnia anthonyi,* is a federal endangered species which has recently been found in the Tennessee River. This species, previously thought to survive only in the lower Sequatchie River and in Limestone Creek (in Limestone County, Alabama), is now known to exist in the western channel of the Tennessee River around Long Island (TRM 412-417). Where it occurs in the Tennessee River, this snail appears to live on large cobbles and boulders along the edge of the channel. No specimens of Anthony’s riversnail were found during the 1995 mussel survey adjacent to Bellefonte in spite of diver awareness that it was present approximately 15 miles upstream.

The paddlefish, *Polyodon spathula*, has been suggested for possible endangered or threatened species protection. Paddlefish have been sought by commercial fishermen in upper Guntersville Lake during the past several decades. The structure of this paddlefish population has not been studied by natural resource biologists; however, it probably fluctuates with the intensity of the commercial harvest. Paddlefish roam open water areas throughout the lakes as they feed and congregate in shallow areas with clean-swept gravel substrates during the spawning season.

The vericose rocksnail, *Lithasia verrucosa*, has been suggested for possible federal endangered or threatened species protection. This snail has been found in several larger-stream areas throughout much of the Tennessee River basin, including one site in upstream Guntersville Lake (TRM 422). Where they occur, these snails live on large rocks in or adjacent to strong current. No vericose rocksnails were found during the 1995 mussel survey adjacent to Bellefonte.

3.1.10.4 Introduced Species

Several organisms which are not native to the TVA system (introduced species) occur near the site and have varying potentials for affecting the aquatic ecology of the area and also operation of the facility. These include Asiatic clams (*Corbicula fluninea*), zebra mussels (*Dreissena polymorpha*), several species of aquatic macrophytes and one species of fish (*Ctenopharyngodon idella*, grass carp) which was introduced into Guntersville Lake for the purpose of controlling non-native aquatic macrophytes.

<u>Asiatic Clams and Zebra Mussels</u>

Asiatic clams (*Corbicula fluminea*) were first discovered in the Tennessee River from Kentucky Lake downstream from Pickwick Dam in October 1959. [77] Although the method of introduction into the Tennessee River is not known, a likely possibility is the indiscriminate dumping of aquaria and fish bowls that contained introduced "aquaria rarities." [77] Since 1959, Asiatic clams have spread and become abundant throughout the Tennessee Valley. Asiatic clams were abundant near the Bellefonte site during the Bellefonte preoperational monitoring period (1974-83), with maximum densities exceeding 400/m^2 in the river channel (TRM 388.0, August 1978) and 600/m^2 on the overbank (TRM 386.4, March 1982). During recent (ecological health) monitoring, Asiatic clam average station densities have ranged from 93-967/m^2 (inflow), 328-355/m^2 (transition zone), and 127-195/m^2 (forebay). These organisms have caused and continue to cause problems in power plant raw water systems that entrain river water during operation. Various molluscicides (i.e., chlorine and chlorine/bromine compounds) have been used to control clogging of plant water systems by these organisms. [77] More recently, several non-oxidizing biocides have been used to control not only Asiatic clams, but also the zebra mussel, a newcomer to the TVA system.

The zebra mussel is a native freshwater bivalve mollusk of eastern Europe and western Asia. It was accidentally introduced into North America around 1986. By the time it was first discovered in Lake Erie (Great Lakes) in 1988, it had established “massive infestations” with hundreds to thousands of zebra mussels per m^2 attached to almost every suitable (hard) substrate. Zebra mussels spread rapidly to all five Great Lakes and a dozen major river systems in the eastern United States. Zebra mussels cause extensive biofouling due to their ability to tenaciously attach to a wide variety of firm substrates. Their veliger larvae are planktonic and can be drawn into raw water piping systems of power plants and other facilities. Large accumulations can occur where the veligers settle and attach, causing partial or total blockage.

The first zebra mussel discovered in the Tennessee River was from Kentucky Lake in September 1991. Since then, an established colony (about $10/m^2$) has been discovered in 1994 near Johnsonville Fossil Plant in Kentucky Lake, and veligers have been observed as far upstream as the Watts Bar Nuclear Plant (in 1995, below Watts Bar Dam). Biweekly zebra mussel monitoring in the Tennessee River near the Bellefonte Plant intake has been carried out during the zebra mussel spawning season since 1993. Sampling was increased to a weekly frequency in August 1995 after established colonies of adults were discovered upstream in the Nickajack and Watts Bar Dam tailwaters. Veligers were first detected at the project in qualitative samples collected during the third week in August 1995. Quantitative sampling in the river and the project intake was initiated the following week. In 1995, the maximum number of veligers was $64/m^3$ in the sample collected from the intake channel on October 3. No adults have yet been observed in the vicinity of the project, so the veligers observed are assumed to have originated upstream. The number of veligers now being observed at the project represent levels commonly associated with small but established populations of adult zebra mussels. The pattern observed in other large commercially navigable rivers, such as the Ohio, Illinois and upper Mississippi, has been that explosive growth of zebra mussel populations follows the establishment of spawning populations within one or two years. If that pattern holds for the Tennessee River, unless controls are in place adult zebra mussels would be causing problems in the project cooling and auxiliary water systems by the summer of 1997. Zebra mussels also have the potential for altering the benthic macroinvertebrate community structure, especially where the bottom is composed of a hard substrate (i.e., the Tennessee River channel adjacent to the project site). Heavy zebra mussel colonization also has some indirect potential for altering the fish community (impacts to fish-food organisms and spawning habitat).

Aquatic Macrophytes

The greatest abundance of aquatic macrophytes in the TVA system is on Guntersville Lake. Over the past decade, coverage of aquatic macrophytes has varied from about 20,000 acres in 1988 (about 29% of water surface area) to about 5,000 acres in 1991. The peak coverage in 1988 occurred at the end of a record drought period (1984-1988) in the Tennessee Valley. [78] Although several native submersed species such as southern naiad, coontail, American pondweed, small pondweed, and muskgrass colonize portions of the lake, the most abundant plants are the introduced or non-native species.

The most widespread and abundant submersed macrophyte is Eurasian watermilfoil (*Myriophyllum spicatum*). This non-native species was introduced into the TVA system in the 1950s, and established colonies were observed on Guntersville Lake in 1963. [79,80] By the late 1960s there were several thousand acres of Eurasian watermilfoil growing in embayments and overbank areas of Guntersville Lake. Coverage of Eurasian watermilfoil on Guntersville Lake over the past decade has ranged from about 3,000 acres in 1991 to about 15,000 acres in 1988. Abundance and coverage of Eurasian watermilfoil and other submersed macrophytes can be expected to fluctuate in response to such factors as flow and water clarity and be most abundant in years with low flows and clear water that are commonly associated with drought conditions.

Eurasian watermilfoil typically grows at water depths of a few inches up to about 10 feet and can form dense colonies that can interfere with small craft navigation, recreational activities, provide habitat for mosquitoes, and can clog water intakes. Eurasian watermilfoil is abundant in shallow embayments near Bellefonte and along the overbank adjacent to the river channel. However, because of the riverine nature of Guntersville Lake in the vicinity of the site, overbank habitat is not as extensive as it is in portions of the lake farther downstream. Extensive colonization of Town Creek Embayment by aquatic macrophytes has little potential for clogging the facility intake structure; however, they have some potential for increasing nuisance vector species (mosquitoes) at the facility.

Spinyleaf naiad (*Najas minor*) and hydrilla (*Hydrilla verticillata*) are two other introduced species of submersed aquatic macrophytes that have established on Guntersville Lake. Like Eurasian watermilfoil, these two species also can colonize shallow water habitats and have the potential to cause similar problems. Spinyleaf naiad was introduced into the TVA system in the 1940s. During the mid to late 1980s, spinyleaf naiad colonized as much as 1,500 to 2,000 acres. These levels have declined to a few hundred acres in the 1990s. Hydrilla has the potential to be an even more problematic plant than Eurasian watermilfoil because of its ability to colonize in deeper water and because it forms a continuous plant mass through the water column. Hydrilla, which was first discovered on Guntersville Lake in 1982, increased to about 3,000 acres in 1988. Although scattered plants of hydrilla are currently present throughout the mid-portion of the lake, visible colonies are less than 10 acres.

The establishment and rapid spread of hydrilla were the primary reasons for the stocking of 100,000 sterile grass carp in Guntersville Lake in 1990. The dramatic decline in hydrilla and spinlyleaf naiad and suppression of these species can be partially attributed to feeding by the grass carp. [81] Like Eurasian watermilfoil, abundance of these species can be expected to fluctuate with lake conditions (e.g., flow and water clarity) and also can be expected to increase as populations of the grass carp decline and feeding pressure becomes less.

Because submersed aquatic macrophytes are so widespread in Guntersville Lake, it is not practical nor is it desirable to attempt to eradicate them from the lake. [78] Rather, as has been the case since the 1970s, aquatic macrophytes should be managed by controlling excessive populations in areas where they conflict with lake use, while allowing them to grow in areas that provide food and habitat for fish, waterfowl, and other aquatic organisms.

<u>Grass Carp</u>

The grass carp, also commonly known as the white amur, is a herbivorous fish native to eastern Asia. They were introduced into the United States in the 1960's and have been used extensively for aquatic plant control in ponds, lakes, and small lakes. After reaching a length of a little more than an inch, grass carp feed solely on vegetation and only incidentally ingest animal matter. [82] Based on fish collections from ponds in the Tennessee Valley, grass carp are not known to exceed 60 pounds. [83] Although grass carp are reported to live 20 years or more in their native range, their life span here has been estimated to be 10-15 years. [82,83,84,85,86] Reproduction of grass carp can be essentially precluded by the use of triploid (sterile) fish available from commercial producers, although both triploid and diploid (fertile) fish have been introduced into Guntersville Lake.

In 1988 and 1989, a mixture of about 18,000 triploid and diploid grass carp, primarily juveniles, were released into Guntersville Lake by Save Our Lakes (SOL), a private organization concerned with controlling aquatic vegetation. TVA released an estimated 1,700 adult diploid female grass carp in 1988 at the termination of a multi-year grass carp study in Town Creek Embayment (at Bellefonte). [83] In addition, TVA released about 100 triploid grass carp in conjunction with radio tracking studies in 1987 and 1988.[83] In 1990, an additional 100,000 triploid grass carp were released into Guntersville Lake (seven fish/vegetated acre based on 1989 levels of vegetative cover) to control hydrilla and other aquatic macrophytes. Introductions by TVA and SOL were made after consultation with the Alabama Department of Conservation and Natural Resources. The grass carp population in 1990 was estimated to be between 15,000 and 16,000 fish. [83]

Although as many as 120,000 grass carp were stocked in Guntersville Lake from 1988 to 1990, attrition rates (25% the first year and 5% subsequent years), limited spawning conditions, and predation of juveniles by largemouth bass likely would preclude this fish from becoming a dominant part of the lake fisheries community. This conclusion and a description of impacts to the lake expected to result from stocking grass carp are presented in TVA’s Final Environmental Assessment for managing aquatic macrophytes in Guntersville Lake. [83] Fish sampling (larval and other) conducted during the 1990s has not found any evidence of grass carp reproduction in Guntersville Lake. Therefore, without reproduction, the influence of grass carp on the existing environment should decline with time.

3.1.11 Wetlands

Wetlands occur along the 12.5 miles of shoreline fronting the Bellefonte tract. Figure 3.1.5-1 illustrates the wetlands located near the plant site. Included are 22 acres of islands along the old river channel, classified as Palustrine, bottomland hardwood, deciduous, temporarily flooded according to the Cowardin classification system. [87] These islands are separated from the mainland by aquatic bed wetlands, which are classified as Lacustrine, aquatic bed, rooted vascular submerged permanently flooded. [88] Fringe wetlands are characterized by the presence of emergent and scrub-shrub plant communities and forested shoreline. These are shallow overbank areas adjacent to the old river channel, lying within the lake fluctuation zone and extending upgradient on the shoreline to elevation 597 ft above msl. Aquatic bed wetlands are found between 590 and 595.44 feet msl. The fringe wetlands include such plant species as:

Common cattail (*Typha latiflolia*),
Giant cutgrass (*Zizaniopsis miliacae*),
Bulrush (*Scirpus americanus*),
Soft rush (*Juncus effussus*),
Button bush (*Cephalanthus occidentalis*),
Black willow (*Salix nigra*),
River birch (*Betula nigra*),
Sycamore (*Platunus occidentalis*),
Willow oak (*Quercus phellos*),
Water oak (*Quercus nigra*), and
Red maple (*Acer rubra*).

Aquatic bed wetlands are formed by floating mats of Eurasian milfoil (*Myriophyllum heterophyllum*), American pondweed (*Potamogeten pectinatus*), and spiny-leafed naid (*Najas minor*).

The higher forested portion of the fringe wetlands is considered to be wetlands under the Hydrogeomorphic classification system developed by Brinson but not under the 1987 U. S. Army Corps of Engineers Wetlands Delineation Manual. [88] TVA fulfills its mandate to protect wetlands as directed by Executive Order 11990 by utilizing the Cowardin, Brinson, and the Corps classification systems. [89] Mitigation for wetlands unavoidably impacted is required under Section 404 of the Clean Water Act only for lands qualifying as wetlands according to the U. S. Army Corps of Engineers 1987 Manual. This would include the aquatic beds, islands, and emergent-scrub/shrub area.

Three ponds were constructed at Bellefonte during previous construction activities in which wetland communities have developed. The dikes of two ponds were breached in 1989, and six acres of Palustine, emergent, persistent, intermittently flooded wetlands have developed. The third pond, (12 acres), used to filter storm water runoff, is classified as Palustrine, scrub-shrub, permanently-flooded wetland.

3.1.12 Socioeconomic Conditions

The purpose of this section is to summarize the existing social and economic conditions in the vicinity of the proposed project. Actual descriptions will be in the three following sections.

3.1.12.1 Demography

The Bellefonte plant is located in Jackson County, Alabama, near the Tennessee River northeast of Scottsboro. Jackson County's population is estimated to be 49,551 as of 1994. This is an increase of 3.7% since 1990. The county's population is relatively evenly distributed, with the largest concentration, almost 14,000 persons, in the city of Scottsboro, about seven miles from the plant site. Table 3.1.12-1 illustrates the population of Jackson County relative to the State of Alabama and the United States.

Table 3.1.12-1 Population

	1970	1980	1990	1994
Jackson County	39,202	51,407	47,796	49,551
Labor Market Area	634,787	724,013	770,459	810,586
Alabama	3,444,354	3,890,061	4,040,389	4,218,792
United States (000's)	203,302	226,542	248,718	260,350

Source: U. S. Department of Commerce, Bureau of the Census

The population of Jackson County is largely white. Other races comprise approximately 6% of the total population, with about 4% of the population being black and 2% Native American. This distribution is very different from either the state or the nation. The county has a considerably higher share of white population and a correspondingly low share of black population. It also has a higher share of Native Americans, although the actual number is still a small share of the total. Table 3.1.12-2 shows the ethnic distribution of Jackson County as compared to the state of Alabama and the United States.

Table 3.1.12-2 Population by Race (%), 1990

	Jackson County	Alabama	United States
White	93.5	73.6	80.3
Black	4.1	25.3	12.1
Native American	2.1	0.4	0.8
Asian or Pacific Islander	0.2	0.5	2.9
Other	0.0	0.1	3.9

Source: U. S. Department of Commerce, Bureau of the Census

3.1.12.2 Economic Conditions

In 1990, according to the U. S. Department of Commerce, Bureau of the Census, about 21,000 Jackson County residents had jobs. Of these, about 71%, or almost 15,000, worked in Jackson County. A majority of the remaining 5,600 workers commuted to Dekalb County, to the south; Madison County (Huntsville), or Hamilton County, Tennessee (Chattanooga). Travel time to work averaged 23 minutes, slightly longer than the state average of almost 21 minutes. About 40% of these workers had jobs in the manufacturing sector, about 20% in the various service industries, and almost 14% in the retail trade sector. The manufacturing share was much higher than the state (23%) or the nation (18%), while the services and retail trade shares were lower.

As reported by the Alabama Department of Industrial Relations, unemployment rates in Jackson County generally have been higher than in the state or the nation. In 1994, unemployment in the county was 9.1%, while the rate in the state was 6.0% and in the nation 6.1%. These elevated rates in the county have been significantly higher for the past 15 years.

The resident work force represents, by percent, more blue-collar workers as compared to the state or the nation. Over 35% were employed as operators, fabricators, and laborers. Statewide, about 21% were in these occupations, and nationally, about 15%. A slightly larger share of the county's workforce was in the higher-paying blue-collar occupations such as precision production, craft, and repair, although the service occupations accounted for a smaller share. Conversely, the county has a smaller share of white-collar workers, including managers and professionals. Table 3.1.12-3 represents the occupational breakdown of Jackson County residents as compared to residents of the state of Alabama and the United States.

Table 3.1.12-3 Employment of Residents by Occupation (%), 1990

	Jackson County	Alabama	United States
Managerial, Professional	15.5	22.7	26.4
Technical, Sales, Administrative	22.7	29.4	31.7
Service	7.4	11.9	13.2
Farming	3.2	2.3	2.5
Precision Prod.,Craft, Repair	15.9	13	11.3
Operators, fabricators, laborers	35.3	20.7	14.9

Source: U. S. Department of Commerce, Bureau of the Census

This occupational distribution is reflected in the income and poverty statistics for the county. In 1993, average per capita income in Jackson County was $16,175, some 94.4% of the average state per capita of $17,129 and 77.8% of the average national per capita of $20,800. In 1989, some 12.6% of families in Jackson County had income below the poverty level. This rate was lower than the state of Alabama at 14.3%, but still higher than the national rate of 10.0%.

The largest share of jobs in Jackson County are in manufacturing, which accounted for nearly 32% of the county's 23,349 jobs (self-employed and wage and salary) in 1993. Other large employment sectors include government, primarily state and local, which accounted for almost 17%; and services and retail trade, both of which accounted for almost 16%. This is a high percentage in manufacturing and a low percentage in the service sector, compared to the state or the nation; however, this is not an atypical situation for a rural county since services tend to concentrate in urban areas. Table 3.1.12-4 illustrates the distribution of jobs in Jackson County as compared to the distribution of jobs in Alabama and the United States.

Table 3.1.12-4 Distribution of Jobs

	Jackson County	Labor Market Area	Alabama	United States
Agriculture	7.5	2.8	3.7	3.3
Manufacturing	31.7	21.2	18.5	13.3
Retail Trade	15.7	16.9	16.4	16.7
Services	15.9	25.0	23.1	29.0
Government	16.9	16.7	18.2	15.3
Other	12.3	17.4	20.1	22.4

Source: U. S. Department of Commerce, Bureau of the Census

3.1.12.3 Community Services and Housing

Jackson County had 18,020 occupied housing units in 1990, slightly more than 1% of all occupied housing units in Alabama. These units housed, on average, slightly more people than in the state or the nation, 2.39 compared to 2.32 in the state and 2.29 nationally. Relatively low vacancy rates indicate that the county does not have a significant surplus of housing. Only 1.5% of non-rental units were for sale, while 8.2% of rental units were available for rent. Both figures are lower than state and national averages. Table 3.1.12-5 depicts housing characteristics for Jackson County versus the state of Alabama and the United States.

Table 3.1.12-5 Housing Characteristics, 1990

	Jackson County	Alabama	United States
Occupied Housing Units	18,020	1,506,790	91,947,410
Homeowner	1.5	1.8	2.1
Rental	8.2	9.3	8.5
Median Persons per Occupied Unit	2.39	2.32	2.29

Source: Department of Commerce, Bureau of the Census

There are two public school systems in Jackson County, the Scottsboro City School System and the Jackson County School System. [90] During the 1995-96 school year, there were 9,188 students in attendance in grades 1 through 12 (2,863 in the Scottsboro system and 6,325 in the Jackson County system). The Scottsboro School System spent $5,120 per student in average daily attendance (ADA) for instructional services, including $3,431 in state funds, $355 in federal funds, and $1,335 in local funds. The Jackson County School System spent $4,240 per student in ADA for instructional services, including $3,076 in state funds, $500 in federal funds, and $664 in local funds. Transportation services for students are provided by both the Scottsboro and the Jackson County systems.

Fire protection in the city of Scottsboro is provided by a city fire department, which has an insurance rating of four. [90] This department has three stations, with 28 full-time personnel, plus 12 volunteers. Equipment includes one ladder truck, four engines (pumpers), one rescue truck and two brush trucks (for small fires, brush fires, etc.). It also has a special service unit, which includes such equipment as air packs, generator, and a cascade. A special response unit, mainly for hazardous materials, is being developed, but is not finished. The only other fire department in the county with any full-time personnel is the Bridgeport Fire Department, which has two full-time personnel and 28 volunteers. This department has an insurance rating of six. The remainder of the county is dependent on volunteer departments.

The county sheriff department has 38 full time personnel and 24 police cars. [90] The city of Scottsboro has 41 full-time personnel and 22 cars. Stevenson has five full-time personnel and five cars, while Bridgeport has seven full-time personnel and three cars. Some of the smaller incorporated municipalities in the county have one police officer.

Hospital care is provided by two hospitals, Jackson County Hospital at Scottsboro and North Jackson Hospital located between Stevenson and Bridgeport. [90] Both of these hospitals have emergency rooms.

Jackson County Hospital is licensed to operate 170 beds and North Jackson 60. County-wide ambulance service is operated by the management company that operates both hospitals. The ambulance services has three stations, one in Pisgah, one at North Jackson Hospital, and one at Jackson County Hospital in Scottsboro. It operates seven ambulances, with staffing of about 20 persons. There is a county-wide Emergency 911 system. Fire protection in the city of Scottsboro is provided by a city fire department, which has three stations and a ladder truck. Elsewhere in Jackson County, fire protection, where available, is provided by volunteer fire departments.

3.1.13 Transportation Resources

The existing transportation facilities in the vicinity of Bellefonte include highways, roads, and railroads for land access, access on the river through the system of locks along the Tennessee River, access by air with existing airport terminals in the vicinity, and existing pipelines.

3.1.13.1 Highways and Roads

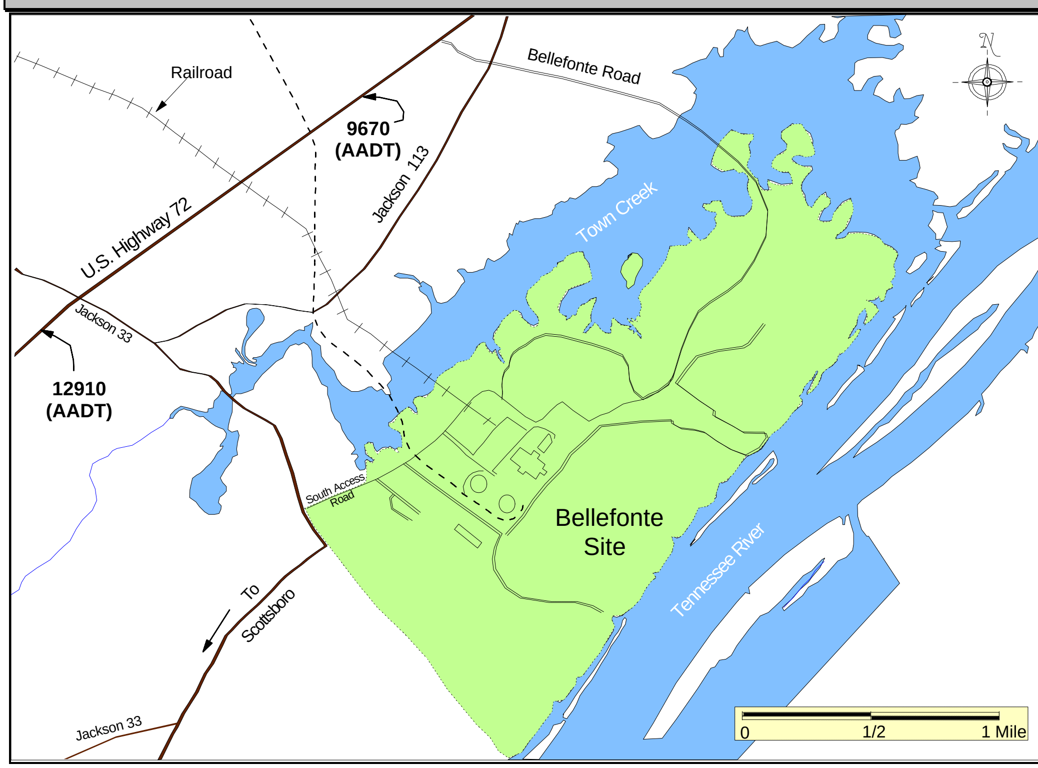
The nearest major interstate highway to Bellefonte is Interstate Highway 59 which is approximately 20 miles southeast of the site. The nearest major highway is U. S. Highway 72, which connects Chattanooga, Tennessee, and Huntsville, Alabama, and passes about two miles northwest of the Bellefonte site. In the site area, U. S. Highway 72 is a four-lane divided highway with 12 ft lanes and 10 ft shoulders. Access to the Bellefonte site is currently from the north on the two-lane Bellefonte Road which extends across the Town Creek Embayment connecting the plant to U. S. Highway 72. Bellefonte Road is well-aligned and has 11 ft lanes with 6 ft shoulders and a 45 mph speed limit. Passing is prohibited on this road. Bellefonte Road was built for the purpose of becoming the permanent access serving the proposed Bellefonte Nuclear Plant. The intersection of Bellefonte Road and U. S. Highway 72 is not signalized; however, there are turning lanes in each direction and U. S. Highway 72 has a median to stop in when making turns. There is also a south access road which extends from the site to Jackson County Road 33. The Bellefonte south access road, with 11 ft lanes, was constructed as a temporary construction road over a former county roadbed. Initial plans and agreements were to close this road after completion of the nuclear plant, but this commitment was never fulfilled.

Jackson County Road 33 extends north toward Hollywood, Alabama, and south toward Scottsboro, Alabama. Jackson County Road 33 has two lanes and a speed limit of 45 mph. The portion of the road north of Bellefonte south access road has sharp curves and varying grades contributing to a limited sight distance and no-passing lanes. Immediately southeast of the Bellefonte south access road on Jackson County Road 33, the road has a 90 degree turn and continues southwest to Scottsboro. This portion of the road is better aligned and has passing zones in places. Jackson County Road 33 North to Hollywood crosses U. S. Highway 72 at a traffic actuated signalized intersection, with dedicated turning lanes and signalized left-turn arrows in each direction. Potential industries contributing to truck traffic in the immediate vicinity of Bellefonte are a local timber harvesting operation located on Jackson County Road 33 and Baker Sand and Gravel and Delta Exports located just south of the site on the Tennessee River.

There are two places where the road crosses Town Creek in the immediate vicinity of the Bellefonte site. One place is on Jackson County Road 33 between U. S. Highway 72 and Bellefonte south access road. Another place is on Bellefonte Road between U. S. Highway 72 and the site. In both locations, the road crosses the creek over box culverts. There are no posted load limits on these structures.

The 1994 Average Annual Daily Traffic (AADT) count supplied by the Alabama Department of Transportation indicated a count of 12,910 vehicles on U. S. Highway 72 in the vicinity of the Bellefonte south access road and U. S. Highway 72 intersection. Approximately 1-1/2 miles northeast of the intersection, a count of 9,670 vehicles was recorded on U. S. Route 72. The traffic count locations are shown in Figure 3.1.13-1. A current traffic count on the country roads would indicate an AADT of less than 1,000 vehicles.

Figure 3.1.13-1 Traffic Count Locations



3.1.13.2 Railroads

The CSX Railway mainline between Chattanooga and Huntsville passes about three miles northwest of the Bellefonte site. TVA's nearby Widows Creek Fossil Plant is served from this same mainline with unit trains delivering coal. A spur line was constructed by TVA and runs from CSX Railroad southeast to the site. The track run, made up of 100 pound rail, is 2.8 miles from the CSX mainline to the Bellefonte perimeter road. In the vicinity of the CSX mainline, there is an interchange yard that was constructed to access the spur line. This interchange yard consists of a delta track and one siding. From there, the Bellefonte railway heads southeast and crosses a county road about 1/2 mile from the interchange, proceeds southeast 3/4 mile and crosses under U. S. Highway 72, proceeds south 3/4 mile and crosses Jackson County Road 113, and proceeds southeast 3/4 mile to cross Bellefonte Road into the plant (see Figure 3.1.13-1). The two county road railroad crossings are at-grade. They both have only crossbuck warning signs but no signals. This spur track has not experienced train traffic in recent years, nor has much maintenance been performed on the track. Vegetation is a problem on considerable portions of the trackage. Tie degradation varies considerably along separate portions of the track.

3.1.13.3 River Transport

Bellefonte is located along the Tennessee River between TRM 392 and 393. Nickajack Lock and Dam are located 31.7 miles upstream from the site and Guntersville Lock and Dam are located 42.3 miles downstream from the site. Traffic on the Tennessee River near Bellefonte includes both commercial and recreational vessels. Existing barge traffic in this portion of the Tennessee River navigation system is considered moderate. Two docks, which have operated in the immediate area, include Bellefonte Nuclear Plant construction dock and Baker Sand and Gravel and Delta Exports dock, located within one mile downstream of the site. The locks and channels are more than adequate in handling the barge traffic. Both Nickajack Lock and Guntersville Lock are operating below their utilization capacity. Lock chamber figures and recent 1995 river traffic figures are summarized in Table 3.1.13-1.

There are additional locks and dams located downstream of the site which could also be affected. These are Wheeler, Wilson, Pickwick, and Kentucky, which are located on the Tennessee River. Recent river traffic data is also shown on Table 3.1.13-1.

Table 3.1.13-1 Estimated River Traffic

	Tennessee River Lock					
	Kentucky	**Pickwick**	**Wilson**	**Wheeler**	**Guntersville**	**Nickajack**
Tennessee River Mile	**22.4**	**206.7**	**259.4**	**274.9**	**349.0**	**424.7**
Lock Chamber Dimensions						
Main Lock: Length (ft) Width (ft)	600 110	1000 110	600 110	600 110	600 110	600 110
Auxiliary Locks Length (ft) Width (ft)		600 110	292 60	400 60	360 60	
Recreational Vessels	650	1657	1620	2108	3895	1861
Recreational Lockages	374	1092	904	1323	1889	976
Barges	36858	19208	13251	12859	9092	5907
Tows	4041	2435	2078	1753	1174	968
Average Tow Size	9.12	7.88	6.38	7.34	7.74	6.10
Commercial Lockages	6067	2742	2655	2450	1712	1265
Governments and other Lockages	93	71	100	61	56	47
Total Lockages	6534	3005	3850	3834	3657	2288
Annual Tonnage (millions)	33.7	15.4	11.4	11.1	8	5.4
Average Commercial Lockage Time (min)	44 single 142 double	59 single 181double	51single 161 double	46 single 139 double	46 single 142 double	41 single 137 double
Average Delay Time for Tows Being Delayed (hr)	4.97	1	1.58	1.3	1.2	0.83
Annual Lock Utilization (%)	84	37	44	37	30	18
Annual Tonnage (millions)	NA	NA	NA	NA	8	5.4

3.1.13.4 Pipelines

Pipelines which run through Bellefonte include a City of Hollywood sewer line and water line. The six-inch diameter sewer line runs south through the site along the western side of the south access road past the access railroad tracks and then crosses to the eastern side of the south access road and runs past Jackson County Road 33 and ties into the City of Hollywood sewer line. The six-inch diameter water line runs from Hollywood on the northern side of Jackson County Road 33 toward the site, turns and runs along the eastern side of the south access road for a short distance, and veers off toward the plant. There are no other commodity pipelines transporting materials within a two-mile radius of the site.

3.1.14 Land Uses

3.1.14.1 Bellefonte Nuclear Plant Environs

The Bellefonte site consists of approximately 1,600 acres of land on a peninsula at TRM 392 on the west shore of Guntersville Lake about seven miles east-northeast of Scottsboro, Alabama. The site lies on the southeast side of Browns Valley which separates Sand Mountain on the southeast from the rest of the Cumberland Plateau on the northwest.

In 1975, the construction of the two proposed nuclear units began. They are currently at different stages of completion. When construction activities were deferred in 1988, Unit 1 was 90% complete and Unit 2 was about 58% complete.

The nuclear plant was designed to have the following facilities many of which have been constructed and are in lay away status:

- Two reactor containment buildings,
- Turbine building,
- Auxiliary building,
- Service building,
- Condenser circulating water pumping station,
- Two diesel generator buildings,
- River intake pumping station,
- Natural draft cooling towers (477 ft in height),
- Transformer yard,
- 500 kV and 161 kV switchyards, and
- Sewage treatment facilities.

More information about plant infrastructure and equipment maintenance activities is contained in section 2.1 “Description of the No-Action Alternative.” Section 2.1 also contains a map showing the location of various buildings and terrain features.

3.1.14.2 Past and Existing Land Uses

Jackson County consists of 1,078.8 square miles of land area, approximately 690,000 acres. The majority of land in the county is in forest or agricultural use or is vacant. The latest land use study for Jackson County was done in 1977. [90] At that time, only 4.9% of the land in the county was in residential, commercial, industrial, transportation and utility, social and cultural, or governmental use. The remaining 95.1% was in agricultural use, forestry, or otherwise undeveloped. It is obvious that development uses of all types have expanded, particularly around Scottsboro, Stevenson, and Bridgeport, which are all located adjacent to U. S. Highway 72. Nevertheless, these changes leave developed uses still occupying only a small percentage of the total land area.

Residential development is more concentrated in and around the urban centers in the county, and most of the new residential development is occurring in these areas as well. Some areas of the county, particularly in the north, are rugged and not readily accessible; residential development in these areas has been sparse.

Commercial development has historically been concentrated in the urban centers, particularly Scottsboro. More recently, it has been spreading out along the main arteries from Scottsboro and the other urban centers, resulting in the type of strip development that is common elsewhere.

Industrial development is largely concentrated along the Scottsboro-Stevenson-Bridgeport corridor. The topography of the county, along with availability of rail service, U. S. Highway 72, waterfront development potential, and the availability of existing or proposed urban services largely explain this concentration.

About 900 acres of Bellefonte have been developed with buildings and facilities, roads, parking lots or other uses related to the nuclear option. Approximately 20 acres is currently used by a local farmer for hay production. The remaining approximately 600 acres is in various stages of grassland or forest combination, with perhaps 200 to 300 acres that would be considered forest.

3.1.14.3 Land Use Planning and Controls

Jackson County has no comprehensive planning authority. However, the incorporated municipalities do have planning and zoning authority. As a consequence, land use controls, subdivision regulations, and building and housing codes exist only in the municipalities. There are countywide requirements for water supply and sewage disposal systems. These are administered under the jurisdiction of the County Health Department and the State. The county also has regulations regarding street construction in newly developed areas.

3.1.15 Aesthetics and Recreation

3.1.15.1 Visual Resources

Bellefonte is buffered from the main river channel by a wooded ridgeline which rises approximately 200 ft above the lake surface. Only distant views of the existing cooling towers are experienced by passing river traffic as a result of the ridgelines close proximity to the lake shoreline. The plant site is situated on level to gently rolling bottomland formally used for agricultural purposes. Pasture and crop land still extend southwesterly from the plant site toward Scottsboro. Scattered residential development can be seen along county roads ranging from abandoned farmhouses to new subdivisions. The terrain is generally open with occasional stands of bottomland hardwoods dotted with patches of pine and cedar.

The existing plant site is most visible to over 50 cabins, second homes, and primary residences located along the north shore of Town Creek Embayment. The embayment which bounds Bellefonte’s west side is only accessible to small boat traffic as passage is limited by a box culvert under Bellefonte’s secondary entrance road. Fishermen and pleasure boaters using other portions of Town Creek and Mud Creek to the northeast of Bellefonte have direct views into the plant site.

The town of Hollywood is located approximately 3 miles to the northwest of Bellefonte. Its location to the north of U. S. Highway 72 is screened somewhat from a view of the plant by Backbone Ridge.

Bellefonte is seen most frequently by passing motorists from various points along U. S. Highway 72. The onground plant facilities such as roads, parking, and administration-type buildings are screened for the most part by low rolling terrain in the foreground. Distant views of the 477-ft cooling towers and the reactor domes can be seen in excess of five miles away. The cooling towers along with the multiple high voltage transmission lines associated with Bellefonte are the dominant man-made visual features in the surrounding landscape.

Sand Mountain stretches in either direction from the plant site as it forms the eastern shoreline of Guntersville Lake. While it is the most dominant natural feature in the landscape, it provides background to easterly views of Bellefonte. Views of the existing plant facilities appear as focal points when one looks west off the rim of the mountain. No public viewing areas appear along the mountain's edge, but a few residences have spectacular views of the valley below. A different visual/aesthetic character of landscape can be experienced in the coves and hollows along the Sand Mountain rim. Laurel and rhododendron line the creeks that cascade over limestone creek beds on their descent to the Tennessee River. Distant glimpses of the plant site can be seen from these mountain-side vantage points. Additional views can be seen by highway travelers traversing the mountain on State Roads 35 and 40 as well as by those crossing the lake on the Comber Bridge.

The Coon Gulf Habitat Protection and Small Wild Area is located approximately four miles upstream of the plant site on the opposite bank. The Mud Creek and Crow Creek Wildlife Management Areas adjacent to and just upstream of Bellefonte also provide a visual quality protector to the scenic environment. A heron rookery can be seen by boaters at the tip of the peninsula between the Town and Mud Creek's confluence with the main lake.

In summary, Bellefonte is located in a valley setting partially screened from the passing Tennessee River and overlooked by Sand Mountain. The existing plant site and its associated transmission lines currently present the most noticeable visual/aesthetic change in character to an area generally within a five to seven mile radius.

3.1.15.2 Recreational Resources

Hunting, fishing, and pleasure boating are among the more popular recreational activities taking place within Bellefonte environment. Two launching areas with limited parking are located on the plant site. A small concrete ramp with gravel parking for about five cars and trailers was developed as a part of the original Bellefonte project. It is located on the Town Creek Embayment behind the north entrance road. The other launching site is at the southern most property corner on one of the low lying barrier islands which fronts the main lake. Parking at this site is also quite limited as a truck to barge log loading operation occupies most of the usable land base. No more than five cars and trailers can be parked at this site. No intensively developed recreational facilities exist within Bellefonte's immediate environment.

A wildlife management area encompasses most of the Mud Creek and Crow Creek embayments and associated shoreline lands. The management area extends along the main lake from Bellefonte upstream just over 15 miles. The Alabama Department of Conservation and Natural Resources operates the area for managed hunting with portions retained as a waterfowl sanctuary. The Coon Gulf Habitat Protection Area on the eastern shore of Guntersville Lake is also included in the State's hunting management. A private hunting club currently exists along the rim of Sand Mountain directly across the lake from Bellefonte. Hunting during open seasons is permitted on TVA lands outside the plant site.

Guntersville Lock had the highest number of pleasure craft lockages in 1995 of locks located downstream of Bellefonte on the Tennessee River, with 1,889 lockages involving 3,895 vessels. A number of boating facilities are located within a 15 mile radius of Bellefonte. They range in size from launching ramps and small boat docks to the relatively new Goose Pond Colony full service marina 12 miles downstream.

A variety of county and municipal parks can also be found near Bellefonte. These provide the local communities with picnicking, walking and hiking trails, ball fields, tennis courts, bank fishing and boat launching facilities, and camping. A municipal golf course is also operated at Goose Pond Colony, as is a marina by the City of Scottsboro.

3.1.16 Cultural Resources

3.1.16.1 Archaeological Resources

An initial archaeological reconnaissance of the 1,600 acres of Bellefonte was conducted in 1972.[91] This reconnaissance resulted in the verification of two sites (1JA978 and 1JA112 discovered during the preinundation archaeological survey of Guntersville Lake in 1936 and the discovery of three additional sites 1JA300-302).[92] Site 1JA978 was noted in the riverbank and contains both Archaic and Woodland components; 1JA112 is on a natural levee adjacent to the original riverbank and is primarily inundated; cultural affiliation could not be determined. Site 1JA300 covers an area of approximately 200- by 250-feet on a knoll adjacent to a small unnamed inlet. The site contains Archaic, Woodland, and Mississippian components. Site 1JA301 consists of surficial remains from the Archaic on a knoll adjacent to two limestone hills. Site 1JA302 consists of a Woodland component in the northeast edge of the peninsula near the confluence of Town Creek and the Tennessee River and is potentially eligible for inclusion in the National Register of Historic Places. None of the other sites are eligible for inclusion.

3.1.16.2 Historical Resources

Archival record search, an initial field check, and discussions with the Alabama Historical Commission deduced that the only historical site of significance within project locality was the original town site of Bellefonte. Bellefonte was incorporated in 1821 and served as the first county seat of Jackson County; it had been determined eligible for the National Register of Historic Places. At the time of the survey, two ante-bellum structures were still standing: the Daniel Martin Inn/Tavern and a one-room cabin with a more recent lean-to addition. The major street layout of Bellefonte was still discernible as were limestone foundations of two antebellum brick structures along with an associated cistern. Brick remnants of the former jail and the chimney and doorstep foundations of a cabin were also present. Since the original survey, all structures associated with the original town site of Bellefonte have been removed.

3.1.17 Noise Levels and Conditions

Because the surrounding area is rural, ambient sound levels not directly related to activities at Bellefonte result primarily from natural sources, with a small contribution from human sources such as local road and river traffic. To document sound quantity in the site area, background ambient sound levels were measured during three periods (Fall 9/12/95, Winter 2/15/96, and Summer 7/10/96). Measurements were taken in four areas (see Figure 3.1.5-1) near the site boundary. The locations were:

1. Site A - NW side of proposed coal storage yard. 100 ft SE of west access road.
2. Site B - NW of cooling towers 100 ft NW of west access road. Under power lines.
3. Site C - NE of site. In proposed slag storage area.
4. Site D - SE of site at river barge unloading site.

Ambient environmental noise levels were measured using a noise dosimeter set to the A-weighted decibel scale (dBA). The dBA scale most accurately corresponds to the human hearing response. Ambient environmental noise is usually documented by the annual average of the day-night noise level (Ldn) (measurements taken during each of the four seasons). The day-night noise level is a combination of the day noise level (Ld), measured from 7 a.m. to 10 p.m., and the night noise level (Ln), measured from 10 p.m. to 7 a.m. The day-night noise level is a weighted logarithmic average of Ld and Ln + 10 dB. Ten dB is added to Ln to emphasize the fact that most people prefer the night time to be significantly quieter than the day.

Community noise impacts are usually judged in reference to the existing background sound levels and the increase the facility noise would have on this background. While there are no federal, state, or local industrial noise statutes for the communities surrounding the Bellefonte site, a comparison can be made between the noise impacts (as a function of Ldn) and guidelines developed previously by the U. S. Department of Housing and Urban Development (HUD).[93] The HUD guidelines are divided into three general categories: "Acceptable," "Normally Unacceptable," and "Unacceptable" for residential settings. In the Acceptable category, the Ldn does not exceed 65 dB. If Ldn exceeds 65 dB, the site is normally unacceptable. Above Ldn = 75 dB, the site is unacceptable for residential areas.

The day-night average sound levels (Ldn) at locations near Bellefonte are typical of a quiet rural community. Noise level measurements taken at Bellefonte are described in Table 3.1.17-1. Sound level values in the area ranged from 41 to 51 dB. The minimum Ldn of 50 decibels (dB) occurred at Site A. The maximum measured Ldn of 55 decibels occurred at Site D. As noted above, 10 dB are added to night measurements to reflect the weighted calculation of day/night averages.

Table 3.1.17-1 Ambient Noise Levels at Bellefonte

Site	Day	Night	Day/night
	Ld	Ln	Ldn
A	49	41	50
B	49	45	52
C	49	46	53
D	51	48	55

Some of the sources are natural, such as the sounds of birds and insects. Other sources are not natural. Noise sources in the vicinity of Bellefonte include the following:

- Barge traffic,
- Road traffic,
- Dogs barking,
- Insects,
- Power boats,
- Plant equipment at Bellefonte (fans, transformers, compressors), and
- Power line hum.

3.2 Environment Affected by Natural Gas Pipeline

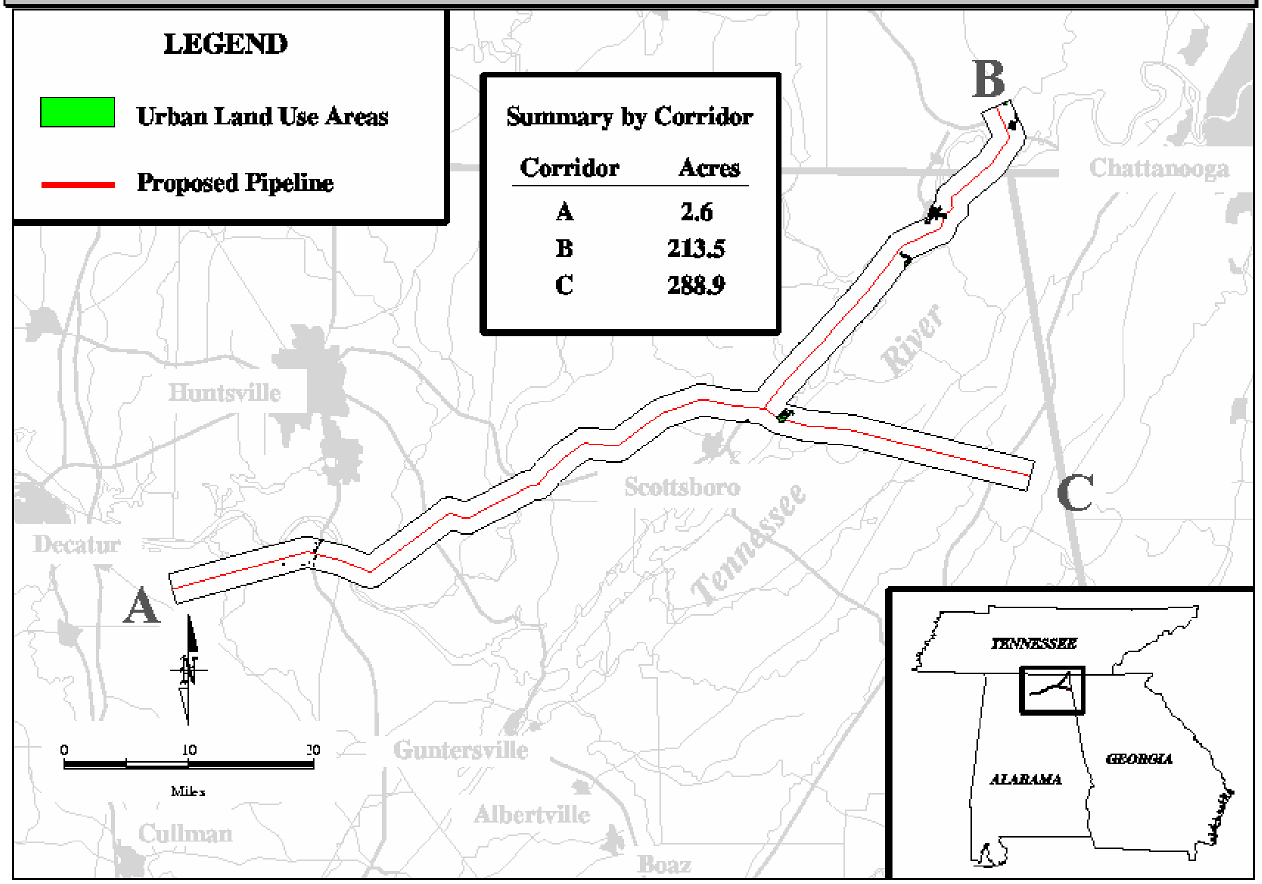
The following sections provide a general description of the land use, resources, and sensitive areas within each of the three pipeline corridors. Features and resources are quantitatively described using common metrics to provide a basis for objectively describing impacts in Chapter 4.

3.2.1 Land Use

TVA has classified land use within the TVA service region with Landsat Satellite Imagery. Urban, cultivated, and forested lands are of concern because of potential safety, socioeconomic, biological, and aesthetic impacts. Urban areas represent a small portion of the land use within the corridors. There are 2.6, 213.5 and 288.9 acres of urban land within corridors A, B, and C, respectively (Figure 3.2-1). Within urban areas, pipeline construction near homes, buildings, roadways, and utilities pose relatively higher risks from safety hazards and would require specific construction techniques and right-of-way (ROW) approvals. Provisions to prevent potential hazards associated with pipeline accidents would be required. Land use generally would be restricted above pipeline ROWs. Although farming could continue, construction of permanent structures would be prohibited and vegetation growth is controlled.

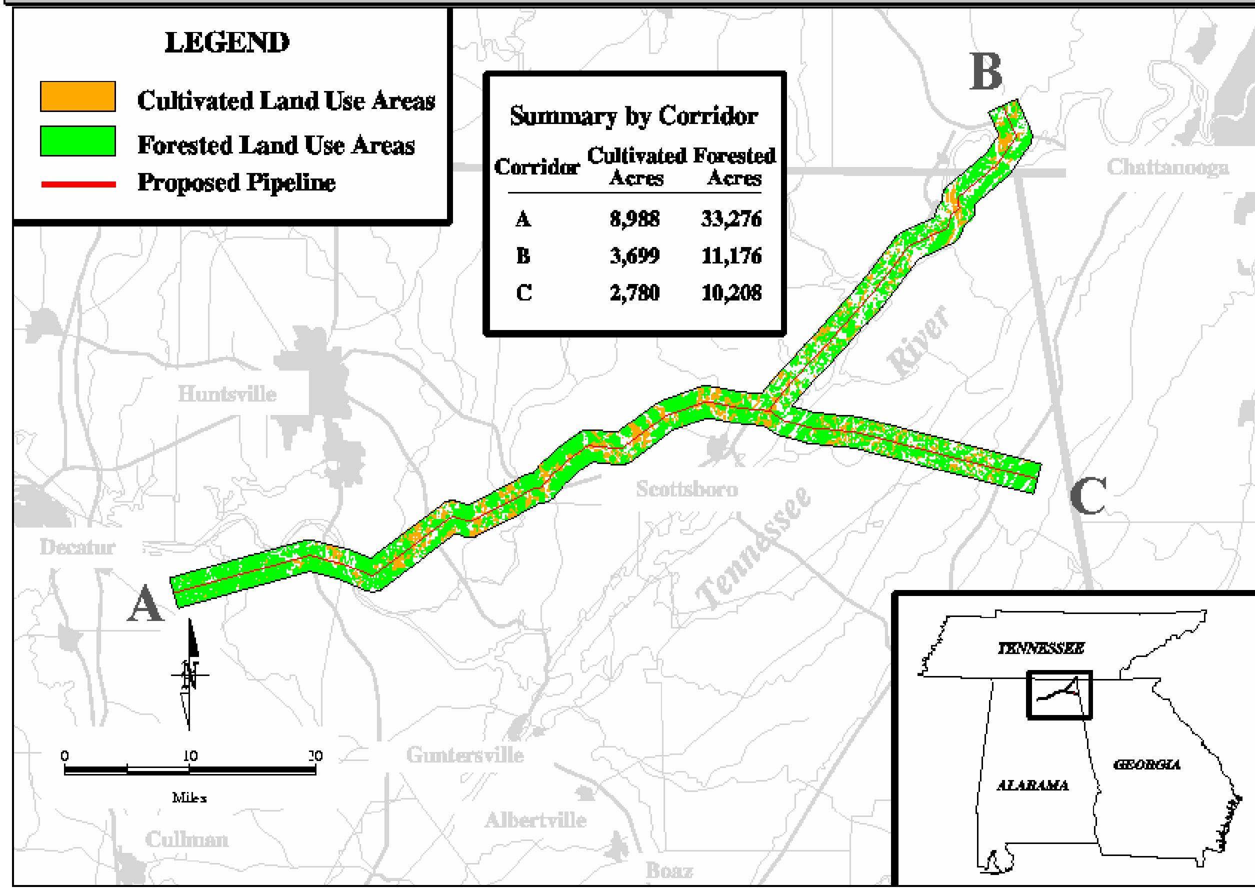
The amount of cultivated areas in each corridor is directly related to the corridor lengths. However, because the proposed pipeline (or centerline) of Corridor B follows existing ROWs for a majority of its length (discussed below), potentially affected cultivated area in Corridor B are smaller than in Corridor C.

Figure 3.2-1 Urban Land Use by Corridor



There are large tracts of undeveloped land in each of the corridors as measured by forested areas, and this is the primary land use for each corridor (Figure 3.2-2). Corridor A has the largest proportion of forested land per area. As is the case with cultivated areas, because the proposed pipeline (or centerline) of corridor B follows existing ROWs for a majority of its length, the areas potentially affected in Corridor B are likely to be smaller than in Corridor C.

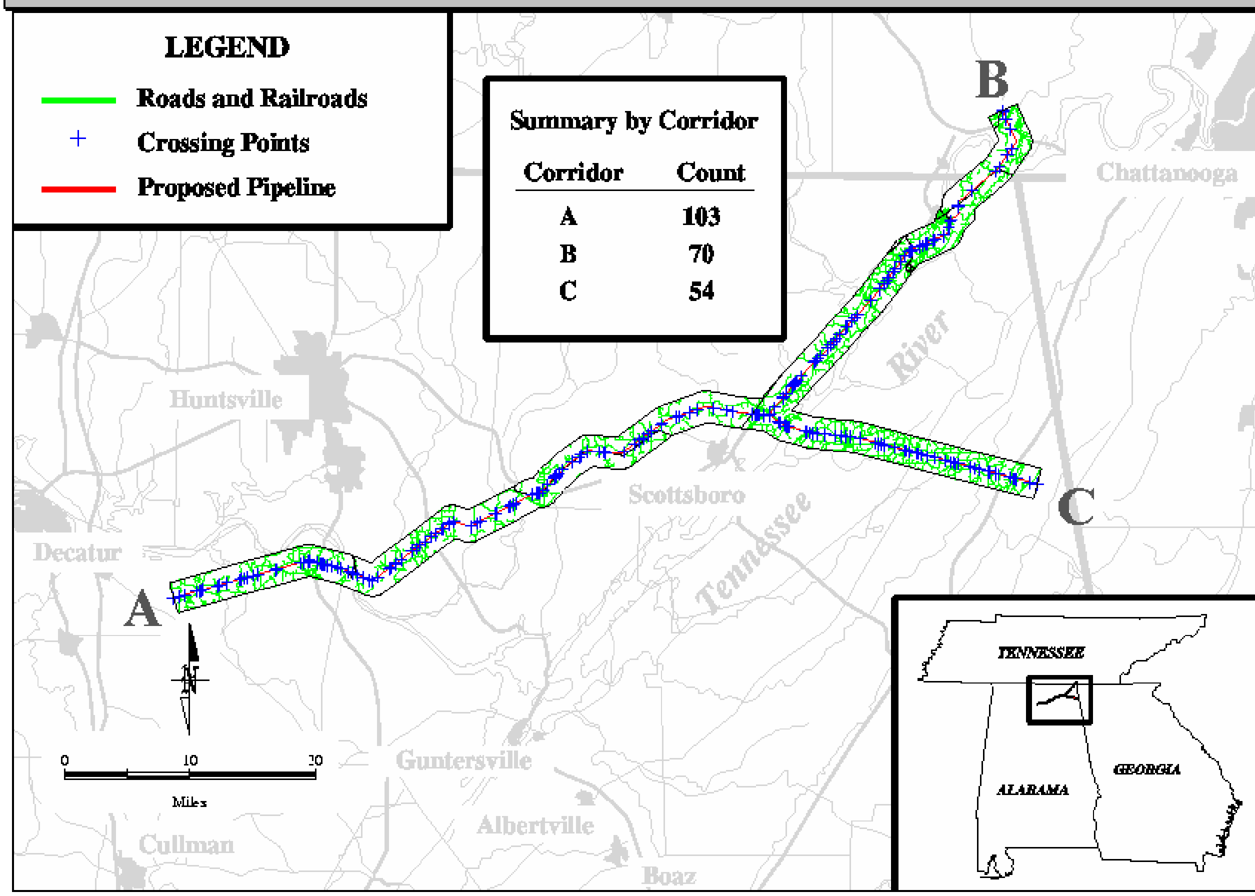
Figure 3.2-2 Cultivated and Forested Areas by Corridor



3.2.2 Roads and Railroad Crossings

Roads and railroads within the corridors are shown in Figure 3.2-3. There are 103, 70, and 54 road and railroad crossing points along the central axis of Corridors A, B, and C, respectively. As would be expected, the numbers of crossing points are approximately related to the lengths of each corridor. Paved roads and railroads would typically be crossed through techniques that bore beneath the surface and therefore are more costly. Smaller roads would be crossed through trenching and therefore would be subject to temporary interruption of traffic.

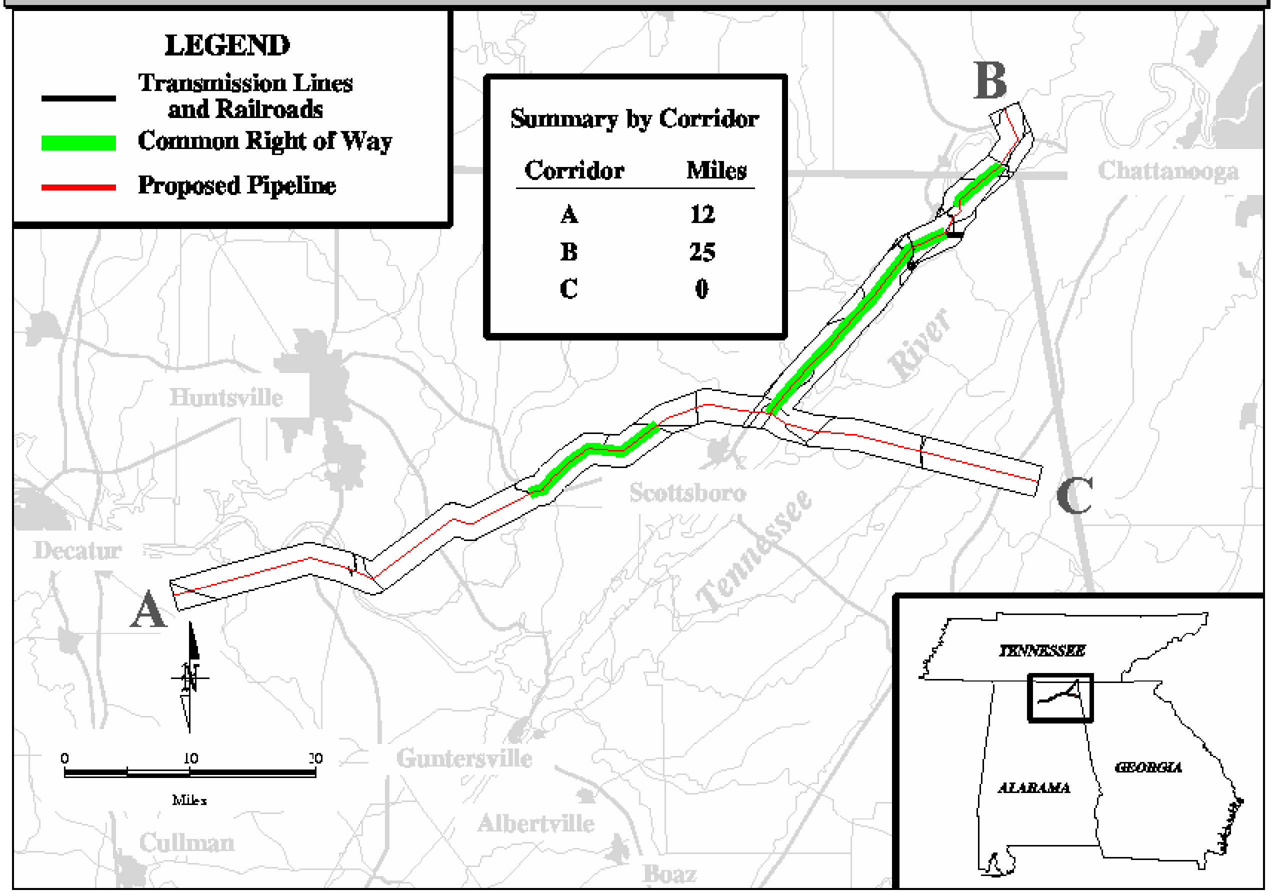
Figure 3.2-3 Roads and Railroad Crossings by Corridor



3.2.3 Common Right-of-Ways

Utilities and transportation routes often share ROWs. This reduces the cumulative area of impact and allows more cost effective construction. Figure 3.2-4 illustrates areas of common ROW within the pipeline corridors. A majority of Corridor B has common ROWs (25 miles or 78%). Corridor A has 12 miles (24%), and Corridor C has no common ROW areas. To the extent that existing ROWs may be available for sharing with a new pipeline, areas potentially affected by construction would be significantly reduced.

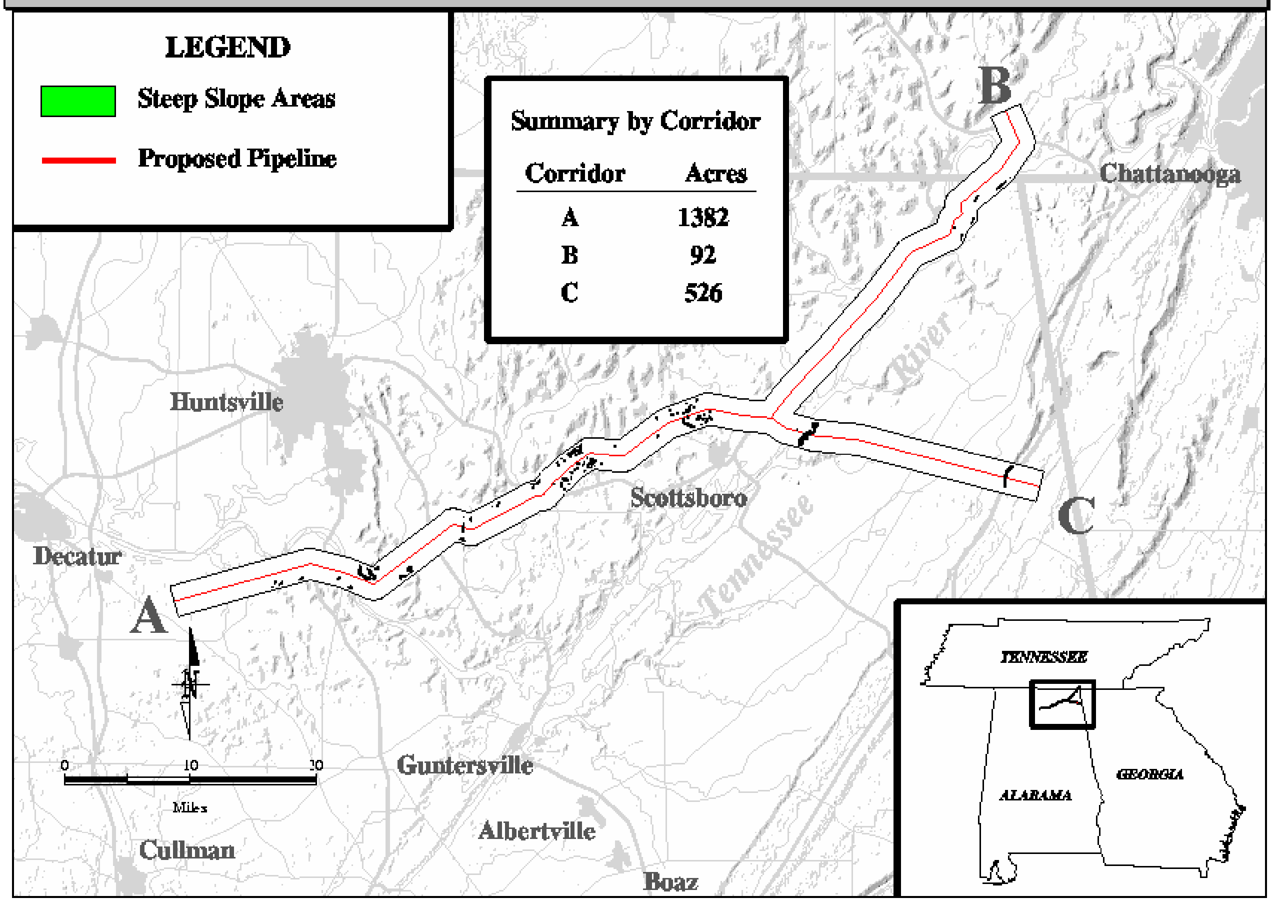
Figure 3.2-4 Parallel ROWs by Corridor



3.2.4 Topography

Topography is an important environmental feature because of potential erosion resulting from pipeline construction and since blasting may be required. Steeply sloped areas frequently serve as habitat to sensitive ecological communities, erosion of steeply sloped areas is more difficult to contain than on areas that are flat.

Figure 3.2-5 Areas of Steep Slope by Corridor

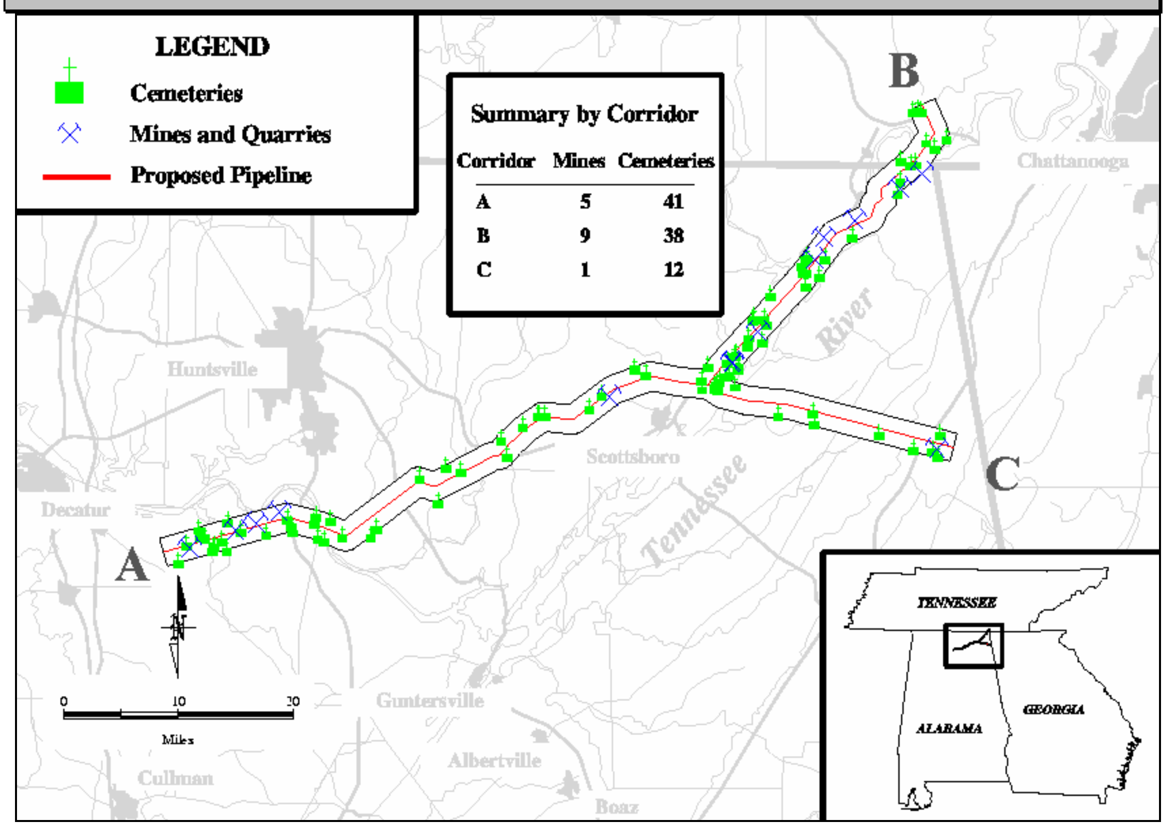


Corridor areas with significant slopes are identified in Figure 3.2-5. These areas were classified using 100 m^2 Digital Elevation Model data. Those areas with slopes greater than 1.5% are considered significant. Corridor A has the greatest amount of steep slopes per area. However, the center line of this corridor is located to avoid the majority of these slopes crossing only one area of significance. Corridor B crosses no significant slopes. Corridor C crosses two significant areas of slope: the western slope of Sand Mountain and the Little Ridge and Big Ridge areas east of the Tennessee Valley Divide. The primary impact is potential erosion resulting from pipeline construction. Steep slopes also correlate with areas where blasting may be required.

3.2.5 Cemeteries and Mines

Cemeteries shown in Figure 3.2-6 are concentrated in the vicinity of urban development. Typically, impacts may be avoided by routing pipelines around cemeteries. However, where unusual construction constraints do not allow rerouting, relocation of cemeteries may be required. While not normally considered to be an environmental resource worthy of protection or avoidance, underground mines are important since they could affect the geological stability of the pipeline. The largest number of underground mines and quarries were encountered in Corridor B, but the number of cemeteries was highest in Corridor A.

Figure 3.2-6 Locations of Mines, Quarries, and Cemeteries by Corridor



3.2.6 Surface Water, Floodplains and Wetlands

Construction of a pipeline through floodplains and wetlands and across streams provide possibly the greatest potential for impacts to important fisheries and wildlife habitat. Several major regulations provide protection to such resources, some require special construction practices and mitigation to minimize impacts. This section quantifies the number of rivers, streams, and springs encountered in each corridor and delineates the number of acres of wetlands and floodplains contained in each corridor.

Figures 3.2-7 through-9 show stream crossings, springs, 100 year-floodplains (derived from Federal Emergency Management Administration Flood Risk Maps), and wetlands (derived from U. S. Fish and Wildlife National Wetland Inventory Maps). Corridor A would result in the largest number of stream crossings and contains a significantly larger area within the 100 year floodplain. The acres of wetlands in Corridor A was more than double the acreage in both B and C.

Figure 3.2-7 Locations of Rivers, Streams, and Springs by Corridor

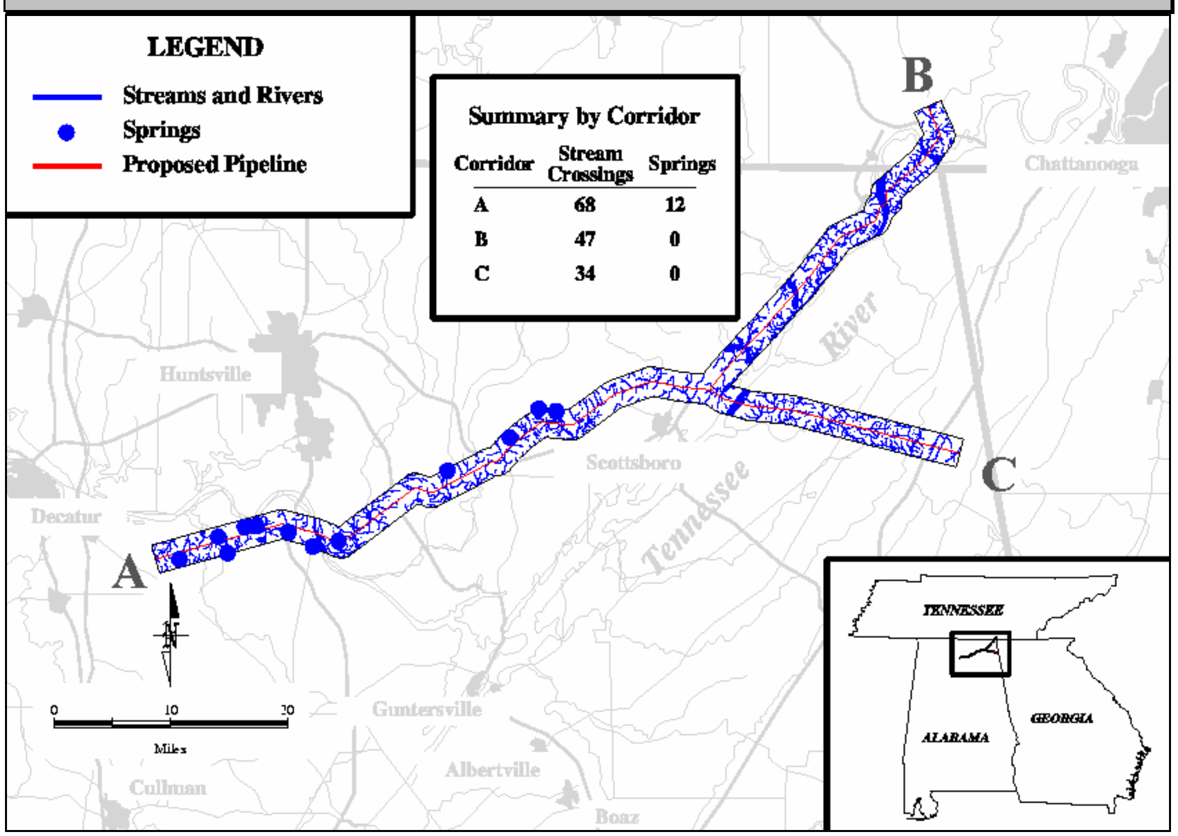


Figure 3.2-8 Locations of Floodplains by Corridor

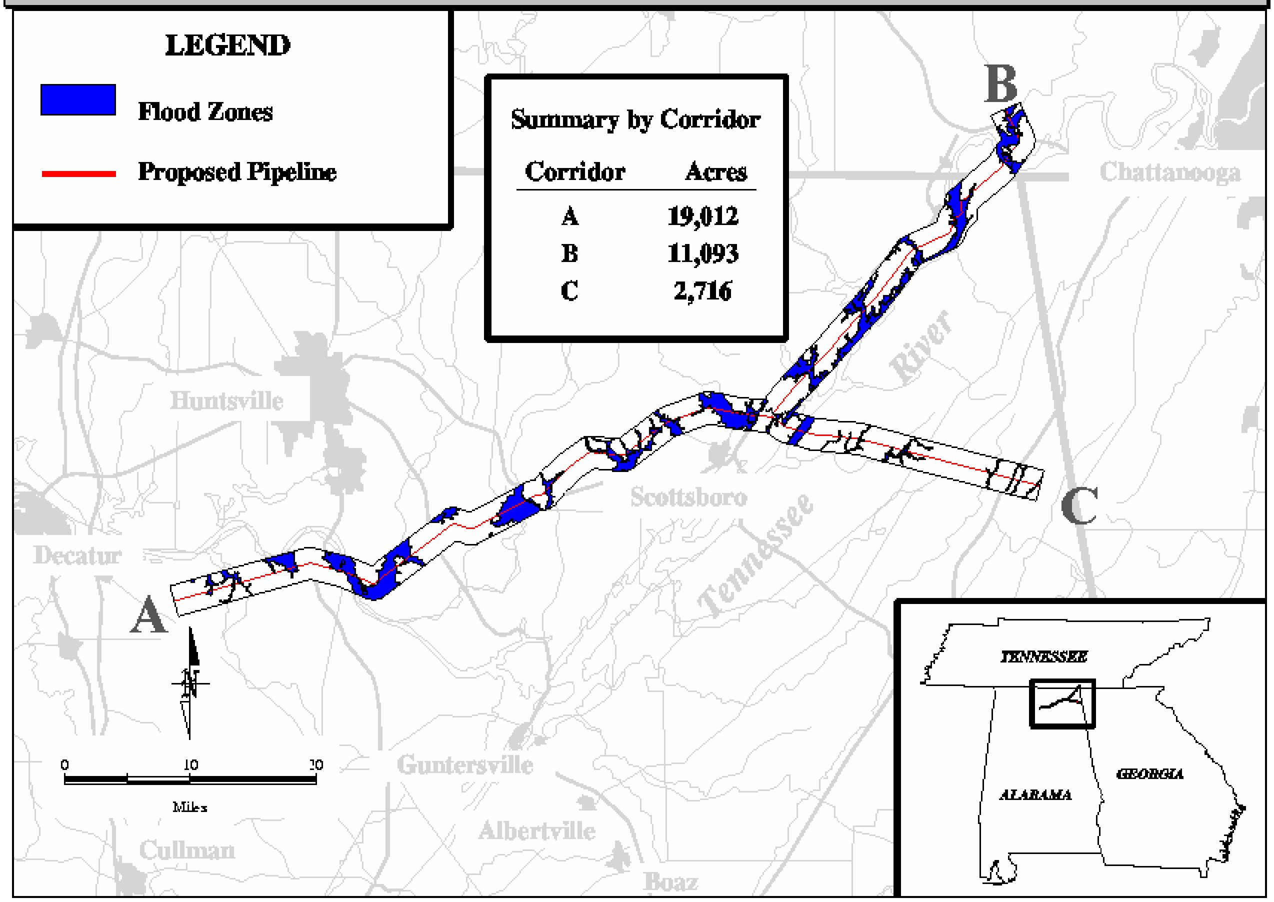
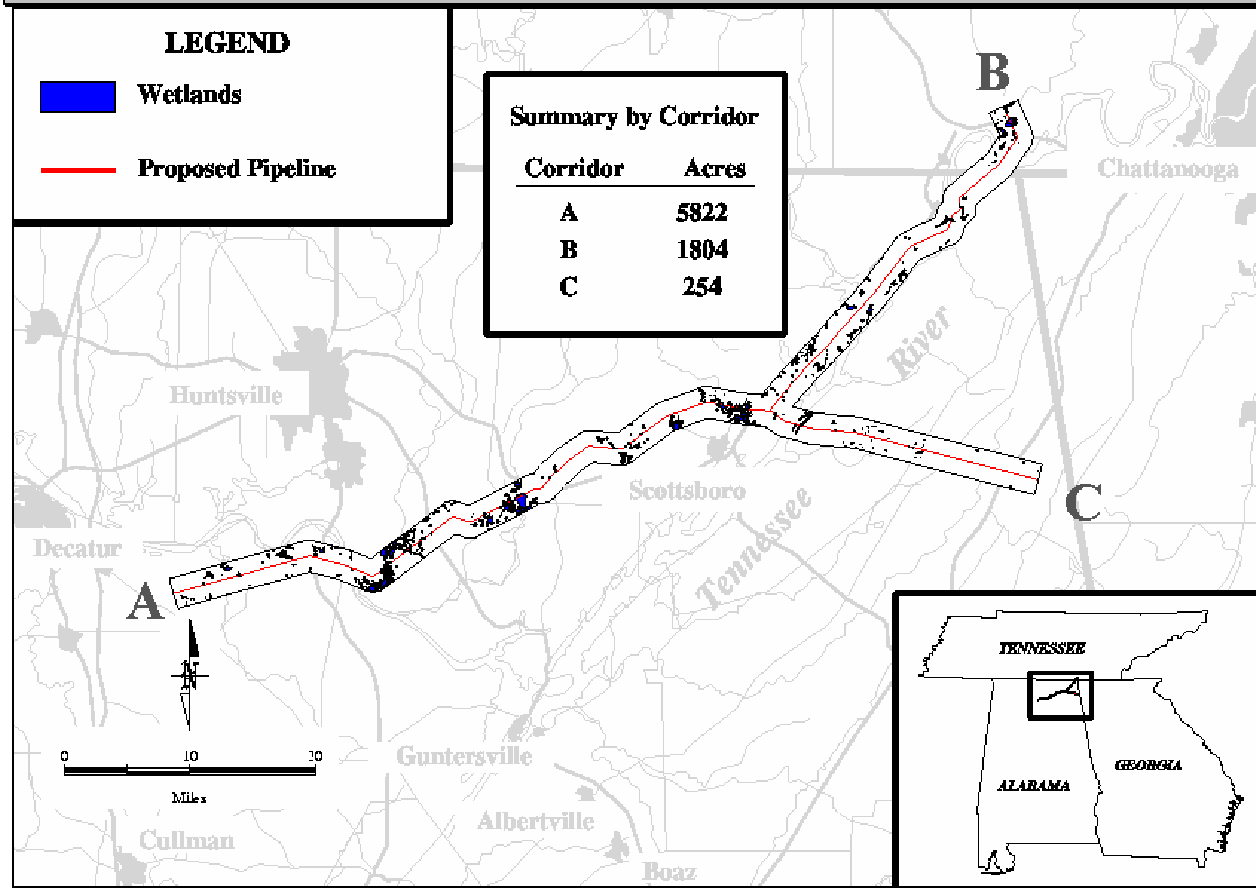


Figure 3.2-9 Locations of Wetlands by Corridor



3.2.7 Protected Ecological Resources

Eight protected animal species are believed to live in or near the corridors designated but no "on the ground" confirmation has been conducted. Exact locations of individual species have been omitted to protect the anonymity of their habitats. Table 3.2-1 contains information about the eight protected species.

Documented occurrences of caves, Federal and/or state protected species, and sensitive ecological habitats are provided in Figures 3.2-10 and 11. Caves are sensitive areas because many are critical habitats for several federally endangered terrestrial and aquatic species. Note that caves were predominantly found in Corridor A. Several stream crossings are considered sensitive habitats because of known occurrences of protected species or because of the occurrence of habitat that may support protected species.

Table 3.2-1 Protected Species Within or in Vicinity of One or More Designated Corridors

Protected Species	Scientific Name	Level of Protection
Bald Eagle	*Haliaeetus leucocephalus*	Federally Threatened
Gray Bat	*Myotis grisescens*	Federally Endangered
Indiana Bat	*Myotis sodalis*	Federally Endangered
Green Salamander	*Aneides aeneus*	Status undetermined in Alabama
Alabama Lip Fern	*Cheilanthes alabamensis*	Species of special concern in Alabama
Green Pitcher Plant	*Sarraccenia oreophila*	Federally Endangered
Amercian Hart's Tongue Fern	*Asplenium (=Phyllitis) scolopendrium var. americanum*	Federally Endangered
Morefield's Leather Flower	*Clematis morefieldii*	Federally Endangered
St. John-wort	*Hypericum spharrocarpum var. turgidum*	State Endangered
Smoketree	*Cotinus obovatus*	Species of special concern in Alabama
Snow-wreath	*Neviusia alabamensis*	State Endangered in Alabama
Yellow Honeysuckle	*Lonicera flava*	Species of special concern in Alabama

Figure 3.2-10 Locations of Caves and Protected Species by Corridor

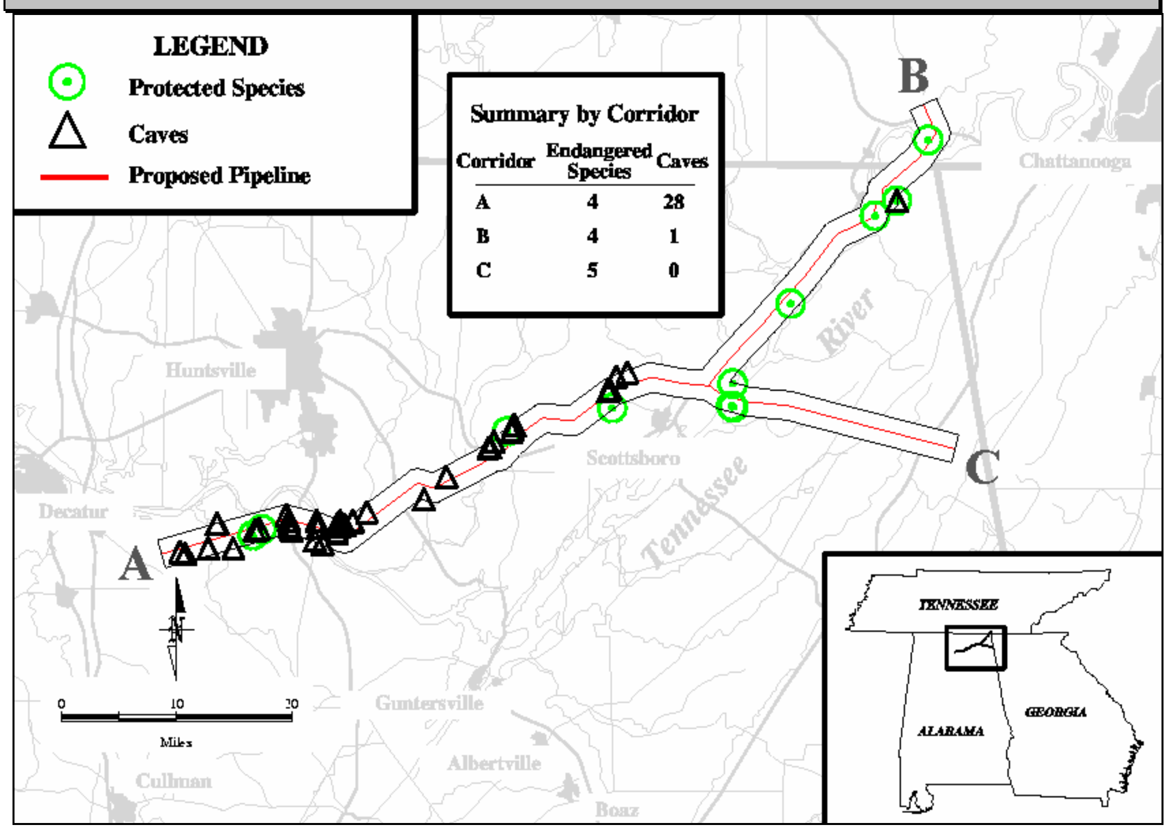
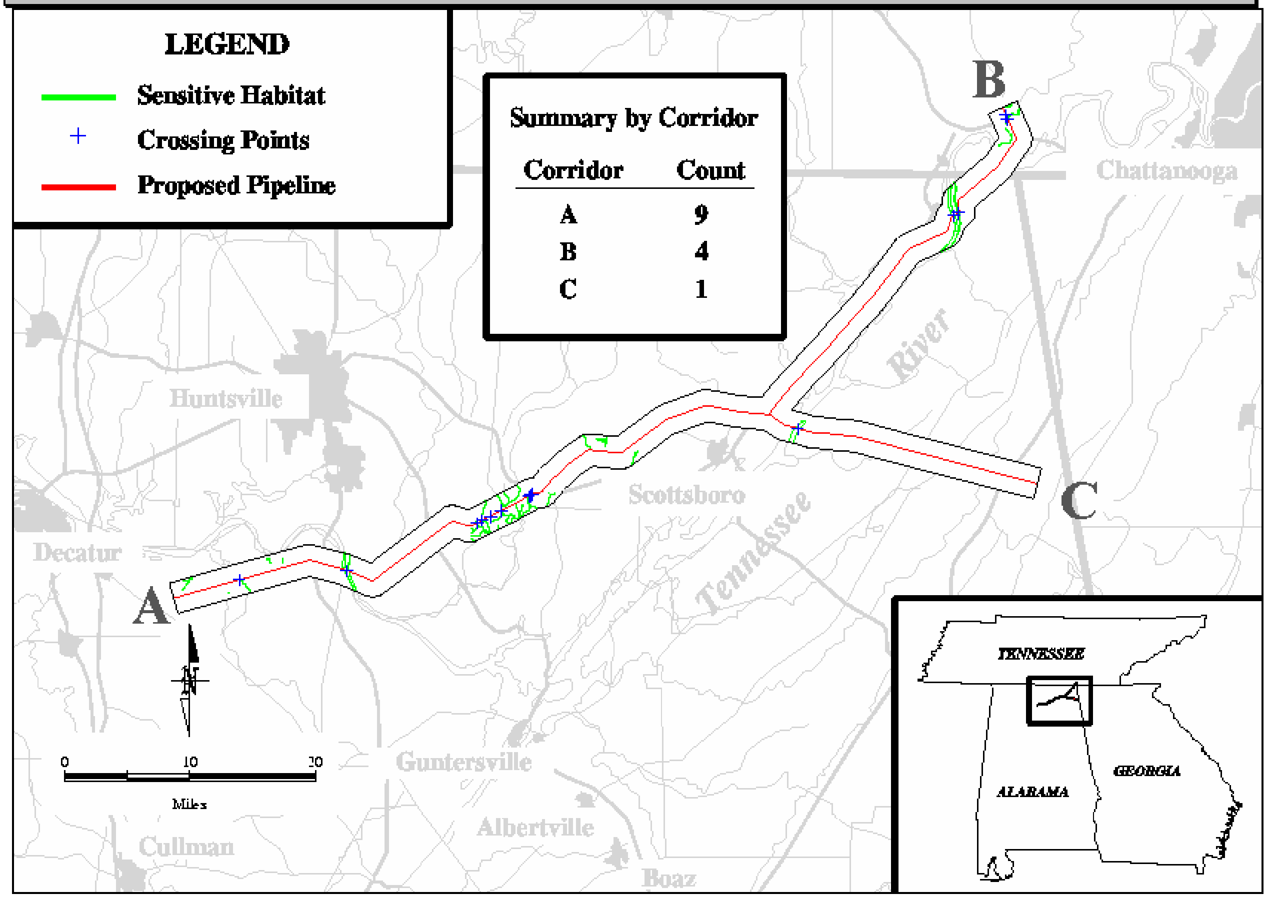


Figure 3.2-11 Sensitive Aquatic Crossings by Corridor



3.2.8 Historic and Archaeological Sites

Within the designated corridors, there are no known archaeological or historic sites nor are there any known sites eligible for the National Register.

3.2.9 Parks, Recreation and Natural Areas

Of the three corridors, only Corridor B has any public parks, recreation areas, or designated natural areas. U.S. Geological Survey maps (15-minute quad sheets) were examined to determine if there were any national or state forests, state or local parks, etc. Corridor B contains a wildlife management area along Mud Creek (a branch of the Tennessee River a few miles northeast of Bellefonte), municipal parks in Stevenson and Bridgeport, and a public campground and park near the Nickajack Dam. The corridor centerline (the presumed ROW for the pipeline) would not cross any of these areas.

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4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED CONVERSION OPTIONS

Environmental consequences associated with the proposed conversion options are described in this chapter. Section 4.1 presents the impacts associated with the No-Action Alternative by resource or impact category. Section 4.2 presents this same information for each of the five conversion options. Section 4.3 describes the impacts that could be associated with the construction of a natural gas pipeline construction in three potential pipeline corridors and its operation. Section 4.4 describes indirect and cumulative impacts. Sections 4.5 and 4.6 address mitigation measures and unavoidable adverse impacts. Section 4.7 compares the relationship of short-term uses and long-term productivity. Section 4.8 presents irreversible and irretrievable commitment of resources and Section 4.9 addresses environmental justice issues.

4.1 Impacts to the Environment From the No-Action Alternative

The No-Action Alternative would continue the maintenance of the Bellefonte Plant as a partially completed nuclear plant. Chapter 3.0, Affected Environment, provides detailed descriptions of the existing resources listed below. Only associated impacts are addressed in this section. The reader is referred to the respective sections in Chapter 3.0 for more information regarding the existing conditions at the site.

4.1.1 Air Quality

Bellefonte Nuclear Plant emissions were evaluated under the Title V of the Clean Air Act Amendments of 1990 and was considered to be a minor source. [1] Subsequently, a minor source permit was granted on June 24, 1996, by the Alabama Department of Environmental Management (ADEM). Impacts associated with these emissions are considered to not be discernible to the surrounding environment.

4.1.2 Geologic Setting

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Any impact to the site's geology would have occurred during previous construction of the nuclear plant. There are no further impacts associated with maintaining the plant in its current status.

4.1.3 Site Soils

Impacts associated with the No-Action Alternative occurred previously during construction of the nuclear plant. There are no impacts associated with maintaining the plant in its current status.

4.1.4 Solid Nonhazardous Wastes

The solid waste generated is minimal as expected with the deferred status. Presently, solid waste is disposed of off site by contract at an ADEM permitted facility.

4.1.5 Hazardous Wastes

Bellefonte currently qualifies as an Environmental Protection Agency (EPA) Small Quantity Generator. This waste is temporarily stored onsite until it is shipped to the TVA Hazardous Waste Storage Facility (HWSF) in Muscle Shoals, which makes arrangements for disposal at a permitted disposal facility off site.

4.1.6 Surface Water

Existing sources of surface discharge for Bellefonte are permitted under National Pollutant Discharge Elimination System (NPDES) Permit No. AL0024635. Three discharge points are active process discharge points: effluent from the cooling tower desilting pond, plant intake trash sluice, and the simulator training facility treated sanitary waste water. There are nine permitted storm water discharge points. Historical analytical data from these discharge points indicate that all priority pollutants were below the method detection limits except for some metals. The background sample (intake water) was also above the detectable limits for the same metals. Sanitary waste from the site is treated at the Hollywood Waste Water Treatment Facility, which was designed to ensure compliance with the effluent limitations of the State. Therefore, there are no discernible impacts to surface water associated with the No-Action Alternative.

4.1.7 Floodplains/Floodway

The only existing facilities that lie within the 500-year floodplain are the northern perimeter road and part of the employee parking lot. All other existing structures meet the requirements of the Executive Order (EO) 11988 (Floodplain Management).

4.1.8 Groundwater

The site activities that could impact groundwater are those associated with the handling and storage of petroleum products needed for operational and maintenance activities. The handling and storage of petroleum products are managed according to the site Spill Prevention Control and Countermeasures (SPCC) and Best Management Practices (BMP) plans in order to prevent releases to the environment. The SPCC also covers actions to be taken in the advent of a spill or release to the environment. Any future impacts are considered to be nominal.

4.1.9 Terrestrial Ecology

Of the 1,600-acre plant site, approximately 900 acres have been developed with buildings and facilities, roads, parking lots, or other uses related to the partially completed nuclear plant. The remaining acreage provides a variety of habitats that are typical throughout the region and are suitable for many terrestrial wildlife species. These habitats are expected to remain stable under the existing plant activities, and therefore, no discernible impacts are anticipated.

4.1.10 Aquatic Ecology

The primary source for potential impact to aquatic ecology as a result of the No-Action Alternative is storm water runoff. Storm water runoff from the site could contain contaminants resulting mainly from spills or leaks. However, most storm water runoff at Bellefonte is collected in holding ponds for treatment (mainly settling solids) before being discharged. Storm water runoff is also managed by the current Storm Water Pollution Prevention (SWPP) plan as required by the NPDES permit. Impacts are expected to be negligible.

4.1.11 Wetlands

There are no impacts to wetlands associated with the current operating status of Bellefonte.

4.1.12 Socioeconomics

Eighty personnel are currently employed at Bellefonte, 50 of whom are in operations and maintenance. These personnel would continue to support the lay-up and preservation of the plant.

4.1.13 Transportation

Transportation impacts associated with the No-Action Alternative are minimal. These impacts result primarily from commuter traffic by the personnel assigned to the site. Typical truck traffic includes deliveries of supplies needed for operation and maintenance activities and shipment of solid and hazardous wastes to the appropriate permitted facilities.

4.1.14 Land Use

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

No changes are anticipated for land use at Bellefonte under the No-Action Alternative.

4.1.15 Aesthetics and Recreation

Bellefonte is located in a valley setting partially screened from the Tennessee River and overlooked by Sand Mountain. Existing plant structures currently most noticeable to the public are the cooling towers, reactor domes, and transmission lines. These structures are visible in excess of five miles away.

4.1.16 Cultural Resources

No further impacts are anticipated for cultural resources at Bellefonte for the continued maintenance and preservation of the facilities.

4.1.17 Noise Impacts

Sources of noise levels generated by the Bellefonte plant equipment are fans, transformers, compressors, and power line hum. Maximum background Ldn (average of day and night) of 50 decibels occurred southeast of the site at the river barge unloading site, which is well within the Housing and Urban Development (HUD) defined acceptable category (see Section 3.1.17).

4.1.18 Health and Safety

The existing facilities and activities are subject to Occupational Safety and Health Administration (OSHA) General Industry Standards. Bellefonte also complies with community right-to-know statutes and the Hazard Communication Program.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

4.2 Impacts to the Environment From Each of the Five Bellefonte Conversion Options

In each of the resource categories, impacts of each option are addressed in an absolute context and relative to other options. Each category of impacts is discussed as it is associated with construction and operation. A summary of impacts is presented in Chapter 2, Section 2.4.

4.2.1 Air Quality

This section contains the evaluation of potential air quality impacts of construction- and operation-related activities associated with Bellefonte fossil-fuel conversion options. Emphasis is placed on ambient air quality, visibility, hazardous air pollutants, and odors. Cumulative air quality impacts, air quality related values, acidic deposition, global climate change, and cooling tower drift are addressed in Section 4.4.2, Cumulative Impacts.

4.2.1.1 Impacts of Construction

Transient air pollutant emissions would occur throughout the construction phase of any Bellefonte conversion option. Although the kinds of emissions would be similar for any option, the amounts of emissions would depend on the nature of new construction required. Since the Bellefonte site was cleared and prepared for nuclear plant construction, site preparation and construction activities, and their attendant transient air pollution emissions, will be substantially less than for a new site. Construction-related air quality impacts are primarily related to three kinds of activities:

- Land clearing, site preparation, and vehicular traffic,
- Open burning of cleared land debris; and
- Operation of internal combustion engines.

Land clearing, site preparation, and vehicular traffic over unpaved roads and construction sites result in the emission of fugitive dust particulate matter (PM) during site preparation and active construction periods. The variation of these emissions and their resultant impacts in time and space are subject to both manmade (e.g., the type and frequency of these activities) and natural (e.g., soil moisture, wind speed) factors. Overall, the largest fraction (greater than 95% by weight) of fugitive dust emissions would be redeposited within construction site boundaries. The remaining PM fraction, small in mass but great in number, would be subject to longer-range transport. If necessary, open construction areas and unpaved roads would be sprinkled with water to reduce fugitive dust emissions by as much as 50%.

Open burning of land debris, almost exclusively wood/vegetation in nature (e.g., trees, stumps, slash, etc.), would result in short-term emissions of PM, carbon monoxide (CO), nitrogen oxides (NO_x), carbon dioxide (CO_2), and trace amounts of volatile organic compounds (VOCs). All open burning activities would be conducted in compliance with applicable federal, state, and local regulations to minimize the likelihood of off site air quality impacts.

Combustion of gasoline and diesel fuel by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, CO, NO_x, VOCs, and sulfur dioxide (SO_2) throughout the site preparation and construction period. The total amount of these emissions are small and would result in minimal off site impacts.

Additional sources of VOCs include evaporative losses from onsite application of paint, coatings, adhesives, waterproofing, cleaning solvents, gasoline and diesel fuel storage and refueling, and construction equipment. These emissions would be relatively minor and are not expected to significantly influence off site air quality.

The air quality impacts related to construction activities would be temporary in nature and are dependent on both manmade (e.g., intensity of activity, control measures, etc.) and natural factors (e.g. wind speed and direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on offsite air quality and should not lead to an exceedence or violation of any applicable ambient air quality standard. Accordingly, the overall air quality impact of construction-related activities for any of the proposed conversion generating options would not be significant.

4.2.1.2 Impacts of Operation

Ambient Air Quality

The potential operational air quality impacts associated with the five proposed Bellefonte conversion options and seven variants were evaluated using EPA recommended air quality models. The approach and techniques utilized in the modeling analyses are described below. Primary air pollutant emissions from the five options and seven variants consist largely of SO_2, NO_x, PM, and CO. Each of these emissions relate to one or more criteria pollutants for which the EPA has set National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments to protect public health and welfare. The NAAQS and PSD increments, including the ozone and particulate matter NAAQS which became effective on September 16, 1997, are provided in Table 4.2.1-1.

The revisions to the ozone and fine particulate air quality standards–and likely future efforts to assure compliance with these standards–have implications for decisions related to the construction of a fossil-fuel generating facility at Bellefonte. The revised standards should prove considerably more stringent to achieve than the previous standards, and it is likely that a number of nearby areas will become nonattainment even if air quality does not decline.

Although the specific impacts of the revised standards on the proposed Bellefonte facility are not known, there will be consequences. These include the following:

- Although the Bellefonte area currently meets the current ozone and particulate matter standards, this is likely to change. Historical ozone and particulate matter data suggest that one or more counties in Northeast Alabama and nearby Southern Tennessee and Northwest Georgia are likely to become nonattainment for one or both of the revised standards.
- If an area near Bellefonte is designated nonattainment for ozone (September 2000), new NO_x sources could be required to obtain NO_x emission offsets from other NO_x sources located in the same airshed to receive air permits.
- If an area near Bellefonte is designated nonattainment for PM2.5 (September 2005), new SO_2 sources could be required to obtain SO_2 emission offsets from other SO_2 sources in the same airshed to receive air permits.

- EPA has indicated its intent to address both ozone and particulate matter nonattainment with a regional management approach to reducing NO_x and SO_2 emissions, particularly from fossil-fueled utility boilers. As a consequence, new NO_x and SO_2 sources could be required to obtain offsets if their emissions caused areas in other air sheds to go into non-attainment.

Table 4.2.1-1 National Ambient Air Quality Standards and Prevention of Significant Deterioration Increments (mg/m^3)

Pollutant and Time Period	NAAQS [a] Primary	NAAQS [a] Secondary	PSD Class I Increment	PSD Class II Increment
Sulfur dioxide				
Annual arithmetic mean	80	-	2	20
24-hour average	365	-	5	91
3-hour average	-	1,300	25	512
Ozone				
8-hour average	157	157	none	none
1-hour average	235	235	none	none
Nitrogen dioxide				
Annual arithmetic mean	100	100	2.5	25
Carbon monoxide				
8-hour average	10,000	10,000	none	none
1-hour average	40,000	40,000		
Particulate Matter				
PM10				
Annual arithmetic mean	50	50	4	17
24-hour average	150	150	8	30
24-hour 99th percentile	150	150	none	none
PM2.5				
Annual arithmetic mean	15	15	none	none
24-hour 98th percentile	65	65	none	none
Lead				
Quarterly arithmetic mean	1.5	-	none	none

[a] - Short-term standards (24-hours and less) are not to be exceeded more than once a year. Standards for periods longer than 24 hours are maximum permissible concentrations that are never to be exceeded.

In addition to the revised standards, two other regulatory issues may have significant consequences for Bellefonte in the future. The U. S. EPA is in the process of revising new source review requirements for NO_x emissions from fossil-fuel boilers. As proposed, this revision will result in considerably more stringent NO_x emissions requirements, particularly for coal-fired utility boilers. U. S. EPA is also considering a regional haze management strategy which could cause sources to reduce SO_2 emissions through implementation of Best Available Retrofit Technology.

In summary, the more stringent revised ozone and particulate matter standards, in combination with regional secondary pollutant management strategies to achieve attainment (or to address new source review or regional haze requirements), will lead to significantly increased regulatory pressure to minimize NO_x and SO_2 emissions from new fossil-fuel boilers.

Source Data

Source data were developed for each of the five conversion options and seven variants. These data are based on the assumption of "most likely conservative configuration." Each option and variant was modeled assuming normal operation and Good Engineering Practice (GEP) stack heights. Inputs to the Industrial Source Complex Model, Version 3 (ISC3) and the Rough Terrain Diffusion Model (RTDM) cooperative model runs are summarized in Tables 4.2.1-2 and 4.2.1-3. Emissions for sources with identical multiple stacks were combined into one common stack for the tables; input data for each stack are presented in Appendix J. The base configurations of each option, and of any variants created by the modification of type of fuel or mode of operation, are briefly summarized in the following (more detailed information is provided in Chapter 2 about operating modes and fuels):

<u>Pulverized Coal (PC)</u>

The PC Option involves the operation of four 600 MW subcritical boilers equipped with flue gas desulfurization systems (capable of 95% SO_2 removal), electrostatic precipitators or baghouses (capable of 99% particulate removal), and low NO_x burners (estimated to achieve 0.40 pounds per million British thermal units [lb/mmBtu] heat input). Two units will be ducted to each stack, each of which is equipped with two flues. The boiler heat rate is 9,500 Btu per kilowatt hour (Btu/kWh). Emissions estimates assume utilization of 24,800 tons per day (tpd) of Illinois No. 6 coal. GEP stack heights are based on a non-enclosed boiler arrangement with a structure height of approximately 77 meters (m).

A variant of the PC Option, pressurized fluidized bed combustion (PFBC), was also modeled to ensure that the impacts evaluation addressed a different boiler type being considered. The model inputs were based on the operation of eight PFBC units utilizing 23,000 tpd of Illinois No. 6 coal. GEP stack height is based on a structure height of 61 m. The PFBC heat rate is 8,443 Btu/kWh. The PFBC involves a gasification step which would involve the occasional operation of a raw gas flare.

Table 4.2.1-2 Source Characteristics for Conversion Options and Variants

No	Easting (km)	Northing (km)	Stack Height (m)	Stack Diameter (m)	Exit Vel. (m/s)	Exit Temp (deg K)	SO_2 Emission Rate (g/s)	NO_x Emission Rate (g/s)	PM10 Emission Rate (g/s)	CO Emission Rate (g/s)
PC										
1	598.475	3841.427	174.65	11.72	19.66	321.30	794	1150	86	74.78
PFBC										
1	597.701	3840.733	106.68	13.42	18.3	380	706	519.85	76.59	0
NGCC										
1	597.881	3840.644	60.96	5.49	20.27	380	2.46	289.89	34.02	362.87
NGCC Bypass										
1	597.917	3840.674	25.91	5.49	46.177	860.93	2.46	289.89	34.02	362.87
NGCC Oil										
1	597.881	3840.644	60.96	5.49	20.27	380	38.33	289.89	45.14	362.88
NGCC Bypass Oil										
1	597.917	3840.674	25.91	5.49	46.177	860.93	38.33	289.89	45.14	362.88
IGCC										
1	597.912	3840.534	99.10	6.71	17.79	380	139.88	602	22.16	127.0
2	597.852	3840.501	99.10	1.22	24.69	1033	43.12	3.44	16.64	1.84
IGCC Bypass										
1	597.954	3840.580	25.91	6.71	46.177	861	139.88	602.48	22.16	127.0
2	597.852	3840.501	99.10	1.22	24.69	1033	43.12	3.44	16.64	1.84
IGCC/C										
1	597.769	3840.739	99.10	6.71	17.79	380	34.97	150.62	5.54	31.75
2	597.764	3840.580	99.10	1.22	24.69	1033	21.56	1.72	8.32	0.92
3	597.276	3840.643	99.10	3.05	17.00	340	0	11.33	9.11	0
Combination										
1	597.769	3840.739	99.10	6.71	17.79	380	34.97	150.62	5.54	31.75
2	597.764	3840.580	99.10	1.22	24.69	1033	21.56	1.72	8.32	0.92
3	598.038	3840.364	99.10	5.49	20.27	380	1.62	193.26	9.24	241.92
4	597.276	3840.643	99.10	3.05	17.00	340	0	11.33	9.11	0
Combination Bypass										
1	597.816	3840.777	99.10	6.71	46.177	861	34.97	150.62	5.54	31.75
2	597.764	3840.580	99.10	1.22	24.69	1033	21.56	1.72	8.32	0.92
3	598.077	3840.379	25.91	5.49	20.27	861	1.62	193.26	22.68	241.92
4	597.276	3840.643	99.10	3.05	17.00	340	0	11.33	9.11	0
Combination Oil										
1	597.769	3840.739	99.10	6.71	17.79	380	34.97	150.62	5.54	31.75
2	597.764	3840.580	99.10	1.22	24.69	1033	21.56	1.72	8.32	0.92
3	598.038	3840.364	99.10	5.49	20.27	380	37.52	193.26	30.02	241.92
4	597.276	3840.643	99.10	3.05	17.00	340	0	11.33	9.11	0

Table 4.2.1-3 Number of Stacks Grouped for Modeling Purposes

	Conversion Option				
Sources	**PC**	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
PC[a]	2 (2 in 1)[b]				
CT/HRSG		9	4 (2 in 1)	1[c]	7[c]
Tail Gas Treatment			8	4	4
Agri-Chem				1	1

[a] - PFBC variant has two stacks (4 in 1)
[b] - "2 in 1" means two flues in each stack
[c] - 1 CT is fed with only one gasifier.

Natural Gas Combined Cycle (NGCC)

The NGCC Option consists of nine modules, each equipped with "F" Class combustion turbines and heat recovery steam generators (HRSGs), fired with natural gas. Each module is served with an HRSG stack, for a total of nine stacks. NO_x emissions estimates are based on a 50 parts per million (ppm) NO_x concentration (15% oxygen [O_2] content). Emission estimates assume utilization of 472 million standard cubic feet per day (mmscf/day) of natural gas. The GEP stack height calculations are based on a HRSG structure height of approximately 26 meters. The heat rate for the combustion turbines is 10,000 Btu/kWh.

A variant of the NGCC Option is the operation of the base system in HRSG bypass mode (i.e., flue gases are emitted prior to entering the HRSG). This would allow operation of the NGCC units in simple cycle mode. Bypass stacks are assumed to be about 26-m high. Bypass stacks are subject to the same GEP considerations as the main stacks, but modeling was conducted at this conservative height pending the outcome of PSD application modeling of this configuration. The bypass stack gas temperature would be much higher than from the HRSG, thereby providing much greater plume buoyancy and consequent pollutant dispersal.

A second NGCC variant is the occasional operation of some combined cycle units with low-sulfur distillate oil. This would provide additional operational flexibility in the event of natural gas shortage or interruption. For conservatively modeling this case, two of the nine units are assumed to operate throughout the months of December, January, and February, while the remaining units operate on natural gas. This approach is conservative since the operation of any units on oil would normally take place over fewer weeks and probably involve only one unit. The third and final NGCC variant is the second variant operating in HRSG bypass mode.

Integrated Gasification Combined Cycle (IGCC)

The IGCC Option consists of eight modules, each module containing one gasification unit, one air separation unit, one acid gas removal unit and sulfur recovery system, and one combustion turbine (CT) with a HRSG. Two gasifier/combustion turbine modules share a single HRSG stack for a total of four stacks. The NO_x emission estimates are based on 50 ppm NO_x. The SO_2 emission estimates are based on a sulfur removal rate of 99.5%. Of the sulfur released to the atmosphere, only a portion is associated with the flue gas stream. Tail gases (containing H_2S and reduced sulfur compounds) from the sulfur recovery step are thermally oxidized to SO_2 and vented following this step. Each sulfur recovery unit has a tail-gas treatment stack for a total of eight stacks. The IGCC Option will consume 24,000 tons per day (tpd) of petroleum coke. The GEP stack height calculations are based on conservative gasification structure heights.

An IGCC variant evaluated for air quality impacts reflects the operation of the base system in HRSG bypass mode. The bypass stacks are shorter (26 meters) following the rationale presented above for NGCC.

Integrated Gasification Combined Cycle with Chemical Coproduction (IGCC/C)

The IGCC/C Option consists of one power generation module similar to the module described for the IGCC Option and three additional gasifiers with the associated syngas clean up equipment for production of chemicals. There is a single HRSG stack. The NO_x emission estimates are based on 50 ppm NO_x. The SO_2 emission estimates are based on a sulfur removal rate of 99.5%. Of the sulfur released to the atmosphere, only a portion of that is associated with the flue gas stream. Tail gases (containing H_2S and reduced sulfur compounds) from the sulfur recovery step are thermally oxidized to SO_2 and vented following this step. Each sulfur recovery unit has a tail gas treatment stack for a total of four stacks. The GEP stack height calculations are based on conservative gasification structure heights.

The IGCC/C case will consume an estimated 12,000 tpd of petroleum coke as fuel. The syngas not sent to the combustion turbine is routed to chemical production facilities. Any organic material emission from the chemical manufacturing plant having heating value will not be vented to the atmosphere but would be routed to a CT for power production. Consequently, chemical plant organic compound emissions would be insignificant.

Combination

The Combination Option consists of the IGCC/C Option with an appropriately sized NGCC plant (six “F”class combustion turbines with HRSGs). “Appropriately sized” means that the number of NGCC units depends on the electricity generating capacity needed to fully convert the plant above and beyond the gasification plant. Fuel consumption for this case is 12,000 tpd of petroleum coke and 260 mmscf/day of natural gas.

Two Combination Option variants modeled were the operation of the syngas operated combustion turbine and the NGCC units in HRSG bypass mode, and the operation of two of the combustion turbines (normally fired with natural gas) with low-sulfur distillate oil during winter months (same basis as described above for the second NGCC variant).

Three of the conversion options (IGCC, IGCC/C, and Combination) also contain stacks used for flaring of raw gas during startup and emergency shutdowns. Emissions from a single flare stack were modeled using the SCREEN3 screening model since flaring occurs intermittently, and from only one stack at a time. Sensitivity modeling was performed for two startup fuel options and several different stack heights to evaluate the effect of stack height on ambient concentrations. The expected duration of flaring would be less than one hour and a total of 90 flaring events per year is expected. Table 4.2.1-4 shows the inputs to the SCREEN3 model. More detailed information describing how emissions estimates were derived is contained in Appendix J.

Table 4.2.1-4 Flare Stack Source Characteristics

Stack Height (m)	Total Heat Release (cal/sec)	SO_2 Emission Rate (g/s)	NO_X Emission Rate (g/s)	PM10 Emission Rate (g/s)	CO Emission Rate (g/s)
30.48 [a]	115,360,000	1,591.25	29.48	2.9	373.34

[a] - also modeled at increments of 30.48 m up to a hight of 182.88 m.

Receptors

A total of 2,817 receptors with locations ranging from easting 588.0 to 608.0 kilometers, northing 3831.0 to 3851.0 kilometers, and elevations 595.0 to 1495.0 feet above mean sea level were used in the modeling. A plot of these receptors and their elevations is presented in Appendix J. Receptors were created in two sets, the first of which was created from 1:24,000 scale topographic maps. This set contained receptors spaced one km apart to a distance of 20 kilometers from the plant. A second set of receptors was created from Digital Elevation Model (DEM) data to focus on the complex terrain (Sand Mountain) southeast of the site. Sand Mountain, at closest point, is 3.3 kilometers away and approximately 250 meters (800 feet) higher in elevation relative to the Bellefonte plant area. The receptors in this sector were spaced 150 meters apart to ensure adequate coverage in the area of rapidly changing features. Elevated terrain to the southeast of Bellefonte is shown as darkened areas on the figure in Appendix J.

Meteorology

Dispersion modeling was performed with three years (1979, 1980, and 1982) of meteorological data based on a combination of hourly onsite measurements, hourly National Weather Service (NWS) surface observations from Huntsville, Alabama, and twice-daily upper air measurements from Nashville, Tennessee. Following is a summary of data used to develop the meteorological data files for each of the dispersion models.

Onsite measurements of wind speed, wind direction, and temperature from the 110-meter meteorological tower located at Bellefonte was used in developing the meteorological data. The tower was instrumented at the 10-, 60-, and 110-meter levels. For periods of missing onsite data at the 110-meter level, the substitution scheme was (in order of priority) 60-meter level of the Bellefonte tower, 10-meter level of the Bellefonte tower, and NWS measurements from Huntsville, Alabama.

Stability data were determined by (in order of priority) Huntsville, Alabama, radiation and cloud data with wind speed from the 10-meter level of the Bellefonte tower, or Huntsville, Alabama, radiation and cloud data with wind speed also from Huntsville, Alabama. Mixing heights were determined from Nashville, Tennessee, morning and afternoon mixing depths and Nashville NWS surface temperature.

Air Quality Models

The ISC3 RTDM combination was run following EPA guidance for performing dispersion modeling in situations where receptor elevations are above the elevation of stack top, and possibly, above the plume height. [2,3] This guidance calls for the use of a simple terrain model (ISC3) for estimating hourly-average concentrations for receptors below stack top, a complex terrain model (RTDM) for receptors above the plume height, and the highest concentration from the two models for receptors at elevations falling between stack top and plume height. This was accomplished by running ISC3 and RTDM under the control of a program designed to extract the appropriate concentration for each receptor and hour.

A description of ISC3 is contained in Volume II of the ISC3 user's guide. [3] The model is based on the straight-line, steady-state Gaussian plume equation, which is used with some modifications to model simple point source emissions. A description of RTDM is contained in Chapter 2 of the RTDM user's guide. [2] RTDM is also based on the Gaussian plume equation, but incorporates features designed specifically for dispersion of plumes as they approach and pass over or around elevated terrain. The SCREEN3 model with VALLEY terrain treatment was used to estimate worst-case concentrations from flaring. SCREEN3 is a simple dispersion model that calculates 1-hour concentrations over a range of worst-case meteorological conditions. A more detailed description of the SCREEN model can be found in EPA guidance. [4]

Air Quality Modeling Results

Normal Operating Mode

Figure 4.2.1-1 presents key results in a bar chart format, which allows a visual comparison of concentration magnitudes for each conversion option. Averages for different averaging times or pollutants are not necessarily at the same receptor point. Specific dispersion modeling results for each conversion option are presented in Appendix J. A tabular summary of key results is presented in Table 4.2.1-5. As shown, all options and variants produced concentrations below the primary and secondary NAAQS.

Figure 4.2.1-1 Dispersion Modeling Results

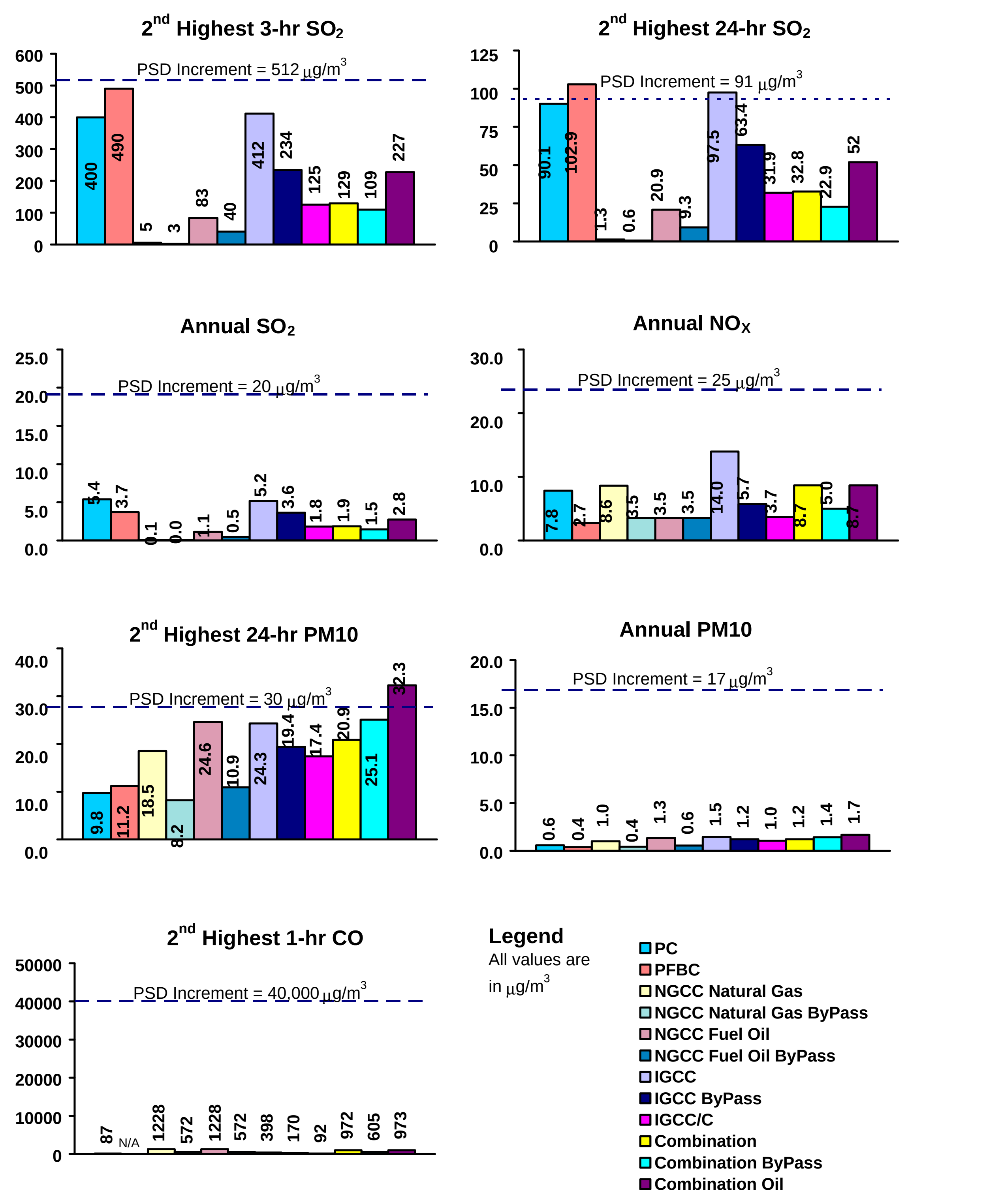


Table 4.2.1-5 Dispersion Modeling Results

Source Option	Pollutant (NAAQS[a]/PSD[b])	Averaging Period	ISC3/RTDM Conc. (ug/m^3)
PC	SO_2 (1,300/512)	2nd high 3-hr	400
	SO_2 (365/91)	2nd high 24-hr	90.1
	SO_2 (80/20)	Annual	5.4
	NO_X (100/25)	Annual	7.8
	PM_{10} (150/30)	2nd high 24-hr	9.8
	PM_{10} (50/17)	Annual	0.6
	CO (40,000)	2nd high 1-hr	87
PFBC	SO_2 (1,300/512)	2nd high 3-hr	490
	SO_2 (365/91)	2nd high 24-hr	**102.9**[c]
	SO_2 (80/20)	Annual	3.7
	NO_X (100/25)	Annual	2.7
	PM_{10} (150/30)	2nd high 24-hr	11.2
	PM_{10} (50/17)	Annual	0.4
NGCC	SO_2 (1,300/512)	2nd high 3-hr	5.3
	SO_2 (365/91)	2nd high 24-hr	1.3
	SO_2 (80/20)	Annual	0.1
	NO_X (100/25)	Annual	8.6
	PM_{10} (150/30)	2nd high 24-hr	18.5
	PM_{10} (50/17)	Annual	1.0
	CO (40,000)	2nd high 1-hr	1,228
NGCC Bypass	SO_2 (1,300/512)	2nd high 3-hr	2.6
	SO_2 (365/91)	2nd high 24-hr	0.6
	SO_2 (80/20)	Annual	0.03
	NO_X (100/25)	Annual	3.5
	PM10 (150/30)	2nd high 24-hr	8.2
	PM10 (50/17)	Annual	0.4
	CO (40,000)	2nd high 1-hr	572
NGCC Oil	SO_2 (1,300/512)	2nd high 3-hr	82.9
	SO_2 (365/91)	2nd high 24-hr	20.9
	SO_2 (80/20)	Annual	1.1
	NO_X (100/25)	Annual	8.6
	PM10 (150/30)	2nd high 24-hr	24.6
	PM10 (50/17)	Annual	1.3
	CO (40,000)	2nd high 1-hr	1,228
NGCC Bypass Oil	SO_2 (1,300/512)	2nd high 3-hr	40.2
	SO_2 (365/91)	2nd high 24-hr	9.3
	SO_2 (80/20)	Annual	0.5
	NO_X (100/25)	Annual	3.5
	PM10 (150/30)	2nd high 24-hr	10.9
	PM10 (50/17)	Annual	0.6
	CO (40,000)	2nd high 1-hr	572

Table 4.2.1-5 Dispersion Modeling Results (Cont'd)

Source Option	Pollutant (NAAQS[a]/PSD[b])	Averaging Period	ISC3/RTDM Conc. (ug/m^3)
IGCC	SO_2 (1,300/512)	2nd high 3-hr	412
	SO_2 (365/91)	2nd high 24-hr	**97.5**[c]
	SO_2 (80/20)	Annual	5.2
	NO_X (100/25)	Annual	14.0
	PM10 (150/30)	2nd high 24-hr	24.3
	PM10 (50/17)	Annual	1.5
	CO (40,000)	2nd high 1-hr	398
IGCC Bypass	SO_2 (1,300/512)	2nd high 3-hr	234
	SO_2 (365/91)	2nd high 24-hr	63.4
	SO_2 (80/20)	Annual	3.6
	NO_X (100/25)	Annual	5.7
	PM10 (150/30)	2nd high 24-hr	19.4
	PM10 (50/17)	Annual	1.3
	CO (40,000)	2nd high 1-hr	170
IGCC/C	SO_2 (1,300/512)	2nd high 3-hr	125
	SO_2 (365/91)	2nd high 24-hr	31.9
	SO_2 (80/20)	Annual	1.8
	NO_X (100/25)	Annual	3.7
	PM10 (150/30)	2nd high 24-hr	17.4
	PM10 (50/17)	Annual	1.0
	CO (40,000)	2nd high 1-hr	92
Combination	SO_2 (1,300/512)	2nd high 3-hr	129
	SO_2 (365/91)	2nd high 24-hr	32.8
	SO_2 (80/20)	Annual	1.9
	NO_X (100/25)	Annual	8.7
	PM10 (150/30)	2nd high 24-hr	20.7
	PM10 (50/17)	Annual	1.2
	CO (40,000)	2nd high 1-hr	972
Combination Bypass	SO_2 (1,300/512)	2nd high 3-hr	82.6
	SO_2 (365/91)	2nd high 24-hr	22.9
	SO_2 (80/20)	Annual	1.5
	NO_X (100/25)	Annual	5.0
	PM10 (150/30)	2nd high 24-hr	25.1
	PM10 (50/17)	Annual	1.4
	CO (40,000)	2nd high 1-hr	605
Combination Oil	SO_2 (1,300/512)	2nd high 3-hr	227
	SO_2 (365/91)	2nd high 24-hr	52.0
	SO_2 (80/20)	Annual	2.8
	NO_X (100/25)	Annual	8.7
	PM10 (150/30)	2nd high 24-hr	**32.3**[c]
	PM10 (50/17)	Annual	1.7
	CO (40,000)	2nd high 1-hr	972

[a] - National Ambient Air Quality Standard (ug/m^3)
[b] - Prevention of Significant Deterioration Class II Increment (ug/m^3)
[c] - Exceeds PSD Class II Increment

As configured, all but three of the 12 options and variants met the PSD Class II increments. The PFBC variant of the PC Option and the IGCC Option exceeded the 24-hour SO_2 increment and the distillate oil variant of the Combination Option exceeded the 24-hour PM10 increment. If any of these options or variants are selected, TVA would have to demonstrate that these increments would not be exceeded as part of the permit application process.

A range of additional design and pollution control mitigation measures are available that would allow these facilities to meet PSD Class II increments. The two most common approaches to lower SO_2 emissions are use of lower sulfur fuel and/or higher efficiency tail-gas sulfur removal equipment. To reduce SO_2 impacts from the IGCC Option to acceptable levels, fuel sulfur content could be reduced by switching from petroleum coke to a petroleum coke/coal blend. A 50/50 blend would reduce sulfur input by approximately 16%, more than enough to accomplish the 10% reduction needed to avoid exceeding the 24-hour PSD Class II increment.

For the IGCC Option, sulfur removal greater than 99.5% is possible, but at increased cost, for the syngas clean up system. In this case, improving removal efficiency to 99.6% would result in lowering ambient SO_2 concentrations to less than 80 ug/m^3. These same types of improvements apply, with differences in applicable fuels and equipment, to the PFBC variant which yielded SO_2 ambient concentrations above the 24-hour increment levels. The necessary reductions in ambient particulate concentrations for the Combination Option (with fuel oil use in two combustion turbines) could be easily achieved with the use of particulate control devices on stacks for units being fired with oil.

In addition to PSD Class II increments which apply to nearly all areas, the Clean Air Act identifies PSD Class I increments which apply to National Parks and Wilderness Areas. Significant emission sources proposing to locate or expand within 100 km of a Class I area must evaluate their potential impact on PSD Class I increments. Although the Bellefonte site is not within 100 km of any Class I area, the impact of the proposed options was evaluated for the nearest Class I area, the Cohutta Wilderness, which is approximately 120 km distant. The ISC3 model was used to estimate emissions impacts on maximum SO_2, NO_x, and PM10 concentrations at a single receptor located at the closest point of the Cohutta Wilderness. Since the ISC3 model results indicated that the Class I increment would be exceeded, the less conservative ISC3/RTDM combination was used. Nevertheless, the maximum estimated concentrations of SO_2 at the boundary of Cohutta Wilderness exceeded the PSD Class I Increment for

SO_2 for both the PC Option and PFBC variant (Table 4.2.1-6). No PSD Class I increment was exceeded for any other option or variant.

Table 4.2.1-6 Maximum Concentrations at the Cohutta Wilderness Area

Pollutant Avg. Period	**SO_2 Annual**	**SO_2 24-hr**	**SO 3-hr**	**NO_X Annual**	**PM10 Annual**	**PM10 24-hr**
PSD Class I Increment	2	5	25	2.5	4	8
PC	0.4	**8.1**	**55.6**	0.6	0.05	0.9
PFBC	0.3	**5.8**	**31.5**	0.2	0.03	0.6
NGCC	0.002	0.02	0.14	0.2	0.02	0.3
NGCC Bypass	0.002	0.04	0.18	0.2	0.02	0.5
IGCC	0.1	2.3	8.6	0.4	0.02	0.4
IGSC Bypass	0.1	2.2	10.3	0.4	0.02	0.4
IGCC/C	0.04	0.7	2.6	0.1	0.01	0.2
Combination	0.04	0.7	2.7	0.2	0.02	0.3
Combination Bypass	0.03	0.4	2.3	0.2	0.03	0.5
Combination Fuel Oil	0.06	1	4.4	0.2	0.03	0.5

Since both PC and PFBC options exceeded the short-term PSD Class I increments for SO_2 at Cohutta, additional SO_2 ISC3/RTDM model runs for these options were made for the Sipsey Wilderness, approximately 150 km distant, and the Great Smoky Mountains National Park, approximately 200 km distant. These results indicated that the PSD Class I SO_2 increments for the Sipsey Wilderness would not be exceeded but that, because of the elevated terrain, the Class I SO_2 increments for 24- and 3-hour standards would be exceeded by both PC and PFBC at the nearest boundary of the Great Smoky Mountains National Park. If PC or PFBC become the preferred option for conversion of Bellefonte, a more detailed and accurate analysis of impact on Class I areas would be performed.

It should be acknowledged that Gaussian dispersion models which assume steady state meteorology, such as ISC3 and RTDM, are recommended and can be used reliably for estimating impacts for locations up to 50 km from the source. Beyond this distance, many of the underlying steady-state assumptions are significantly compromised. If the wind speed were 2 m/s, for example, it would take nearly seven hours for a plume to travel 50 km and 24 hours to travel 200 km. It is extremely unlikely, perhaps even unreasonable, to assume that “worst-case” wind speed, wind direction, and stability conditions would be constant for that long. The use of these models for assessing PSD Class I increments at these long distances is, therefore, highly conservative and their results should be interpreted as more suggestive than conclusive.

A range of additional design and pollution control mitigation options are available that would allow these facilities to meet PSD Class I SO_2 increments. The two most common approaches to lowering SO_2 emissions are use of lower sulfur fuel and/or higher efficiency tail-gas sulfur removal equipment.

Gasifier Startup/Upset Mode

Entrained flow gasifiers are used in the IGCC, IGCC/C, and Combination Options. The largest number of gasifiers are operated for IGCC, so the following discussion will be directed to the IGCC Option. The startup procedures for the oxygen-fed, entrained flow gasifiers (Texaco, Shell, & Destec) are very similar; however, the techniques and specific startup hardware may differ. Generally, they all begin with a 24- to 48-hour preheat of the gasifier using air and fuel such as natural gas at minute quantities compared to the coal feed rate. After preheat to the desired temperature, the natural gas firing is stopped, and the gasifier is started up by injecting coal or coal slurry and then oxygen. As soon as the oxygen is fed to the gasifier, combustion of the coal and thus production of the raw syngas begins.

As the pressure of the gasification plant rises to the design pressure, operation of the gasifier stabilizes. This period of stabilization may take 15 to 60 minutes depending on the startup technique and the design of the plant. Historically, the Texaco and Shell gasification technologies have sent the raw syngas (no sulfur removed) to the flare during the stabilization period. After the gasification plant has stabilized, the raw syngas is routed downstream to the acid gas removal plant where the sulfur (as hydrogen sulfide) is removed from the syngas.

Modeling results for the flare stack operation are presented in Table 4.2.1-7. These results, separately estimated using SCREEN3 with VALLEY terrain treatment, suggest that SO_2 emissions during flaring may cause high ambient concentrations during worst-case meteorological conditions. Table 4.2.1-7 presents 1-hour estimated SO_2 concentrations for several different flare stack heights. These results indicate that the flare stack height would need to be at least 200 feet high in order for ambient SO_2 concentrations to remain below the 3-hour NAAQS of 1,300 $\mu g/m^3$ (assuming blended fuel use and ambient concentration in the adjacent two hours is zero). For petroleum coke, the flare stack should be between 200 and 250 feet high to ensure that the 3-hour SO_2 NAAQS is met. It should be noted that 213 feet is the maximum flare stack height for which GEP credit is given if there are no structures nearby.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Geologic Stability

Mitigation of the environmental impacts of the raw gas (flared upstream of acid gas/sulfur removal) flaring will be addressed during the detailed design of the implemented option, if raw gas flaring applies. For gasification technologies, Destec gasification technology currently avoids the impacts caused by flaring of raw gas during startup by routing the syngas through the acid gas removal unit during startup. Currently, the Texaco and Shell gasification technologies have “bypassed” or flared raw gas upstream of the acid gas removal unit during startup; thus emitting sulfur for 30 minutes to an hour during the early stage of startup. Since the Bellefonte site is near elevated terrain, reduction of the sulfur in the flared raw gas during startup or flare design considerations will be required to prevent significant environmental impact. Sand Mountain, which reaches nearly 220 m (700 feet) above the flare stack base, is located just over 2.5 km (1.5 miles) to the southeast. Additional equipment and/or modified startup procedures should allow both Texaco and Shell gasification technologies to achieve acceptable sulfur emissions during startup. Strategies for sulfur control during startup might include:

- Low sulfur feedstock for startup,
- Sulfur absorbers specifically for startup,
- Additional pumps, piping, and instrumentation to allow the acid gas removal absorber to operate at lower-than-design pressures,
- Startup at higher rates and pressures to reduce the time to ramp up to design feed rate and pressure,
- Employ faster pressure ramp-up techniques to allow the acid gas removal absorber to come on line quicker,
- Elevated flare stack, and
- Increased flare exit velocities.

Table 4.2.1-7 Flare Stack Ambient Impact Under Worst-case Meteorological Conditions

			Blended Fuel	Petroleum Coke Only
Source	Pollutant	Stack Height (ft)	Estimated 1-hr Concentration (mg/m^3)	Estimated 1-hr Concentration (mg/m^3)
Flare	SO_2	100	5,796	6,908
	SO_2	200	3,560	4,244
	SO_2	300	1,793	2,138
	SO_2	400	740	883
	SO_2	500	716	853
	SO_2	600	748	892
	NO_X	100	108	108
	PM10	100	12	12
	CO	100	1,360	1,360

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Visibility

The VISCREEN model was used to determine if a plume from any of the Bellefonte conversion options or variants would be visible at the Cohutta Wilderness. VISCREEN considers primary particulates (PM10) and nitrogen oxides (NO_x) emissions, as well as the background visual range, distance to the nearest Class I area (approximately 120 km), wind speed, and stability classes. VISCREEN was run with the emissions for each conversion option using the annual median background visual range at Cohutta (about 65 km) and worst-case wind direction (towards Cohutta), wind speed (one m/s), and stability class (very stable [F]) conditions. Under these highly unusual conditions, VISCREEN predicted that the plumes from all of the conversion options could be visible from Cohutta at some time during the year. Conversely, when meteorological conditions are less stable and wind speeds are greater than 4 m/s, VISCREEN predicts that a plume would not be visible for any conversion option.

Plume visibility is greatly dependent on background visual range as well as the wind speed, direction, and stability conditions. On days when the visual range is substantially greater than the 65 km annual median (such as in December or January when the median visual range is as high as 122 km) the plume is more likely to be visible than on days when visual range is substantially lower than the median (such as in July or August when the median visual range is 25 km). To further bound this issue, VISCREEN was run while varying the visual range and holding the worst-case wind speed, direction, and stability class constant. These results are summarized in Table 4.2.1-8. The relatively small IGCC/C Option could not have a visible plume at Cohutta until the background visual range exceeds 79 km. At the other end of the spectrum, the PC Option could exhibit a visible plume at Cohutta if the visual range exceeds 41 km. Therefore, it is possible that a plume from any conversion option could be visible on clear winter days with stable conditions and low wind speeds, and not at all visible during hazy summer months regardless of the stability class and wind speed.

Table 4.2.1-8 Maximum Visual Range When Plume Would Not Be Visible at Cohutta

Conversion Option	Visual Range (km)
IGCC/C	79
NGCC	59
NGCC Bypass	59
NGCC Oil	56
NGCC Bypass Oil	56
Combination	55
Combination Bypass	53
Combination Oil	52
IGCC	47
IGCC Bypass	47
PFBC	45
PC	41

Hazardous Air Pollutants

A hazardous air pollutants analysis was performed to assess the potential health effects associated with the direct inhalation of air toxic constituents potentially present in emissions from the proposed conversion options or variants at Bellefonte. Hazardous air pollutants were identified for the 10 conversion options (no modeling was conducted for configurations involving only natural gas as a fuel) and are presented in Tables 4.2.1-9a and 4.2.1-9b along with emissions estimates for each option. Threshold pollutant levels are levels which would require evaluation in the PSD permit application (i.e., a BACT analysis would be conducted). These toxic emissions would presumably be emitted from the CT/HRSG stack and the flare stack for the options listed. Conservatively, both stacks were modeled assuming the total emissions from each. Therefore, the modeling results represent worst-case scenarios. The air modeling analysis was performed using the SCREEN3 to estimate the maximum 1-hour concentrations under worst-case meteorological conditions.

Table 4.2.1-9a Hazardous Air Pollutants Emissions from Flares (ton/yr)

		Conversion Option/Variant			
Pollutant	**PSD Threshold Level[a]**	**PFBC**	**IGCC**	**IGCC/C**	**Combination**
Antimony			1.858	0.031	0.031
Arsenic	0[b]	0.082	1.899	0.031	0.031
Barium		0.993			
Beryllium	0.004	0.016	0.320	0.005	0.005
Cadmium		0.033	1.105	0.018	0.018
Calcium			0.448	0.224	0.224
Chromium		0.131			
Cobalt		0.066	0.836	0.014	0.014
Lead	0.6	0.049	0.557	0.009	0.009
Manganese		2.550	33.641	0.555	0.555
Mercury, Elemental	0.1	0.004	5.161	0.085	0.085
Nickel, total		0.164	120.671	1.991	1.991
Selenium		1.310	0.516	0.009	0.009
Vanadium			0.444	0.007	0.007
Benzene	0		1.166	0.019	0.019
Hydrogen Fluoride	3.0[c]		12.387	0.204	0.204
Naphthalene			29.171	0.481	0.481
Benzo (a) Pyrene		0.1640	3.107	0.051	0.051
Formaldehyde			26.859	0.443	0.443
Acetaldehyde			3.107	0.051	0.051
Ammonia		0.3120	97.745	1.613	1.613

[a] - Source: 40 CFR Part 52
[b] - inorganic arsenic
[c] - as fluorides

Table 4.2.1-9b Hazardous Air Pollutants Emissions from Stacks (ton/yr)

	Conversion Option/Variant					
Pollutant	**PC**	**PFBC**	**IGCC and IGCC Bypass**	**IGCC/C, Combination, and Combination Bypass**	**NGCC Oil and NGCC Oil Bypass**	**Combination Fuel Oil**
Antimony	0.025	0	1.858	0.008	0.148	0.156
Arsenic	0.177	0.0821	1.899	0.008	0.033	0.041
Barium		0.9930			0.002	
Beryllium	0.027	0.0164	0.320	0.001	0.028	0.003
Cadmium	0.080	0.0328	1.105	0.005	0.316	0.033
Calcium		0	13.585	0.056		0.056
Chromium	0.956	0.1310				0.316
Cobalt	0.140	0.0657	0.836	0.004	0.061	0.065
Lead	0.539	0.0493	0.557	0.002	0.390	0.392
Manganese	0.971	2.5500	33.641	0.139	2.285	2.424
Mercury, Element		0.0041	5.161	0.021	0.006	0.027
Nickel, total	1.024	0.1640	120.671	0.498	8.064	8.562
Selenium		1.3100	0.516	0.002	0.036	0.038
Vanadium		0	0.444	0.002		0.002
Benzene		0	1.166	0.005		0.005
Hydrogen Fluoride	0.375	0	12.387	0.051		0.051
Naphthalene		0	29.171	0.120		0.120
Benzo (a) Pyrene		0.1640	3.107	0.013		0.013
Formaldehyde		0	26.859	0.111		0.111
Acetaldehyde		0	3.107	0.013		0.013
Ammonia		0.3120	97.745	0.403		0.403

Modeling results are presented for the HRSG stack in Tables 4.2.1-10a and 4.2.1-10b and for the flare stack in Table 4.2.1-11. Threshold Limit Value-Time Weighted Averages (TLV-TWA) for the hazardous air pollutants evaluated were taken from guidance developed by the American Conference of Governmental Industrial Hygienists (ACGIH). [5] The TLV-TWA is the time weighted average concentration for a normal 8-hour work day and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect. In Tables 4.2.1-10a and 4.2.1-10b, the highest 1-hour concentrations for each pollutant for each option was compared to the TLV-TWA/40 which is the value used by ADEM to convert occupational levels to community safety levels for comparison with 1-hour average concentrations.

As shown in the results, none of the options produced concentrations which exceeded the TLV-TWA/40 for any of the pollutants. In summary, direct inhalation of hazardous air pollutant emissions from the operation of any of the proposed conversion options would not cause significant adverse effects to the human health of the area population.

Table 4.2.1-10a Modeling Results for Hazardous Air Pollutants (mg/m^3)

		Conversion Option/ Variant				
Pollutant	**TLV-TWA/40**	**PFBC 1-Hour Conc.**	**PC 1-Hour Conc.**	**IGCC 1-Hour Conc.**	**IGCC/C 1-Hour Conc.**	**Combination 1-Hour Conc.**
Antimony	12.50		<0.001 [a]	0.040	<0.001	<0.001
Arsenic	0.25	0.013	0.003	0.041	<0.001	<0.001
Barium	12.50	0.154				
Beryllium	0.05	0.0025	<0.001	0.007	<0.001	<0.001
Cadmium	0.25	0.0051	0.001	0.024	<0.001	<0.001
Calcium	250.00			0.293	0.001	0.001
Chromium	12.50	0.020	0.015			
Cobalt	0.50	0.010	0.002	0.018	<0.001	<0.001
Lead	1.25	0.0076	0.008	0.012	<0.001	<0.001
Manganese	5.00	0.395	0.015	0.726	0.003	0.003
Mercury, Element	0.625	<0.001	0.009	0.111	<0.001	<0.001
Nickel, total	25.00	0.025	0.016	2.603	0.011	0.011
Selenium	5.00	0.200	0.055	0.011	<0.001	<0.001
Vanadium	1.25			0.010	<0.001	<0.001
Benzene	800.00		0.006	0.004	<0.001	<0.001
Hydrogen Fluoride	NA [b]		21.51	0.267	0.001	0.001
Naphthalene	1,300.00		0.006	0.629	0.003	0.003
Benzo (a) Pyrene	NA	0.025	<0.001	0.067	<0.001	<0.001
Formaldehyde	NA		0.004	0.579	0.002	0.002
Acetaldehyde	NA		0.005	0.067	<0.001	<0.001
Ammonia	425.00	0.048		2.108	0.009	0.009

[a] - insignificantly low numbers are shown as <0.001
[b] - not available

Table 4.2.1-10b Modeling Results for Hazardous Air Pollutants (mg/m^3)

		Conversion Option/Variant				
Pollutant	**TLV-TWA/40**	**IGCC Bypass 1-Hour Conc.**	**NGCC Oil 1-Hour Conc.**	**NGCC Oil Bypass 1-Hour Conc.**	**Combination Bypass 1-Hour Conc.**	**Combination Oil 1-Hour Conc.**
Antimony	12.50	0.009	0.004	0.001	<0.001	0.003
Arsenic	0.25	0.009	0.001	<0.001	<0.001	<0.001
Barium	12.50		<0.001	<0.001		
Beryllium	0.05	0.002	0.001	<0.001	<0.001	<0.001
Cadmium	0.25	0.005	0.009	0.002	<0.001	0.001
Calcium	250.00	0.065			<0.001	<0.001
Chromium	12.50					0.007
Cobalt	0.50	0.004	0.002	<0.001	<0.001	0.001
Lead	1.25	0.003	0.011	0.003	<0.001	0.008
Manganese	5.00	0.160	0.064	0.016	<0.001	0.049
Mercury, Element	0.625	0.025	<0.001	<0.001	<0.001	<0.001
Nickel, total	25.00	0.574	0.226	0.056	0.002	0.174
Selenium	5.00	0.002	<0.001	<0.001	<0.001	<0.001
Vanadium	1.25	0.002			<0.001	<0.001
Benzene	800.00	<0.001			<0.001	<0.001
Hydrogen Flouride	NA[b]	0.059			<0.001	<0.001
Naphthalene	1,300.00	0.139			<0.001	<0.001
Benzo (a) Pyrene	NA	0.015			<0.001	<0.001
Formaldehyde	NA	0.128			0.001	<0.001
Acetaldehyde	NA	0.015			<0.001	<0.001
Ammonia	425.00	0.465			0.002	<0.001

[a] - insignificantly low numbers are shown as <0.001
[b] - not available

Table 4.2.1-11 Modeling Results for Hazardous Air Pollutants from the Flare Stack (μg/m^3)

		Conversion Option							
		PFBC 1-Hour Conc.		IGCC 1-Hour Conc.		IGCC/C 1-Hour Conc.		Combination 1-Hour Conc.	
Pollutant	**TLV-TWA/40**	**100 ft**	**213 ft**	**100 ft**	**213 ft**	**100 ft**	**213 ft**	**100 ft**	**213 ft**
Antimony	12.50	<0.001[a]	<0.001	0.20	0.11	0.003	0.002	0.003	0.002
Arsenic	0.25	0.001	0.001	0.20	0.11	0.003	0.002	0.003	0.002
Barium	12.50	0.008	0.008						
Beryllium	0.05	<0.001	<0.001	0.034	0.019	<0.001	<0.001	<0.001	<0.001
Cadmium	0.25	<0.001	<0.001	0.115	0.066	0.002	0.001	0.002	0.001
Calcium	250.0	<0.001	<0.001	1.42	0.807	0.023	0.013	0.023	0.013
Chromium	12.50	0.001	0.001						
Cobalt	0.50	0.001	0.001	0.088	0.050	<0.001	<0.001	0.001	<0.001
Lead	1.25	<0.001	<0.001	0.058	0.033	<0.001	<0.001	<0.001	<0.001
Manganese	5.00	0.021	0.020	3.53	2.00	0.058	0.033	0.058	0.033
Mercury, Element	0.625	<0.001	<0.001	0.541	0.307	0.009	0.005	0.009	0.005
Nickel, total	25.0	0.001	0.001	12.65	7.17	0.208	0.118	0.209	0.118
Selenium	5.0	0.011	0.010	0.054	0.031	<0.001	<0.001	0.001	<0.001
Vanadium	1.25	<0.001	<0.001	0.046	0.026	0.001	<0.001	<0.001	<0.001
Benzene	800.0	<0.001	<0.001	0.122	0.069	0.002	0.001	0.002	0.001
Hydrogen Flouride	NA[b]	<0.001	<0.001	1.30	0.746	0.021	0.012	0.021	0.012
Naphthalene	1,300.0	<0.001	<0.001	3.06	1.73	0.050	0.028	0.050	0.029
Benzo (a) Pyrene	NA	0.001	0.001	0.325	0.185	0.005	<0.003	0.005	0.003
Formaldehyde	NA	<0.001	<0.001	2.81	1.60	0.046	0.026	0.046	0.026
Acetaldehyde	NA	<0.001	<0.001	0.325	0.185	0.005	0.003	0.005	0.003
Radio Nucleides	NA	<0.001	<0.001	0.004	0.002	<0.001	<0.001	0.001	0.001
Ammonia	425.0	0.003	0.002	10.24	5.81	0.17	0.10	0.17	0.10

[a] - insignificantly low numbers are shown as <0.001
[b] - not available

Odors

The SCREEN3 model was used to estimate maximum concentrations beyond the property boundary of six chemical compounds which produce odors for each conversion option. The six chemicals are:

- Benzene,
- Naphthalene,
- Formaldehyde,
- Acetaldehyde,
- Ammonia, and
- Hydrogen sulfide.

These maximum concentrations were compared to the odor thresholds published in literature. [6] The article referenced is a compilation of odor thresholds for over 400 chemical substances which lists a lower threshold and a higher threshold for each chemical compound. Generally, the range is quite large, due to the differences in sensitivity of individuals and differences in methods of determining the threshold in various studies. If the maximum concentration is less than the lower odor threshold, there is confidence that it would not produce an odor. If the maximum concentration is between the lower and higher thresholds, it may cause an odor to sensitive individuals. If the maximum concentration is greater than the higher threshold, it would cause a noticeable odor. It is also important to consider that some odors are more offensive than others; benzene and acetaldehyde, for example, are described as being fairly sweet, while hydrogen sulfide is described as being repulsive. Typical responses are described in the following list.

Chemical	Description of odor
Benzene	sweet, solventy
Naphthalene	mothball, tar-like
Formaldehyde	pungent, hay
Acetaldehyde	green, sweet, fruity
Ammonia	pungent, irritating
Hydrogen Sulfide	rotten eggs

Odors from Flares

Emissions from the flares were modeled using emission rates for Shell and Texaco gasification technologies and based on two stack heights, 100 feet (30.48 m) and 213.25 feet (65 m), and are presented in Table 4.2.1-12. Modeling results are presented in Table 4.2.1-13. While the 213-foot flare produced lower maximum concentrations than the 100-foot flare, it did not reduce the concentrations enough to make a difference; the chemicals which exceeded the odor threshold based on 100 feet also exceeded the odor threshold at 213 feet. There are no emissions from the flare for these chemical for the PFBC Variant. The hydrogen sulfide concentrations from both flare heights exceeded the higher odor threshold for the IGCC, IGCC/C, and Combination Options. Therefore, a hydrogen sulfide odor would be noticeable to all people for the IGCC, IGCC/C, and Combination Options; yet since the raw gas flares would operate less than 100 hours per year, this impact would be intermittent and be noticeable only immediately downwind of the plant. Further, these intermittent impacts could be mitigated through the use of strategies for sulfur control discussed in the section on gasifier startup/bypass mode or through the use of the Destec technology.

Table 4.2.1-12 Emissions Used for Odor Analysis of Flare Stack (g/s)

Pollutant	IGCC	IGCC/C	Combination
Hydrogen Sulfide	17.6	17.6	17.6
Benzene	0.00335	0.00055	0.00055
Naphthalene	0.839	0.0138	0.0138
Formaldehyde	0.773	0.0127	0.0127
Acetaldehyde	0.0894	0.00147	0.00147
Ammonia	2.81	0.0464	0.0464

Table 4.2.1-13 Modeling Results for Odors From Flares (ug/m^3)

Pollutant	Odor Threshold		IGCC 1-Hour Conc.		IGCC/C 1-Hour Conc.		Combination 1-Hour Conc.	
	Lower	Higher	100 ft Stack	213 ft Stack	100 ft Stack	213 ft Stack	100 ft Stack	213 ft Stack
Hydrogen Sulfide	0.7	14	64.0	36.3	64.0	36.3	64.0	36.3
Benzene	4,500	270,000	0.122	0. 069	0.020	0.001	0.020	0.001
Naphthalene	1,500	125,000	3.06	1.73	0.50	0.029	0.50	0.029
Formaldehyde	1,470	73,500	2.81	1.60	<0.046	0.026	0.046	0.026
Acetaldehyde	0.2	4140	0.3325	0.2185	<0.005	0.003	0.005	0.003
Ammonia	26.6	39,600	10.2	5.81	0.169	0.096	0.169	0.096

Odors From Continuously Operated Stacks

Emissions from the continuous operating stacks were modeled using emission rates for Shell and Texaco gasification technologies (Table 4.2.1-14) and the maximum concentrations were compared to the lower and higher odor thresholds for each option. Modeling results from these stacks are presented in Tables 4.2.1-15a and 4.2.1-15b. The IGCC Option produced ammonia and acetaldehyde concentrations which were above the lower threshold, indicating they may cause an odor noticeable to some people during worst-case meteorology. The IGCC Bypass Variant produced concentrations of acetaldehyde which exceed the lower threshold, also indicating they may cause an odor noticeable to some people during worst-case meteorology. None of the options produced concentrations exceeding the higher odor threshold for any of the chemicals.

Table 4.2.1-14 Emission Rates for Odor Analysis of All Continuously Operating Stacks (g/s)

Pollutant	PC	PFBC	IGCC	IGCC/C	Combination	IGCC Bypass	Combination Bypass	Combination Fuel Oil
Hydrogen Sulfide	0	0	0.262	0.131	0.131	0.262	0.131	0.13
Benzene	0.00546	0	1.166	0.005	0.005	1.166	0.005	0.005
Naphthalene	0.0018	0	29.171	0.12	0.12	29.171	0.12	0.12
Formaldehyde	0.0075	0	26.859	0.11	0.11	26.859	0.11	0.11
Acetaldehyde	0.0092	0	3.107	0.013	0.013	3.107	0.013	0.013
Ammonia	0	0.009	97.7	0.4	0.4	97.7	0.4	0.4

Table 4.2.1-15a Modeling Results for Odors From All Continuously Operating Stacks (ug/m^3)

Pollutant	Lower Threshold	Higher Threshold	PC 1-Hour Conc.	PFBC 1-Hour Conc.	IGCC 1-Hour Conc.	IGCC/C 1-Hour Conc.	Combination 1-Hour Conc.
Hydrogen Sulfide	0.7	14.0	0	0	0.19	0.10	0.10
Benzene	4,500.0	270,000.0	0.003	0	0.87	0.004	0.004
Naphthalene	1,500.0	125,000.0	0.001	0	21.87	0.09	0.09
Formaldehyde	1,470.0	73,500.0	0.004	0	20.14	0.08	0.08
Acetaldehyde	0.2	4,140.0	0.005	0	**2.33**	0.01	0.01
Ammonia	26.6	39,600.0	0	0.05	**73.3**	0.3	0.3

Table 4.2.1-15b Modeling Results for Odors From All Continuously Operating Stacks (ug/m^3)

Pollutant	Lower Threshold	Higher Threshold	IGCC Bypass 1-Hour Conc.	Combination Fuel Oil 1-Hour Conc.	Combination Bypass 1-Hour Conc.
Hydrogen Sulfide	0.7	14.0	0.04	0.1	0.02
Benzene	4,500.0	270,000.0	0.2	0.004	0.0008
Naphthalene	1,500.0	125,000.0	4.8	0.09	0.02
Formaldehyde	1,470.0	73,500.0	4.4	0.08	0.02
Acetaldehyde	0.2	4,140.0	**0.5**	0.01	0.002
Ammonia	26.6	39,600.0	16.2	0.3	0.07

Cooling Tower Drift

Cooling tower drift, defined as the dispersion and deposition of wet or dry aerosols emitted from natural or mechanical draft cooling towers, may have localized environmental effects. Under the original design plan for Bellefonte Nuclear Plant a cooling tower drift of 45 gpm was estimated and used to evaluate drift impacts in the Bellefonte Nuclear Plant EIS. [7] The modeled impact of this drift, both in terms of total dissolved solids and trace hazardous air pollutants, suggested that the impact would be within the site boundary and would be minor and environmentally inconsequential.

The maximum cooling tower drift estimates for any of the Bellefonte conversion options and variants is 28% less (IGCC, 32.4 gpm) than the original drift estimates for the Bellefonte Nuclear Plant. Therefore, the cooling tower drift impacts would likewise remain within the site boundary and would be environmentally inconsequential.

Another issue sometimes raised in connection with the operation of natural draft cooling towers is whether tower drift interacts with pollutant gases and particles being emitted from a nearby fossil-fueled power plant. This issue was addressed in the Watts Bar Nuclear Plant Environmental Statement which is the only instance of collocated fossil and nuclear plants in the TVA system. [8] The Watts Bar situation involved a much higher potential for interaction of water droplets and pollutants since the Watts Bar Fossil Plant was equipped with relatively inefficient particulate emission controls and employed no sulfur dioxide or nitrogen dioxide controls. The Environmental Statement concluded that, on the basis of a study completed by TVA staff, that acid mists and acid fly ash formed due to mergence of cooling tower plumes with the plumes from and the Watts Bar coal-fired plant should be minimal. Bellefonte air pollutant sources will be equipped with best available technology for reducing emissions; consequently, the formation of acid mist due to plume mergence should be insignificant. [8]

4.2.2 Geologic Stability

4.2.2.1 Impacts of Construction

Surface Faulting

Although large areas of eastern North America have been deformed one or more times through plate tectonic processes operating since Precambrian time or earlier, very few areas show evidence of significant deformation during the last 250 million years. Evidence of geologically recent faulting in the eastern United States is extremely rare. No recent surface faulting is known near Bellefonte; however, small to occasionally moderate earthquakes continue to occur in the southern Appalachians. Essentially all of these recent earthquakes occur within the basement rocks of the southern Appalachians at depths from 5 to 26 km. Reactivation of zones of existing weaknesses within the basement rocks are believed to be responsible for present day earthquake activity in the region. [9]

Soil Amplification and Ground Deformation

Liquefaction of soils at Bellefonte due to earthquake ground motion is believed to be very unlikely. However, because portions of some conversion options may have to be located in the flood plain of the Tennessee River, the effects of amplification of ground motions through soil columns should be considered in the seismic design of structures not founded on rock. Likewise, the potential for liquefaction beneath any new structure, pipeline, or conduit not founded on rock should be evaluated in areas that were not investigated as part of the original Bellefonte Safety Analysis Report. [10]

Seismic Hazard Assessments

The ground shaking maps in the 1994 National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions place Bellefonte in Seismic Hazard Zone 2. [11] Seismic Zone 2 is considered a “low” seismic hazard zone on a scale that ranges from Seismic Zone 1 (lowest computed hazard) to Seismic Zone 7 (highest hazard).

The earthquake hazard to ordinary buildings at Bellefonte can be adequately addressed through use of existing building codes. Special structures that house hazardous processes or sensitive equipment may require additional considerations. Transport of hazardous substances through underground or above ground piping may also require nonroutine design to address seismic hazards at the site.

The regional seismic hazard in the vicinity of Bellefonte is relatively low. However, it is imperative that the effects of site soil conditions on the amplitudes of ground shaking and on the possibility for ground deformations be evaluated.

Bedrock

Beneath the main plant site and footprint areas of the conversion options, the bedrock is the Chickamauga Formation, a limestone interbedded with shale. Subsidence incidents in the Chickamauga Formation are rare and can be mitigated by appropriate planning and design based upon a sound geotechnical investigation and proper construction practices. Within the main plant area footprint areas of alternative conversion options, no problems are expected to be created by activities such as excavation or dewatering. Even if groundwater is extracted near the plant site (none is planned), it should not affect the geologic competence of the foundation since the Chickamauga Formation is a consolidated bedrock.

All of the rock at the site where unweathered is capable of supporting intended loads. Unconfined compression strength determinations were made on nine bedrock core samples taken at random from the strata underlying the major Seismic Category I structures at the site. [10] The values ranged from 15,300 to 30,500 pounds per square inch (psi) and averaged 22,700 psi. For proposed foundations of new facilities/appurtenances on bedrock, a geotechnical investigation that includes examination of bedrock cores/coreholes would assist in final siting. Visual inspections of the extent of weathering during excavation would probably be sufficient for the majority of the new plant features. However, additional coring work may be necessary to adequately characterize bedrock foundation conditions beneath relatively high design load areas. During construction of Bellefonte Nuclear Plant, bedrock foundation treatment consisted of: over-excavation of weathered joints/seams and filling with concrete/grout mixtures; and coring accompanied by pressure grouting to fill deeper fractures, joints, and cavities.

<u>Overburden</u>

Soils underlying the footprint areas of alternative conversion options are variable in depth (0 to 7 m) and are expected to be primarily stiff silty clays and clayey silts. For proposed foundations of new facilities/appurtenances on soil, structural design would be based upon in-situ soil investigations at the proposed foundation location and appropriate safety factors.

4.2.2.2 Impacts of Operation

No impacts to geologic stability should occur as long as all structures are designed and constructed according to sound engineering practices, no materials are injected underground, and large volumes of groundwater are not removed.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

4.2.3 Soils

4.2.3.1 Impacts of Construction

With any of the five conversion options, the land within the site not physically occupied by power plant facilities and waste storage areas could be maintained in their present low intensity agricultural (pasture/hay), woodland, and wildlife uses. Future construction related to each conversion option at Bellefonte should have very minimal impact on agricultural production of the immediate vicinity or Jackson County.

Section 1540 (c) (1) of the Farmland Protection Policy Act, subtitle I of Title XV of the Agriculture and Food Act of 1981, Public Law 97-98, has defined prime farmland and regulations for its protection and land use conversion. Prime farmland is defined as the best land suited for producing food, feed, forage, fiber, and oil seed crops and also available for these uses (the land could be cropland, pasture land, range land, forest land, or other land, but not urban built-up land or water). [12] It has the soil quality, growing season, and moisture needed to produce sustained high yields of crops economically when treated and managed including water management, according to modern farming methods.

According to 1994 amendments to the Farmland Protection Policy Act, "Federal agencies are not required to consider the impact of their projects on prime farmland that is already in or committed to urban development or water storage, even if this land would otherwise fall within the definition of prime farmlands." According to an 1994 amendment to 7 CFR Part 658 which implement the farmland protection policy act, land committed to industrial or other nonagricultural uses by a local land use plan is regarded as "committed to urban development." [13] Since Bellefonte was established in the 1970s for industrial use, there should be no legal requirements to provide a form AD-1006. However, a form AD-1006 was completed and is presented in Appendix K. The total point score was 86, very much below the 160 point score considered critical for consideration of an alternative site for the project.

Two other farmland categories are defined in the legislation: unique farmland and other farmland of state or local importance. These farmland categories are not considered to be of primary significance at the Bellefonte project site, and therefore will be discussed here only very briefly, primarily by showing the occurrence of any other important farmland land category.

Using the soils data base described in Chapter 3, acreage estimates and interpretative maps were developed for the project site which groups all the soils that are in each of the three categories: prime farmland, other important farmland, and other land.

A list of the soil phases that comprise the areas designated as *prime farmland* at Bellefonte is as follows:

Abernathy silt loam -	0 to 4% slopes
Bruno fine sandy loam -	0 to 2% slopes
Capshaw silt loam -	0 to 5% slopes
Colbert silty clay and silty clay loam -	2 to 5% slopes
Cumberland silt loam and silty clay loam -	2 to 5% slopes
Dewey silt loam and silty clay loam -	2 to 5% slopes
Egam silt loam -	0 to 2% slopes
Etowah loam, silt loam, and silty clay loam -	0 to 5% slopes
Fullerton cherty silt loam -	2 to 5% slopes
Hermitage silty clay loam -	2 to 5% slopes
Huntington silt loam -	0 to 2% slopes
Lindside silt loam -	0 to 2% slopes
Ooltewah silt loam -	0 to 2% slopes
Sequatchie fine sand loam -	2 to 5% slopes
Swaim silty clay loam -	2 to 5% slopes
Talbott silt loam and silty clay loam -	2 to 5% slopes.

Most of the soils designated as *other important farmland* consist of rolling (5 to 12% slope) stream terrace and upland soils, as well as level to undulating soils with poor internal drainage. This land category occupies 340 acres (or 21%) of Bellefonte. The *other land* category consists of the very steep or very severely eroded land, most of which is in forest use. This land category occupies 613 acres (38%) of the project site (Table 4.2.3-1 and Figure 4.2.3-1).

Table 4.2.3-1 Impact of Each Conversion Option on Prime Farmland

Land Category	Original acreage in site (Pre-Bellefonte Construction)	Acreage lost				
		PC	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
Prime Farmland	657	434 (66%) [a]	190 (29%)	312 (47%)	312 (47%)	309 (47%)
Other Important Farmland	340	197 (58%)	89 (26%)	127 (37%)	127 (37%)	126 (37%)
Other Land	613	207 (34%)	81 (13%)	157 (26%)	157 (26%)	143 (23%)
Total Land in Bellefonte Site	1,610					

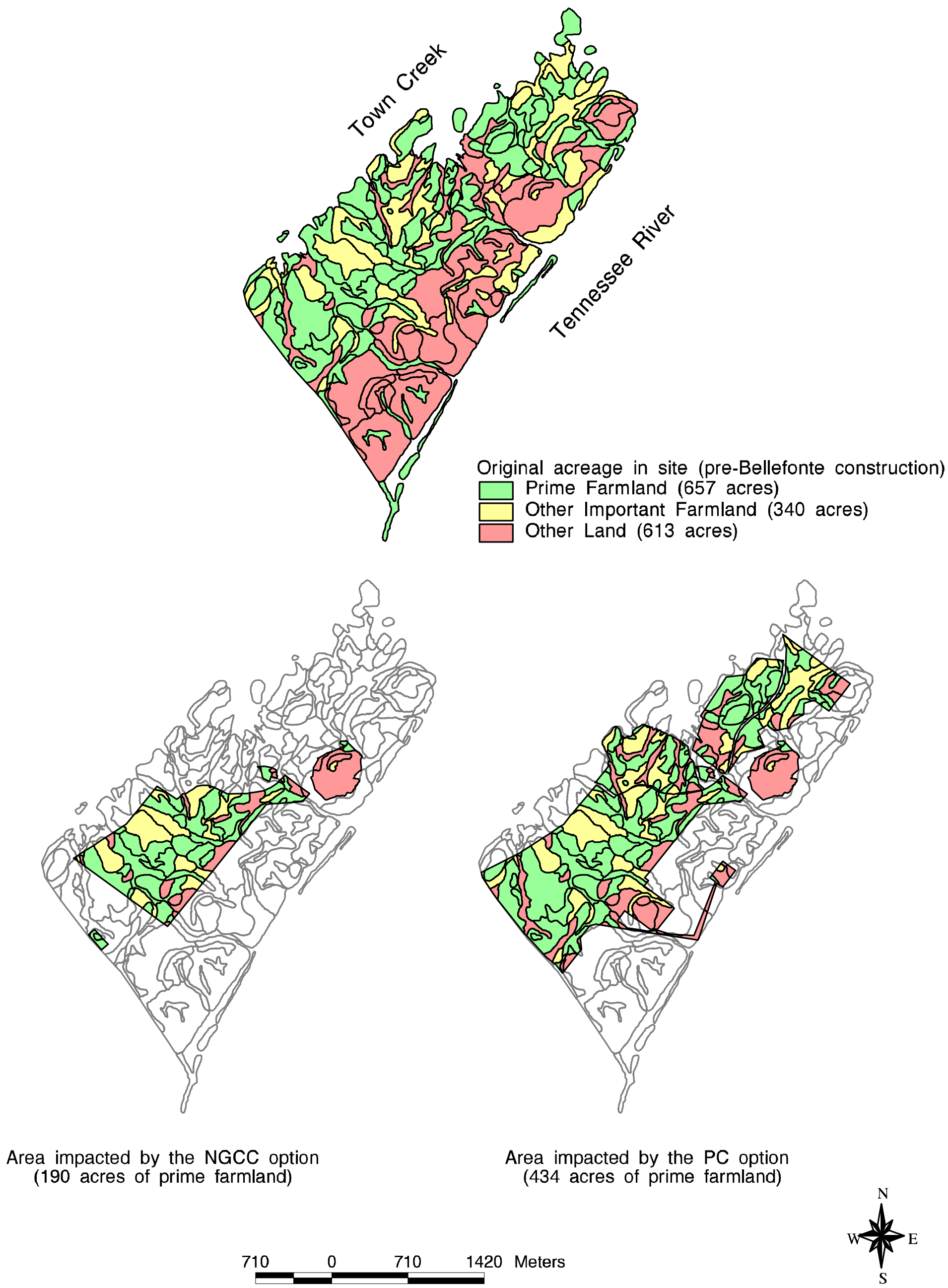
[a] - Percent of original land category lost

The potential impacts on *prime farmland* (acreage loss) associated with each of the five conversion options are shown in Table 4.2.3-1. Of the approximately 1,610 acres in Bellefonte, 657 acres (or 41%) was classified as *prime farmland* prior to TVA acquisition of the site in the 1970s (Table 4.2.3-1 and Figure 4.2.3-1). Of the five conversion options being considered, the NGCC Option would have the least impact (190-acre loss) on *prime farmland*, and the PC Option would have the greatest impact (434-acre loss) (Table 4.2.3-1). A map illustrating the least and most impact on *prime farmland* loss is given in Figure 4.2.3-1 for the NGCC and PC Options. The IGCC and IGCC/C Options would result in a 312-acre loss of prime farmland. The Combination Option would result in a 309-acre loss of prime farmland.

4.2.3.2 Impacts of Operation

The impacts of operations on soils and prime farmland for each of the five options are expected to be the same as already described in impacts of construction. Although land requirements for storage and handling of fuels, by-products, and waste storage differ among the five options, these needs were included with the construction impact section.

Figure 4.2.3-1 Prime Farmland Categories at Bellefonte



4.2.4 Solid Nonhazardous Waste

4.2.4.1 Impacts of Construction

Because the footprint for each of the proposed conversion facilities falls completely within the mostly completed Bellefonte plant site, it is expected that only a small amount of brush, tree limbs, and tree stumps would be generated by clearing and grubbing of the site itself. Much of the waste from construction would be typical construction/demolition waste, generated by the modification of existing buildings and the building of new ones, such as:

- broken concrete,
- rock,
- asphalt,
- scrap lumber,
- scrap metal, and
- packing materials.

Limited quantities of asbestos-containing waste may be generated during the construction phase of the proposed conversion. Any such waste will be disposed of offsite at an approved landfill. Any disposal of asbestos-containing waste will be done in accordance with State regulations which provide specific guidance with regard to packaging and burial. Other solid waste generated during construction may be disposed of either onsite or offsite, depending on the outcome of further analysis.

There appears to be enough available space to install a landfill onsite to accommodate construction/demolition waste generated during the construction phase. However, the economics of and other considerations related to onsite disposal would have to be investigated and compared against the alternative of disposal off site before selecting that option. Any construction/demolition landfill would have to be constructed so as to have low permeability materials below the waste and adequate separation from the groundwater table below, among other regulatory requirements, in order to minimize any possible adverse impacts from these usually inert wastes.

There are several landfills within five to 50 miles of Bellefonte that have the capacity to accept construction/demolition waste generated during the construction phase. These landfills are listed in

Table 4.2.4-1 with their respective storage capacities and life expectancies. All of the landfills listed in the table accept asbestos-containing waste. It is expected that the construction/demolition waste would be disposed of off site at a state-approved landfill. If the quantity of brush, tree limbs, and tree stumps from the site prove to be significant, then TVA would apply to the state for a one-time permit to burn this vegetative waste.

Table 4.2.4-1 Landfills Near Bellefonte

Landfills	Scottsboro	Fort Payne	Huntsville
Storage Capacity (tons)	1,250,000	214,000	780,000
Life Expectancy (years)	20	5 to 10	12

4.2.4.2 Impacts of Operation

Of the five conversion options, all except the NGCC option, which utilizes natural gas, produce solid material streams in significant quantities. Information regarding these solid material streams is provided in Tables 4.2.4-2 and 4.2.4-3.

Table 4.2.4-2 Solid Waste/By-product Information for PC Option

Waste Stream	Generation Rate (tpy)	Classification	Comments on Composition	Disposal Requirements
Fly ash	676,921	Solid waste/ By-product	Nonhazardous	Onsite
Bottom ash	169,230	Solid waste/ By-product	Nonhazardous	Onsite
FGD sludge (gypsum)	1,255,189	Solid waste/ By-product	Nonhazardous	Onsite
Raw water treatment sludges[a]	1,280	Solid waste	Nonhazardous	Off site
General water treatment sludges	800	Solid waste	Nonhazardous	Off site

[a] - Actual quantities will depend on local raw water quality

Option 1: PC

For this option, PC is the primary technology with PFBC as a potential variant. The PC Option features the conventional combustion of pulverized coal with the generation of the residual fly ash, bottom ash or boiler slag, and flue gas desulfurization (FGD) sludge (gypsum) from the cleanup of flue gas effluents, with smaller quantities of water treatment sludges (Table 4.2.4-2). The manner in which these materials are generated is described earlier, in Chapter 2.

Fly Ash and Bottom Ash or Boiler Slag

The predominant constituents of fly ash are inert mineral oxides. About 95% of the ash is made up of silicon, aluminum, iron, and calcium as oxides. Magnesium, potassium, sodium, titanium, and sulfur are also present to a lesser degree, also as oxides. Fly ash also contains many other elements in much smaller quantities. Typically about 0.1% of fly ash, by weight, is composed of these trace elements but the types and proportions provided by the trace elements is quite variable. Carbon is also present in various amounts but only sufficient to be considered as a contaminant of the fly ash. [14]

Bottom ash consists of angular particles which have a porous surface texture and are normally gray to black in color. Boiler slag is composed of black angular particles having a glassy appearance. For a particular type of coal, the gross chemical composition of the bottom ash or boiler slag derived from that coal would be similar to but may have a lower carbon content than the fly ash derived from the same combustion process. The trace element composition varies more between fly ash and bottom ash or boiler slag depending on the relative trace element volatility which controls the partitioning of the element between the fly ash and the bottom ash or boiler slag. Thus, the fly ash would be enriched with the more volatile trace elements, such as arsenic, cadmium, and lead, and conversely, the bottom ash or boiler slag would be enriched with the less volatile trace elements such as chromium. [14]

Some of these trace elements are considered to be toxic, and the leachabilities of several of the trace elements, and other chemical species, are among the criteria used to determine whether wastes should be classified as hazardous. As it is, large volume utility wastes such as fly ash and bottom ash or boiler slag that are generated by coal combustion are exempt from the Federal Resource Conservation and Recovery Act (RCRA) regulations. Nevertheless, in part because states may choose to have more stringent regulations, the RCRA extraction procedure has been applied to these materials.

The fly ash and bottom ash or boiler slag from the PC technology commonly test out as nonhazardous via the EPA RCRA Toxicity Characteristic Leaching Procedure (TCLP). [15] Also, Electric Power Research Institute (EPRI) research has shown that toxic metals such as chromium, cadmium, arsenic, and selenium are present in coal combustion ash wastes in forms that have very low solubility. In addition, other metals such as lead, mercury, and silver, do not leach appreciably because of their low concentrations in the ash and presence as insoluble compounds. [16] However, chemical species such as calcium, sulfate, and boron are soluble constituents which leach and thus have the potential to reach groundwater.

Constituents that do leach from the waste/by-product are still subject to a number of attenuation processes within the soil below, before they could reach the groundwater. These include adsorption and solid-phase precipitation reactions which represent complex physical and chemical interactions between soil/geologic matrices and the hydrogeochemical environment. [16] Finer-grained soils because of greater specific surface and composition tend to be greater attenuators than coarser soils, with pH and oxidation-reduction potential exerting significant modifying roles. Also, the utilization of dry stacking as a method of disposal/storage is likely to reduce the generation of leachate.

Fly ash and bottom ash or boiler slag would be stored onsite pending the marketing of these materials and by-products. Materials not sold would be disposed of onsite (see preliminary footprints in Appendix B). The disposal of these materials is not regulated by ADEM; however, good engineering practices require that a buffer zone of low permeability geological materials/soil separate the disposed solids from the groundwater. The native clay and silty clay soils at Bellefonte are adequate either as is or compacted in situ. Local monitoring and past records would be used to establish the appropriate groundwater levels. Notably, as mentioned earlier, dry stacking would be used in order to reduce the generation of leachate. These measures would minimize the likelihood that disposal of these solids would have an adverse impact on groundwater and the environment.

Gypsum

Gypsum is produced by the use of an alkaline slurry to react with and remove the acidic SO_2 gas from the post-combustion effluent flue gases. This material is comprised primarily of calcium-based reaction products (such as calcium sulfate and calcium sulfite solids), excess scrubbing reagent, and fly ash as solid components, along with the excess scrubbing liquor. [17]

The most important factors affecting the chemical composition of raw scrubber sludge solids are coal characteristics (such as ash quantity and quality and sulfur content), extent of oxidation (sulfate/sulfite), reagent type, quantity, and purity, and the amount of fly ash present.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Gypsum, like other large volume wastes from coal combustion, is exempt from classification as a hazardous waste. Nevertheless, by EPA extraction procedures (EP) and TCLP leaching procedures, scrubber sludges from a number of TVA fossil plants have tested as nonhazardous. However, gypsum which is composed largely of calcium sulfate, produces leachates with readily measurable concentrations of calcium and sulfate. Thus, gypsum would be a potential source of calcium and sulfate ions in groundwater.

Transport water for scrubber use is recycled and cannot be discharged to the river without an NPDES permit. Gypsum would normally be marketed. The unsold gypsum sludge would be wet stacked to reduce leachate generation (see preliminary footprints in Appendix B). However, because a surface impoundment may be created by this process, a liner may be required. The gypsum storage/disposal area will be provided with either a 2-foot clay liner with a permeability of less than 10^{-7} cm/sec or a synthetic liner underlain by a "smoothing" layer of clay. These factors taken together minimize the likelihood that disposal of these solids would have an adverse impact on the groundwater and the environment.

Raw water and general water treatment sludges are expected to be similar to those for the other options and their disposal is discussed later in this section.

Option 3: IGCC, Option 4: IGCC/C, and Option 5: Combination

For the IGCC, IGCC/C, and Combination Options, the major solid waste and by-product streams are generated by the gasifiers. The IGCC, IGCC/C, and Combination Options include eight, four, and four gasifier units, respectively, and would utilize coal at the rates of 24,000, 12,000, and 12,000 tpd, respectively. Thus, the solid waste and by-product streams for these options differ quantitatively but not qualitatively. This is reflected in the data presented for these options in Table 4.2.4-3.

Slag and Fly ash

Characteristics of the wastes and by-products from the gasifiers are based on the Shell Coal Gasification Process pilot plant (SCGP-1) formerly operated near Houston, Texas. The Shell system is one of three gasifier brands under consideration at this time, the other two being Destec and Texaco. All are entrained flow gasifiers that differ primarily in the manner in which the coal is fed into the gasifier. The nature of the solid waste streams should be similar for these three gasifiers.

Table 4.2.4-3 Solids Information for IGCC, IGCC/C, and Combination Options

Solids Stream	Generation Rate (tpy) for IGCC	IGCC/C	Combination	Classification	Comments on Composition	Disposal Requirements
Slag	504,000	252,000	252,000	Marketable byproduct	Nonhazardous	Temporary storage for sale
Fly ash	40,800	20,400	20,400	Marketable byproduct	Nonhazardous	Temporary storage for sale
Sulfur	200,000	100,000	100,000	Marketable byproduct	Nonhazardous	Elemental sulfur market
Spent catalysts	520	260	260	Solid waste	Possibly hazardous	Reclaimed by vendor or off site
Raw water treatment sludges[a]	1,280	640	640	Solid waste	Nonhazardous	Off site
General water treatment sludges	800	400	400	Solid waste	Nonhazardous	Off site
Biotreatment sludges	40	20	20	Solid waste	Nonhazardous	Off site

[a] - Actual quantities would depend on local raw water quality.

Slag, fly ash, and sulfur account for more than 99% of the solids produced by the IGCC systems after which the TVA facility would be modeled. Notably, the spent sorbent from dry chloride removal, a solid waste sometimes associated with IGCC systems, is not considered here because a wet process would be utilized instead and no equivalent solid waste stream would be generated.

The slag is black and composed of glassy irregular granules and spherical particles the size of coarse sand. Fly ash is finer than sand and less dense. It contains about 5 to 20% carbon compared with less than 1% carbon for slag with percentages varying according to coal type and process configuration. The gross chemical compositions of slag and fly ash generated at SCGP-1 in Houston by a similar process using different coal feedstock are presented in Table 4.2.4-4. The physical characteristics are from a proposal submitted to the U.S. Department of Energy for consideration in its Clean Coal Technology Program Round V. [18]

Table 4.2.4-4 Major Element Analysis Bellefonte Conversion Project

Component	Design Coal Elements, %Wt. of Ash Before Adding Flux	Design Slag[a] Elements, %Wt.		Design Fly Ash[a] Elements, %Wt.	
		10% Flux	20% Flux	10% Flux	20% Flux
Aluminum	7.41	6.7	5.93	6.30	5.60
Calcium	6.00	17.54	20.06	1.33	9.94
Iron	12.46	11.21	11.16	12.56	11.16
Magnesium	0.48	0.43	0.50	0.48	0.42
Potassium	1.33	1.19	1.12	2.43	2.60
Silicon	14.18	12.76	11.35	13.91	12.37
Sodium	0.67	0.60	0.53	1.00	0.89
Titanium	0.43	0.38	0.29	0.32	0.29
Phosphorus	0.31	0.28	0.16	0.46	0.41
Sulfur	2.96	2.66	2.13	5.73	5.09

Source: Information obtained from TVA Coproduction Demonstration Project Proposal
[a] - Calculated from design coal analysis using typical splits on elements from SCGP-1 Pike County Run-87

The critical characteristic of a potential solid waste is whether it is hazardous or nonhazardous, as specified by the RCRA regulations. Characteristics which would result in a solid waste being classified hazardous under the RCRA regulations include ignitability, corrosivity, reactivity, and toxicity. [19] Solid effluents, including slag and fly ash, generated by the proposed plant (Tables 4.2.4-2 and 4.2.4-3) are not ignitable (D001) or corrosive (D002) (whose designations are based on levels of flammability and pH, respectively). However, these effluents may be hazardous based on reactivity and/or toxicity.

The toxicity of the solid effluents generated by the proposed plant would be assessed on the basis of the RCRA TCLP test (or the RCRA reactivity test). [19] The TCLP test is applied to an unlisted waste and if the concentration of any one of 39 designated chemical compounds or elements in the TCLP extract exceeds specified levels, then the waste is considered to be hazardous and is given designation(s) keyed to the chemical compound(s) or element(s) causing the waste to be hazardous (D004 through D043).

During its 4-year demonstration period, the SCGP-1 plant in Houston was operated on 18 different coal feedstocks. Table 4.2.4-5 presents the results of the TCLP testing of slag and fly ash from the gasification of an eastern bituminous coal during the operation of the SCGP-1 plant. Table 4.2.4-5 shows the metal concentrations in the TCLP leachate from the slag and fly ash to be below the analytical detection limits and well below the RCRA threshold limits for hazardous designation, indicating that these wastes are nonhazardous based on the metal levels. Although the results presented do not include tests for organics, it is unlikely that these compounds would survive the high (3000^{o}F) gasifier temperatures and be retained in the ash or slag. Representative samples of the fly ash and slag for changes in coal feedstock or significant changes in process conditions of the proposed would be subjected to the TCLP test to determine the appropriate management strategy.

Table 4.2.4-5 Trace Metal Concentrations from the TCLP Tests on SCGP-1 Slag and Fly Ash from Gasification of Pike County Coal (mg/L)

Trace Metal	Slag [a]	Fly Ash [a]	RCRA Limit
Silver	<0.05	<0.05	5.0
Arsenic	<0.02	<0.02	5.0
Barium	<0.50	<0.50	100.0
Cadmium	<0.02	<0.02	1.0
Chromium	<0.10	<0.10	5.0
Mercury	<0.02	<0.02	0.2
Lead	<0.50	<0.50	5.0
Selenium	<0.02	<0.02	1.0

[a] - Information obtained from TVA Coproduction Demonstration Project Proposal

Slag and fly ash from high sulfur coals (i.e., greater than 3% sulfur by weight) sometimes approach the interim RCRA reactivity test limits. In the SCGP-1 testing of two high sulfur coals (3.7 and 4.2%), 15 samples averaged 451 ppm, or about 10% below the reactivity threshold of 500 ppm H_2S. In the operation of the SCGP-1, when values above the reactivity threshold were observed, the test material was isolated for a short period (typically a few days) until reactivity levels decreased due to weathering/aging (without the evolution of H_2S and without any form of treatment).

Storm water runoff from piles of slag stored at the SCGP-1 demonstration plant was tested for concentrations of pollutants and compared with the National Interim Drinking Water Standards.[20] The runoff water easily met the existing standards for arsenic, barium, chromium, mercury, selenium, nitrate nitrogen, fluoride, and turbidity. As such, this runoff should not pose any risk to surface water in the event of accumulation of substantial amounts of the slag prior to marketing. However, the current standards for cadmium and lead are lower than the detection limit for the data presented. As such, the status of the runoff with regard to these two elements is indeterminate. Slag runoff would be routed to the general waste water treatment system along with other waste streams prior to discharge.

As stated earlier, while the above discussion shows that the slag and fly ash from the proposed plant are nonhazardous, the slag generated from its operation when using different feedstocks would have to be tested to verify its nonhazardous characteristics. Any storage or disposal of nonhazardous slag and fly ash when using untested feedstock would be in areas constructed over low-permeability materials and separated from the underlying groundwater so as to minimize any potentially adverse environmental impacts from these materials. Any such material testing as hazardous would be disposed of off site in an appropriately approved facility.

Sulfur

Gasification utilizing the Claus process for sulfur recovery produces a pure elemental sulfur for which there is a well established market. Sulfur generated by the proposed plant would be stored in a solid state but handled in the molten state. It would be transported in heated or insulated trucks or rail cars. Elemental sulfur is a nonhazardous material and represents no threat to the environment.

Spent catalysts

Periodically, spent catalysts generated in the IGCC mode would be removed from the SCOT, Claus, and HCN/COS (Hydrogen cyanide/Carbonyl Sulfide) hydrolyzer systems and the chemical plants and replaced with fresh catalyst material. The catalyst changeout period varies from about once per year for the HCN/COS catalyst to three to seven years for the SCOT catalysts. Industrial experience with the SCOT and Claus catalysts operating in refinery service indicates that these two spent catalysts pass the EPA RCRA TCLP test and would be nonhazardous. Little is known about the spent HCN/COS hydrolyzer catalyst. Note also that catalyst vendors may want to reclaim the spent catalysts for either proprietary purposes or to use the remaining metal for new catalysts. In the event that the hydrolyzer catalyst proves to be hazardous and would be treated as a waste (rather than reclaimed), then it would be disposed of off site in a RCRA-approved disposal facility. Similar tests would have to be performed on the additional spent catalysts from the coproduction phase to determine the appropriate disposal strategy. Unreclaimed nonhazardous spent catalysts would be disposed of off site in an appropriately approved facility.

Treatment Sludges

There are four solid waste streams comprised by sludges from raw water or waste water treatment. The estimated quantities of raw water treatment sludge, general waste water treatment sludge, sanitary sewage treatment sludge, and sludge from the biotreatment of the gasification process waste water are included in Table 4.2.4-3. These sludges are expected to be nonhazardous, as they typically are. These wastes would be disposed of at the nearest state-approved municipal disposal site. A survey of selected landfills within 50 miles of Bellefonte indicates that there is adequate storage capacity for these wastes within the area (see Section 4.2.5). Sanitary waste water currently is sent to the Hollywood Waste Water Treatment Facility located adjacent to Bellefonte.

Raw water treatment residues are derived from sedimentation and filtration of chemically conditioned water. These sludges vary widely in composition depending on the water source and chemicals added during treatment. Surface water normally requires chemical coagulation to eliminate turbidity, color, and taste and odor producing compounds, while well water supplies are commonly treated to remove dissolved minerals such as hardness, iron, and manganese. [18] If surface water is used for makeup, then the treatment sludge is likely to include inerts, organics, and chemical precipitates such as aluminum and other metal hydroxides.

The composition of the sludges from general waste water treatment depends on the various waste streams contributing to the waste water. These waste water streams include slag pile runoff, process condensate, and effluent from the treatment of selected process waters. The general waste water treatment processes would include pH adjustment, heavy metal precipitation and filtration. [18] Heavy metal precipitation would probably be accomplished by treatment with lime to generate the insoluble metal hydroxides. The relatively low levels of metals are not expected to cause the sludge to fail the TCLP test.

The sludge from the sanitary waste treatment plant would be similar to the sludge generated by the local municipal waste water treatment plant from the treatment of domestic sewage. The sludge from the biotreatment of gasification waste water should be largely similar to the sludge from the treatment of domestic sewage also. Both of these sludges are expected to be nonhazardous. Disposal at the local municipal landfill should be acceptable.

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Air Quality

4.2.5 Hazardous Waste

4.2.5.1 Impacts of Construction

Hazardous wastes associated with construction are likely to be generated by maintenance activities. These wastes are expected to be comprised of materials such as waste oils containing solvent residuals or high in selected trace metal content, waste paint and paint thinners, solvents and degreasers. It is expected that the quantities of hazardous wastes would be generated at more than 100 kg but less than 1,000 kg per month, thus qualifying the site as an EPA Small Quantity Generator, which is the current status of the existing plant. Hazardous wastes would be stored onsite temporarily, prior to shipment to the TVA HWSF in Muscle Shoals, Alabama, which makes arrangements for disposal at a permitted disposal facility off site.

4.2.5.2 Impacts of Operation

Hazardous wastes generated during plant operation may be either those produced by routine maintenance operations or those produced as a direct result of the energy/chemical production processes.

Hazardous wastes are generated by activities associated with the service and repair of equipment, cleaning of parts and equipment, and maintenance of the physical plant. These wastes would include materials such as waste oils containing solvent residuals or high in selected trace metal content, waste paint and paint thinners, and solvents and degreasers. Thinners and degreasers are usually organic solvents and are hazardous because of toxicity and/or ignitability. Undetermined but limited quantities of potentially hazardous wastes may be generated by the IGCC/C processes also. Off-specification chemicals, and unused intermediates that are combustible would most likely be burnt with fuel for energy. Those that are noncombustible and hazardous, and any analytical wastes that are hazardous would be disposed of appropriately.

TVA would adopt a hazardous waste minimization policy for the proposed facility, among other things substituting nonhazardous for hazardous materials wherever feasible. It is expected that sufficient quantities of hazardous wastes will be generated to qualify the site as an EPA Large Quantity Generator, i.e., more than 1,000 kg for any one calendar month. Hazardous wastes will be stored onsite temporarily

(< 90 days), prior to shipment to the TVA HWSF in Muscle Shoals which makes arrangements for disposal at a permitted disposal facility off site. The TVA HWSF has a storage capacity of 720 55-gallon equivalent containers.

TVA currently contracts with Chem Waste Management (CWM) for hazardous waste disposal. CWM has access to disposal capacity well beyond the projected needs of TVA for this project. Liquid organics, such as those listed above, are typically disposed of either by fuel blending or by incineration. If the solids content in these liquid wastes are beyond a certain threshold level, then they are stabilized and landfilled. Available CWM capacity for these disposal methods are presented in Table 4.2.5-1. [21]

Table 4.2.5-1 Hazardous Waste Storage/Disposal Capacity Available to Bellefonte Conversion Project

Facility	Specialty	Capacity
TVA HWSF	Interim storage prior to shipment for disposal	720 55-gallon equivalent containers
CWM RMI, Morrow, Georgia	Fuel blending	87,750 gal/day treatment in containers 110,000 gal/day treatment in tanks 167,500 gallons storage in containers 176,598 gallons storage in tanks
CWM TWI, Sauget, Illinois	Incineration	4x63 cubic yards solid bulk[a] 300,000 gallons liquid bulk[a] 11,380 55-gallon containers[a]
CWM Emelle, Alabama	Stabilization and landfilling	~ 800,000 tons/year for 10 to 20 years

[a] - Maximum to be held onsite at any one time.

CWM, as for any other company on the TVA Restricted Awards List (RAL), is subject to a rigorous screening process to establish a valid permit status and document the likelihood of long term financial solvency. In addition, the facilities on the TVA RAL are subsequently audited to verify that there is continued adherence to the appropriate standards. This minimizes the likelihood that TVA-generated hazardous waste, including any from the Bellefonte conversion project, would result in adverse impacts to the environment.

There are several solids streams which may test hazardous. For the three options which include gasifiers, it is possible but highly unlikely that the slag may test hazardous. Any solids streams testing as hazardous would be stored onsite temporarily, prior to disposal off site at a permitted disposal facility. For the temporary onsite storage, the storage area would have to be lined with a low permeability clay liner and/or flexible membrane liner. Also, any runoff from the area would have to be contained and treated prior to discharge, if appropriate. These measures would prevent any adverse impacts from these materials on either groundwater or surface waters. Any ash or slag to be disposed of as hazardous waste could be sent to the CWM facility at Emelle, Alabama.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

4.2.6 Surface Water

4.2.6.1 Impacts of Construction

Surface water availability

Raw water for construction needs in fire protection, equipment cooling, and other services would be obtained from the Tennessee River (Guntersville Lake). The quantities needed are expected to have a negligible effect on the availability of water from the river which provides average flows of 38,800 cfs (25,100 mgd), and 7-day, 10-year minimum flows of 12,875 cfs (8,320 mgd) in the vicinity of Bellefonte.

Hydrologic

Construction of new facilities and overall site reclamation activities would affect surface hydrology. However, there should not be extensive site excavation, filling, or grading. To minimize the impacts of storm water flow during construction, additional onsite retention areas (storm water detention pond) would be designed to detain storm water from the 25-year, 24-hour rainfall event, in compliance with regulatory requirements. Runoff detention ponds would be designed to detain runoff within the containment areas to allow for settling and to reduce peak discharges. These flows would not exceed estimated discharges to receiving waters.

Water Quality

Surface water quality pertains to the quality of water in the streams and lakes within the area of influence and to water leaving the site due to runoff and discharges from processes. The primary surface water impact during construction would be soil erosion. BMPs would also be required during construction (see Appendix L for more information on BMPs). Therefore, soil erosion and associated water quality impacts are expected to be low.

An individual NPDES permit was issued for the Bellefonte Nuclear Plant and covers the existing site outfalls and storm water monitoring during construction of the nuclear facility. New construction and restoration of this area would disturb the land surface, which may temporarily affect surface water quality. Potential water quality impacts would consist of suspended solids from disturbed soils, biochemical oxygen demand (BOD), and nutrient loading from disturbed vegetation, and oil and grease from construction equipment. An Engineering Report must be submitted to ADEM for approval before construction of a new, or a modification of an existing waste treatment facilities, e.g., retention pond, can begin.

No significant construction-related impacts to surface water resources are expected as a result of the proposed project. The majority of the power plant and associated facilities would be constructed on land that has been previously altered due to the Bellefonte Nuclear Plant construction. The surface water resources within the areas of the proposed development are currently monitored under the NPDES Permit AL0024635 issued by ADEM. The proposed project would have potential minor effects on the water quality in the vicinity of the site. New construction activities that disturb five acres or more would require an NPDES permit for storm water discharges from the site to ensure the implementation of BMPs and to minimize impacts to surface waters during construction. (See Appendix L more information on BMPs).

As part of the NPDES permit, TVA would submit a revised pollution prevention plan to ADEM to protect water quality from the effects of storm water discharges during construction. Both structural and nonstructural (vegetative) measures would be designed, implemented, and properly maintained in accordance with the BMPs. TVA would also employ additional vegetative controls of erosion and sedimentation, including seeding of the berms and swales. Other erosion control structure practices would include, as necessary, the construction of temporary perimeter berms, rip-rap in potentially high-velocity areas, straw bales or other barriers, silt fences, diversionary berms or swales, and graveled road and railroad beds.

The quality of off site waters would be protected by the retention of storm water onsite during construction. Swales would be constructed for directing runoff around the construction site to existing collection holding ponds. These swales would be excavated, graded, and stabilized with gravel, sod, etc. They would be designed such that erosional flow velocities would not be reached. If additional surface water storage basins are needed during construction, an Engineering Report on the design and estimated discharges would be submitted for state approval before construction of the basins begins.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Site preparation and construction of the proposed projects are not expected to have adverse water quality effects on off site surface water bodies. Construction activities would not create any additional surface discharges of sanitary or industrial wastes. Construction would cause no significant consumption of surface water resources.

Sanitary waste water would be generated by construction personnel . Discharges from showers, wash basins, bathrooms, drinking fountains, and other facilities would be treated at the Hollywood Waste Water Treatment Facility located near the plant. This public owned treatment works (POTW) was designed to ensure compliance with the effluent limitations of the state. Based upon the worst-case work force populations for the Combination Option with fewer than 3,500 site personnel, additional load handling capabilities would be added to the Hollywood Waste Water Treatment Facility. However, this need was also anticipated for the Bellefonte Nuclear Plant and the City of Hollywood agreed to add the additional treatment facilities provided they are notified in advance.

4.2.6.2 Impact of Operation

Surface Water Availability

The river water intake requirements of the five conversion options are presented in Table 4.2.6-1, and range from 13,000 gpm for the IGCC/C to 36,700 gpm for the IGCC by itself. For all of the options, the major proportion of the intake water is for cooling via the cooling tower system. However, the proportion of water used in the cooling tower system is quite variable ranging from 55% for the IGCC/C Option to 91% for the PC and NGCC Options.

Table 4.2.6-1 Surface Water Availability and Water Requirements for Bellefonte Conversion Options

Conversion Option	Plant River Intake Requirements (gpm)		Plant River Intake Requirements as a Percentage of	
	Total	Cooling tower	Average river flow[a]	River 7Q10 flow[b]
PC	18,000	16,300 (91%)[c]	0.10	0.31
NGCC	20,000	18,200 (91%)	0.11	0.35
IGCC	36,700	18,100 (62%)	0.21	0.64
IGCC/C	13,000	7,130 (55%)	0.075	0.22
Combination	26,000	19,170 (74%)	0.15	0.45

[a] - Average river flow is estimated at 38,800 cfs ($17.4x10^6$ gpm) at Bellefonte
[b] - River 7Q10 flow is estimated at 12,875 cfs ($5.78x10^6$ gpm) at Bellefonte
[c] - Number in parentheses is the cooling tower intake as a percentage of total plant intake.

Surface water is available in the immediate vicinity of Bellefonte directly from the Tennessee River (Guntersville Lake) which bounds the plant site on the southeast, and from the Town Creek Embayment which bounds the plant site on the north and northwest and joins the river less than a mile upstream of the plant site. The current plan is to obtain needed raw water directly from the river. Values for the river flow rates at Bellefonte, as presented earlier in impacts of construction, are 38,800 cfs (17.4×10^6 gpm) for the average and 12,875 cfs (5.78×10^6 gpm) for the 7-day, 10-year minimum (7Q10). As shown in Table 4.2.6-1, the option with the highest intake rate, (IGCC), requires only 0.21 and 0.64%, of the average and 7Q10 flows, respectively, of the river.

On this basis, it is clear that there is an adequate supply of water from the river for any of the five conversion options, and moreover, the water removed from the river by any of these technologies should have a negligible effect on the water availability downstream of the site.

Hydrologic Impacts

The hydrologic analysis of the drainage basins acreage and discharge under the 25-year 24-hour storm event was previously discussed in the impacts of construction.

Water Quality

Operation of any of the five Bellefonte conversion options would result in three types of surface water discharge:

- Impacts to existing storm water and process outfalls covered by existing NPDES,
- New storm water discharges associated with industrial activity, and
- Internal outfalls may require special treatment and monitoring.

National technology-based effluent limitations have not been developed for gasification plants but the guidelines for new source chemical plants and steam electric generating plants would be used where applicable. Water quality based limitations on effluent discharge quality are likely to be more constraining than technology-based limits.

Regarding internal outfalls, ADEM would establish discharge limits and standards for internal waste streams, particularly in cases where waste at the outfall is so dilute that monitoring would be impracticable or interference among pollutants would make detection or analysis impracticable. Water quality-based limitations include the following:

- Use classification of upper stretch of Tennessee River Basin is public water supply (PWS), swimming, fish, and wildlife protection.
- Select water quality criteria for PWS-designated segments for temperature, dissolved oxygen, and toxics.
- All industrial, sanitary, and/or combined discharges are subject to secondary treatment or its equivalent for biologically degradable waste. Parameters of interest are BOD, total suspended solids (TSS), and pH.

Effluent from all industrial waste water sources would ultimately be discharged to the holding ponds for final treatment.

Table 4.2.6-2 provides the estimated average process flows from each of the waste water streams for each of the options.

Cooling Water System

The use of the two existing closed-cycle natural draft cooling towers is proposed as the method of heat dissipation for all of the project options, except IGCC/C which would use only one. Cooling of the facility's main condensers and miscellaneous components would be achieved by an open recirculation cooling water system. The cooling loops recirculate water for this application through the towers with the blowdown subsequently being discharged through diffusers to the Tennessee River. A biocide would be used to protect the cooling water system from biological growths. All options would utilize the cooling towers with the IGCC/C Option having the least amount of blowdown at 1,400 gpm. The blowdown would not contain any detectable amounts of the priority pollutants. Blowdown is monitored in accordance with discharges to the Tennessee River via the diffuser pipe and the NPDES permit.

Table 4.2.6-2 Waste Water Discharge (gpm)

Sources for Discharge	PC	NGCC	IGCC	IGCC/C	Combination
Process Water from Coproduction	-	-	-	100	100
Coal Pile Runoff & Contaminated Storm water	500	-	500	500	500
Demineralizer Regeneration Wastes	225	225	225	50	225
Sanitary Sewer	-	-	-	-	-
Contaminated Storm water and Plant Drains	306	30	60	30	55
Chemical Drains	15	10	20	10	15
Service Water / Pretreatment Waste	100	50	102	50	75
Gasifier (boiler) Blowdown	-	-	9,000	4,500	4,500
Cooling tower Blowdown	3,239	3,617	4,486	1,409	4,122
Steam Cycle Blowdown	252	282	286	87	298
Non-contaminated Storm water	540	540	540	540	540
Commingled Effluent	5,000	4,800	15,300	7,300	10,500
Water Intake Requirements	18,000	20,000	36,700	13,000	26,000

Fuel Oil Storage Facilities

Fuel oil storage facilities could potentially harm the environment by discharging oil into or on the navigable water or adjoining shorelines. However, prior to storing fuel oil onsite, TVA would prepare a Facility Response Plan in accordance with 40 CFR Part 112.20. [22] Part 112 usually applies to oil storage tanks greater than one million gallons located such that a discharge would shut down a public drinking water intake. NGCC, IGCC, IGCC/C, and Combination Options would utilize large fuel oil storage tanks.

Runoff associated with industrial activities from the fuel oil unloading area, the transformer area, and the oil-bearing equipment areas would be collected, treated in an oil/water separation system, and then directed to the holding basin. Runoff from the switchyard area would be directed to the holding ponds. The BMP and SWPP Plans would address potential problems associated with the handling of fuel oils and oil contaminates and monitoring discharges.

Potential impacts to surface waters could occur from accidental spills of fuel oil. Storm water collected in the fuel oil storage area would be routed to the collection pond and removed via the oil/water separator. Inspection and maintenance of the system would be performed according to the SPCC plan developed in conformance with the requirements of 40 CFR Part 112.7. [22] These procedures call for routine inspection of all facilities and observation of all storm water for the presence of oily sheen before discharge from the storage area. If a sheen is present, cleanup procedures would be performed. The measures set forth in the SPCC Plan are intended to prevent spills, detect any leaks or spills, and identify clean up methods.

<u>Sanitary Waste Water</u>

Sanitary waste water would be generated by the administrative, maintenance, and operating personnel. After the peak construction period, normal site personnel capacity would drop to less than 500 people for all the options. Discharges from showers, wash basins, bathrooms, drinking fountains, and other facilities would be treated at the Hollywood Waste Water Treatment Facility. This POTW was designed to ensure compliance with the effluent limitations of ADEM. No industrial wastes would be sent to the POTW. [23] The facilities in the Simulator Training Building that are presently discharged through a sand filter system under the NPDES permit may eventually be tied to the POTW.

<u>Waste Water Treatment System</u>

A waste water treatment facility would be constructed onsite to collect and treat, on a continuous basis, the process waste water and storm water runoff and washdown from the material storage areas. The treatment strategy is to collect waste water at its source, and pretreat if necessary, and direct it to the waste water equalization basin prior to discharge. All of the waste water streams generated by the project would be commingled prior to discharge to the Tennessee River via the plant's existing NPDES permitted outfall.

<u>Technology-based limitations</u>

<u>Electricity Production</u>

Table 4.2.6-3 lists the New Source Performance Standards (NSPS) effluent guidelines that apply to the categorized waste waters. These guidelines are based on discharges from generating units primarily engaged in the generation of electricity utilizing fossil-type fuels or nuclear fuels with a thermal cycle employing a steam system as the thermodynamic medium. The waste water system would be designed to achieve the TSS, oil and grease, metals, and pH effluent guidelines for the respective waste streams.

Table 4.2.6-3 NSPS Effluent Guidelines for Steam Electric Power Generation

Waste Type	Daily Maximum	30-Day Average
Low Volume Waste		
TSS	100.0 mg/L	30.0 mg/L
Oil and grease	20.0 mg/L	15.0 mg/L
pH	6.0 - 9.0 std units	-
Chemical Metal Cleaning Waste		
TSS	100.0 mg/L	30.0 mg/L
Oil	20.0 mg/L	15.0 mg/L
Copper, total	1.0 mg/L	1.0 mg/L
Iron, total	1.0 mg/L	1.0 mg/L
pH	6.0 - 9.0 std units	-
Cooling Tower Blowdown		
Free available total residual chlorine	0.5 mg/L	0.2 mg/L
126 Priority pollutants (except: Chromium & Zinc)	No detectable amount	
Chromium, Total	0.2 mg/L	0.2 mg/L
Zinc, Total	1.0 mg/L	1.0 mg/L
pH	6.0 - 9.0 std units	-
Coal Pile Runoff		
TSS	<50 mg/L	
Discharge Bottom Ash (Transport Water)		
TSS	100.0 mg/L	30.0 mg/L
Oil and Grease	20.0 mg/L	15.0 mg/L
Fly Ash (Transport Water)	No detectable amount	
PCBs	No detectable amount	

The low volume wastes would mainly consist of equipment area drains, laboratory wastes, boiler blowdown, and makeup water treatment system waste (filter backwash, reverse osmosis (RO) concentrate, and demineralizer regeneration wastes). This waste stream would typically contain high concentrations of TSS and total dissolved solids (TDS) and possibly minute amounts of plant chemicals or some trace metals, such as copper and iron. Low-volume waste waters would be treated according to the nature of the waste. Boiler blowdown, laboratory wastes, and the RO concentrate stream would be combined in the neutralization tank. The pH of the water would be adjusted to between six and nine standard units before it is discharged.

The chemical metal cleaning wastes would contain dirt, organic matter, oil and nonhazardous detergent, variable pH, high TSS, and trace metals. These wastes would not be discharged to surface waters, but would be removed from the site (for all five options) by licensed contractors for disposal at a licensed disposal facility.

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Coal pile runoff is the rainfall runoff from or through any coal storage pile. To prevent leachate and runoff from entering the surficial aquifer, the coal storage area and the runoff basin would be lined with synthetic material or other materials with low permeability. The properly designed leachate and storm water collection system will route the collected waste water to the lined recycle basin. This applies to all options except NGCC.

Runoff from the dry stacking of fly ash and bottom ash would be collected in the recycle basin. The gypsum storage area would be lined with a synthetic material or other low-permeability materials and runoff would also be sent to the recycle basin.

The lined recycle basin would accept flows from the coal pile runoff, ash storage area runoff, gypsum storage area runoff, and miscellaneous other drains and would be designed to handle runoff in excess of the 25-year, 24-hour storm event. The water from the recycle basin would be reused, with no direct discharge to the surface water.

Fertilizer Manufacturing

Table 4.2.6-4 lists the effluent guidelines for fertilizer production that apply to the manufacturing of ammonia, urea, and ammonium nitrate. [24,25,26] These limitations constitute the maximum permissible discharge under the standard of performance for new sources. The IGCC/C and Combination Options have the greatest potential for releasing contaminants based on maximum fluid storage volumes. The NGCC Option has the least potential since it requires no onsite chemical storage.

Table 4.2.6-4 NSPS Effluent Guidelines for Fertilizer Manufacturing

Waste Type	Daily Maximum	30-Day Average
Ammonia Subcategory		
Ammonia (as N)	0.1875 lb per 1,000lb	0.0625lb per 1,000 lb
pH	6.0 - 9.0 std units	
Urea Subcategory (granulated)		
Ammonia (as N)	0.53 mg/L	0.27 mg/L
Organic nitrogen (as N)	0.86 mg/L	0.46 mg/L
Ammonium Nitrate Subcategory		
Ammonia (as N)	0.08 mg/L	0.04 mg/L
Nitrate (as N)	0.12 mg/L	0.07 mg/L

Commodity Organic Chemicals

Table 4.2.6-5 lists the effluent guidelines for commodity organic chemicals that apply to the manufacturing of acetic acid, ethanol, formaldehyde, and methanol. These limitations constitute the maximum permissible discharge under the standard of performance of new sources. The IGCC/C and Combination Options have the greatest potential for releasing contaminants based on maximum fluid storage volumes. The NGCC Option has the least potential since it requires no onsite chemical or storage.

Table 4.2.6-5 NSPS Effluent Guidelines for Organic Chemicals, Plastics, and Synthetic Fibers

Waste Type	Daily Maximum	30-Day Average
Commodity Organic Chemicals		
BOD_5	80 mg/L	30 mg/L
TSS	149 mg/L	46 mg/L
pH	6.0 - 9.0 std units	
Bulk Organic Chemicals		
BOD_5	92 mg/L	34 mg/L
TSS	159 mg/L	49 mg/L
pH	6.0 - 9.0 std units	

Bulk Organic Chemicals

Table 4.2.6-5 lists the effluent guidelines for bulk organic chemicals that apply to the manufacturing of methyl tert-butyl ether (MTBE). These limitations constitute the maximum permissible discharge under the standard of performance of new sources. The IGCC/C and Combination Options have the greatest potential for releasing contaminants based on maximum fluid storage volumes. The NGCC Option has the least potential since it requires no onsite chemical storage.

Monitoring Programs

In general, all erosion sedimentation controls would be checked monthly and after major storms and be maintained as follows:

- Sedimentation basins would be cleaned,
- Rip-rap would be checked for washout or sediment buildup and replaced or cleaned,
- Straw bale barriers would be checked for washout or deterioration and replaced,
- Seeded areas would be checked and re-seeded if required,
- Silt fences would be checked for washout and repaired or replaced, and
- Sediment deposits at any barrier would be periodically removed as necessary.

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Air Quality

Compliance monitoring would likely be required for treated waste water systems as a condition of the NPDES permit for the facility. Supplemental monitoring may be conducted to obtain baseline information.

Surface Water Temperature

All steam-electric generating plants release heat to the environment. A portion of the thermal energy produced in the plant would be converted to electrical energy through the turbine and generator, while the remainder is absorbed by cooling water flowing through the condenser. To meet the cooling needs at Bellefonte, and minimize thermal impacts on Guntersville Lake, the existing closed-cycle natural draft hyperbolic cooling towers would be utilized for all conversion options. The condenser cooling water system would cycle cool water from the cooling towers through the condensers and discharge warm water back to the cooling towers. During the operation of cooling towers, a portion of the circulated water is continually lost through evaporation, and drift. Additionally, a portion of the circulated water would be discharged to the river to prevent the buildup of dissolved salts and minerals in the system (blowdown). Therefore, makeup water must be continuously added to the system. To provide this makeup, water would be withdrawn from Guntersville Lake.

NPDES Permit AL0024635 for Bellefonte limits instream temperature to less than or equal to 30°C. Ambient upstream temperatures typically exceed this limit in July and August, an average of 8.5 days per year. The maximum measured upstream temperature is 32.22°C. The intake structure is located upstream of the diffuser, and would not entrain discharged water except during periods of low or no ambient lake flow past Bellefonte. During periods of low and zero flows, intake and discharge temperatures would increase as the intake pumps entrain warm water from the discharge. Periods of zero or reverse flows rarely last more than half a day.

The combined blowdown, storm water, plant drains, and other waste water flows would be discharged to Guntersville Lake through a submerged diffuser to provide dilution with the stream flow, consistent with the need to protect the aquatic biota of the lake. The temperature of the discharge would vary with the ambient wet bulb temperature. The maximum wet bulb temperature measured at the Chattanooga Airport (1948-1994) and the Huntsville Airport (1958-1994) was 29.4°C. The maximum discharge temperature was estimated assuming that the towers perform according to the performance curves provided by Hamon Cooling Towers. [27] The maximum discharge temperature and estimated discharge flow for each option are shown in Table 4.2.6-6.

Table 4.2.6-6 Predicted Surface Water Discharge Temperature and Flow

Option	Maximum Predicted Summer Discharge Temperature (^{o}C)	Winter Discharge Temperature Under Maximum Rise Conditions (^{o}C)	Combined Effluent Flow (gpm)
PC (2,400 MW)	36.17	27.78	5,000
NGCC (2,680 MW)	35.94	26.78	4,800
IGCC (2,720 MW)	36.11	27.11	15,300
IGCC/C (450 MW)	32.22 - 36.11	19.44-27.11	7,300
Combination (2,460 MW)	36.22	27.56	10,500

Alabama water quality standards limit maximum temperature rise (difference between upstream and downstream temperature) to no more than 2.8°C. The maximum temperature rise would occur when the river is cold and the discharge is warm. This would take place when the wet bulb temperature greatly exceeds the ambient water temperature. Huntsville and Chattanooga airport meteorological data were compared with Guntersville Lake TRM 391.2 temperatures. The maximum recorded difference occurred in February 1994 when the ambient water temperature was 7.72°C and the wet bulb was 19.44°C. Under these conditions, the cooling tower performance curves were utilized to predict discharge temperatures, as shown in Table 4.2.6-6.

The Cornell Mixing Zone Expert System (CORMIX) was utilized to evaluate the thermal impact of the proposed options. [28] The subsystem used, CORMIX2, predicts dilution characteristics of effluent from a submerged multi-port diffuser. The methodology neglects the details of the individual jets issuing from the diffuser ports, and assumes the flow arises from a long slot discharge with equivalent dynamic characteristics. Based on cross sectional data measured at TRM 391.06, the lake channel is assumed to be rectangular, 23 ft deep and 1735 ft wide, with uniform ambient velocity under steady-state conditions.[29] The discharge is assumed to be conservative (no decay or growth processes included). Manning's n (a measure of the channel roughness) is assumed to be 0.025.

Option 1: PC

The PC Option would require the use of both existing cooling towers. The flow through each tower is estimated as 435,000 gpm. The PC Option would utilize the existing diffuser system, which consists of two diffuser pipes, as shown in Figure 4.2.6-1. To accommodate barge traffic, the diffuser would be lowered by five feet. Using the 3Q20 of 9560 cfs as ambient flow, model results indicate a maximum summer temperature of 32.38°C at 10 feet downstream from the diffuser, diluting to 32.26°C at 2,600 feet downstream, when the ambient water temperature is 32.22°C (Table 4.2.6-7). The predicted maximum rise at 10 feet downstream under winter or spring conditions is 0.81°C, decreasing to 0.11°C 10 miles (mi) downstream (Table 4.2.6-8).

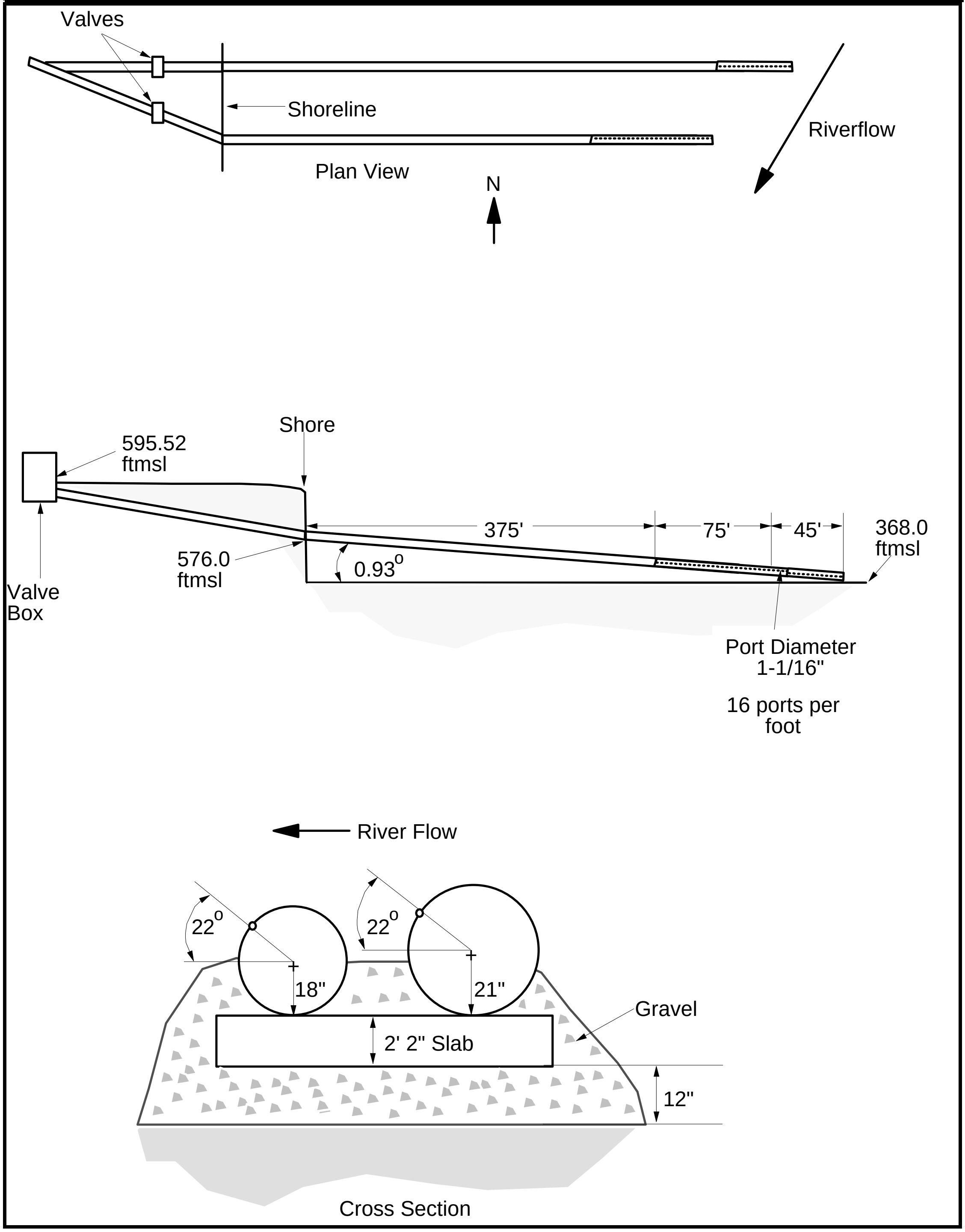
Table 4.2.6-7 Predicted Maximum Downstream Water Temperature

	Distance Downstream			
	10 ft	33 ft	330 ft	2,600 ft
Option	Maximum Temperature (^oC)			
PC	32.38	32.31	32.28	32.26
NGCC	32.39	32.32	32.26	32.23
IGCC	32.57	32.43	32.35	32.31
IGCC/C	32.22-32.55	32.22-32.43	32.22-32.35	32.22-32.33
Combination	32.51	32.39	32.33	32.29

Table 4.2.6-8 Predicted Maximum Temperature Rise

	Distance Downstream			
	10 ft	1,000 ft	1 mi	10 mi
Option	Maximum Temperature Rise (^oC) - February			
PC	0.81	0.23	0.13	0.12
NGCC	0.82	0.24	0.13	0.11
IGCC	1.76	0.53	0.43	0.42
IGCC/C	0.84-1.76	0.26-0.53	0.15-0.43	0.13-0.42
Combination	1.43	0.42	0.33	0.32

Figure 4.2.6-1 Existing Diffuser



Option 2: NGCC

The NGCC Option would require the use of both existing cooling towers. The flow through each tower is estimated as 435,000 gpm. Unlike the other options, NGCC does not require receiving fuel by barge, and thus it would not be necessary to lower the diffuser to permit barge traffic. Using the 3Q20 of 9,560 cfs as ambient flow, model results indicate a maximum temperature of 32.39°C at 10 ft downstream from the diffuser, diluting to 32.23°C 100 feet downstream (Table 4.2.6-6). The predicted maximum rise at 10 feet downstream is 0.82°C, decreasing to 0.11°C ten miles downstream (Table 4.2.6-7).

Option 3: IGCC

The IGCC Option would require the use of both existing cooling towers. The flow through each tower is estimated as 435,000 gpm. To accommodate barge traffic, the diffuser would be lowered by five feet. Using the 3Q20 of 9560 cfs as ambient flow, model results indicate a maximum temperature of 32.57°C 10 feet downstream from the diffuser, diluting to 32.31°C at 2,600 feet downstream (Table 4.2.6-7). The predicted maximum rise at 10 feet downstream is 1.76°C, decreasing to 0.42°C 10 miles downstream (Table 4.2.6-8).

Option 4: IGCC/C

The IGCC/C Option differs from the IGCC Option in that only one combined cycle combustion turbine would be built, as opposed to eight units. IGCC/C would require the use of only one cooling tower. The flow through the tower is estimated as 108,750 gpm, which is about one-fourth of the flow for which the tower was designed. Modification of the cooling tower water distribution system would be necessary to evenly disperse the flow to facilitate cooling. A new cooling system may be constructed for this option, if modifications prove too costly. Additionally, icing may occur in the tower in the winter, due to low water flow. The cooling tower performance curves are not valid at this low flow rate. [30] Discharge temperature for one 338 MW IGCC unit was estimated by Black and Veatch as 32.22°C, coincidentally equal to maximum ambient water temperature. [31] The discharge temperature for the IGCC/C Option would be slightly higher, due to slightly higher power generation (450 gpm). The discharge temperature would be lower than the discharge temperature of 36.11°C predicted for the IGCC Option. Maximum downstream temperatures for the IGCC/C Option are thus projected to be between ambient temperatures and those estimated for the IGCC Option. The discharge under maximum rise conditions is estimated to be between wet bulb temperature (19.44°C) and the discharge temperature for the IGCC Option (27.11°C). The predicted maximum rise at 10 feet downstream is estimated as 0.84-1.76°C, decreasing to

0.13-0.42°C 10 miles downstream (Table 4.2.6-8). To accommodate barge traffic, the diffuser would be lowered by five feet.

Option 5: Combination

The Combination Option would require the use of both existing cooling towers. The flow through each tower is estimated as 435,000 gpm. To accommodate barge traffic, the diffuser would be lowered by five feet. Using the 3Q20 of 9,560 cfs as ambient flow, model results indicate a maximum temperature of 32.51°C 10 feet downstream from the diffuser, diluting to 32.29°C at 2,600 feet downstream (Table 4.2.6-7). The predicted maximum rise at 10 feet downstream is 1.43°C, decreasing to 0.32°C 10 miles downstream (Table 4.2.6-8).

Summary

Ambient water temperatures are predicted to exceed permitted levels. A 316(a) variance to the NPDES permit would be required regardless of which option is chosen. The maximum discharge temperature (36.22°C) would occur with the PC or Combination Options and would normally occur in July or August. There is great uncertainty in the discharge temperature of the IGCC/C Option. The maximum instream temperatures would occur under the IGCC Option. The maximum water temperature within 10 feet downstream from the diffuser would be 32.57°C, compared to ambient temperature of 32.22°C. The plume is diluted to 32.31°C at 2,600 ft downstream. The maximum temperature rise (difference between upstream and downstream temperature) would normally occur in January or February. Under the IGCC Option, the maximum temperature rise would be 1.76°C within 10 feet downstream from the diffuser, diluting to 0.4°C 10 miles downstream. Regardless of which option is chosen, the impact on maximum surface water temperature is very slight. The maximum temperature rise would be well below the Alabama limit of 2.8°C.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

4.2.7 Floodplains/Floodway

4.2.7.1 Impacts of Construction

For all of the proposed options, facilities would be sited to provide a reasonable level of protection from flooding. In doing this, the requirements of Executive Order (EO) 11988 (Floodplain Management) would be fulfilled. For non-repetitive actions, EO 11988 states that all proposed facilities must be located outside the limits of the 100-year floodplain unless alternatives are evaluated which would either identify a better option or support and document a determination of "no practicable alternative" to siting within the floodplain. If this determination can be made, adverse floodplain impacts would be minimized during design of the project.

For a "critical action", facilities must be protected to the 500-year flood elevation where there is no practicable alternative. A "critical action" is defined in the Water Resource Council Floodplain Management Guidelines as any activity for which even a slight chance of flooding would be too great. One of the criteria used in determining if an activity is a critical action is whether essential and irreplaceable records, utilities and/or emergency services would be lost or become inoperable if flooded. Based on this criterion, components of the proposed options used for generating power would be considered "critical actions" because flooding of these facilities would render them inoperable. All facilities that would force the shutdown or curtailment of power generation if flooded, would either be located above or floodproofed to the 500-year flood elevation at that location. Many of the support facilities that would not impact power generation if flooded, would only be subject to evaluation using the 100-year flood.

<u>Option 1: PC</u>

Under Option 1, some development would be located within the limits of the 100-year floodplain, and is therefore subject to the requirements of EO 11988. The coal barge unloading facilities would be a repetitive action in the floodplain as defined in TVA's "Class Review of Certain Repetitive Actions in the 100-Year Floodplain". Adverse impacts would be minimized by designing and constructing these facilities to withstand flooding with minimum damage, by using best management practices during construction, and by using the least amount of fill possible to complete the facilities which would ensure compliance with EO 11988.

Portions of the flyash and bottom ash storage area, and the gypsum storage area would be located within the limits of the 100-year floodplain. As discussed in Appendix M, alternatives to locating these facilities within the floodplain have been evaluated and documented to support a determination of “no practicable alternative” to the proposed floodplain siting. Adverse impacts would be minimized by using the least amount of area possible to handle the required storage volume, and by constructing the dikes with top elevations above the 500-year flood elevation to significantly reduce the possibility of flooding these storage areas. The encroachment into the floodplain of Town Creek would not be expected to increase flood elevations because these elevations are controlled by Tennessee River backwater. The storage areas would result in the loss of approximately 270 acre-feet of flood control storage. As stated above, this quantity of loss is unavoidable because of the area needed for the required storage volume and the necessity of locating in the floodplain.

Option 2: NGCC

For Option 2, the only development proposed within the floodplain would be the natural gas pipeline which is considered to be a repetitive action in the floodplain. Adverse impacts would be minimized by constructing the pipeline underground and returning the area to its natural condition after construction. Best management practices would be used during construction which would ensure compliance with EO 11988.

Option 3: IGCC

Under Option 3, some development would be located within the limits of the 100-year floodplain, and is therefore subject to the requirements of EO 11988. Several of these activities, including the coal/fuel oil barge unloading facilities, the railroad(s), the fuel oil pipeline, the access road(s), the security fence and the storm water detention pond would be repetitive actions in the floodplain. Adverse impacts would be minimized by designing and constructing these facilities to withstand flooding with minimum damage, by using best management practices during construction, and by using the least amount of fill possible to complete the facilities which would ensure compliance with EO 11988.

The rail car scale would be located within the limits of the 100-year floodplain. This equipment must be located at the entrance of the plant to allow for the weighing of materials before they are delivered to the storage areas. There is no practicable alternative to siting the rail car scale in the floodplain. The equipment would be floodproofed and would not sustain damage if flooded. Therefore, siting of rail car scale complies with EO 11988.

Option 4: IGCC/C

Some development under Option 4 would be located within the limits of the 100-year floodplain, and is therefore subject to the requirements of EO 11988. Several of these activities, including the coproduction barge loading facility, the coal/fuel oil barge unloading facilities, the railroad(s), the fuel oil pipeline, the access road(s), the security fence and the storm water detention pond would be repetitive actions in the floodplain. Adverse impacts would be minimized by designing and constructing these facilities to withstand flooding with minimum damage, by using best management practices during construction, and by using the least amount of fill possible to complete the facilities which would ensure compliance with EO 11988.

The rail car scale would be located within the limits of the 100-year floodplain. This equipment must be located at the entrance of the plant to allow for the weighing of materials before they are delivered to the storage areas. There is no practicable alternative to siting the rail car scale in the floodplain. The equipment would be floodproofed and would not sustain damage if flooded. Therefore, siting of rail car scale complies with EO 11988.

Option 5: Combination

Under Option 5, some development would be located within the limits of the 100-year floodplain, and is therefore subject to the requirements of EO 11988. Several of these activities, including the barge loading facility, the coal barge unloading facilities, the railroad(s), the access road(s), the security fence, the storm water detention pond, and the natural gas pipeline would be repetitive actions in the floodplain. Adverse impacts would be minimized by designing and constructing these facilities to withstand flooding with minimum damage, by using best management practices during construction, and by using the least amount of fill possible to complete the facilities which would ensure compliance with EO 11988.

The rail car scale would be located within the limits of the 100-year floodplain. This equipment must be located at the entrance of the plant to allow for the weighing of materials before they are delivered to the storage areas. There is no practicable alternative to siting the rail car scale in the floodplain. The equipment would be floodproofed and would not sustain damage if flooded. Therefore, siting of rail car scale complies with EO 11988.

4.2.7.2 Impacts of Operation

All components of each option would either be located above or floodproofed to the 500-year flood elevation at that location. Therefore, operation would not be impacted.

4.2.8 Groundwater

4.2.8.1 Impacts of Construction

Groundwater Availability

As described in Section 3.8, all homes relying on groundwater supplies near the plant site are located on the opposite side of Town Creek Embayment (Figure 3.1.8-2) which serves as a hydraulic boundary along the western side of the site. The nearest known municipal groundwater supply consists of two deep wells for the city of Hollywood, Alabama located about four km northwest of the site. Considering the hydraulic isolation of the site by Town Creek Embayment and the Tennessee River, and the fact that groundwater occurs in a relatively shallow zone beneath the water table at the site, groundwater availability would not be affected by construction activities such as excavation or dewatering.

Groundwater Quality

A concern related to groundwater quality impacts at the site is associated with potential contaminant releases during construction activities. The potential contaminants are primarily fuels, oils, solvents, and other chemicals used for operation and maintenance of vehicles and equipment. Considering that soil might be thin or absent at certain locations, little protection would be afforded to local groundwater resources from a contaminant release. However, this potential problem can be averted by careful handling and proper disposal of potential contaminants. Additionally, the Bellefonte Nuclear Plant SPCC Plan provides a methodology for mitigating groundwater releases at the site. [32] Should a release occur, remediation methods would be employed to prevent impacts to water supplies.

4.2.8.2 Impact of Operation

Groundwater Availability

Groundwater availability would not be affected by operation of any conversion option facility.

Groundwater Quality

Solid Wastes

Any impacts to groundwater quality during operation would most likely be associated with the storage and handling of feedstocks used and the storage, handling, and disposal of wastes generated. Solid wastes produced during plant operation are:

- PC Option: fly ash, bottom ash, and gypsum,
- IGCC, IGCC/C, and Combination Options: fly ash, sulfur, spent catalysts, raw water treatment,
- Sludges, general water treatment sludges, biotreatment sludges, and
- NGCC Option: none.

Solid by-products and wastes are described in Sections 4.2.4 and 4.2.5. Bottom ash, slag, fly ash and gypsum comprise the majority of the total waste volume. As noted earlier, the portions of these materials that are unmarketable will be disposed of onsite in accordance with state requirements. All of these materials are nonhazardous, but gypsum disposal areas will be equipped with suitable impermeable liners and all areas will be equipeed with leachate collection and treatment systems. Fly ash and bottom ash would be handled and placed dry in disposal areas. Any materials determined to be hazardous will be disposed of off site in appropriately permitted disposal facilities (sludges, etc.) or recycled to suppliers (spent catalysts). Consequently, no impacts to groundwater are expected.

There are two sludges that might be produced from raw water or waste water treatment. The estimated quantities of raw water treatment sludge, and general waste water treatment sludge are included in Table 4.2.4-2. These sludges are typically nonhazardous and would be disposed of at a state-approved municipal disposal site.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

The IGCC Option produces a pure elemental sulfur which would be stored ins solid state and handled in the molten state. The elemental sulfur is a nonhazardous material and represents no threat to groundwater.

Fuel and Fluid Storage

Fuels to be stored at the site include coal, petroleum coke, and fuel oil. A 30-day supply of coal and/or petroleum coke would be stored onsite during operation. Runoff from the coal and petroleum coke storage areas would be collected in a drainage basin and treated as needed. Leachate production and runoff to the drainage basin is a product of climatic and physiographic factors. The relationship between runoff and precipitation is not direct; factors such as storm frequency, initial soil and coal moisture conditions, storm duration, and temperature are important. The initial oxidation of freshly exposed coal falls off rapidly with time and is proportional to the total surface area of the coal (particle size and gradation). Freshly fractured coal particles are more subject to oxidation. Fresh surfaces are also created within the coal pile by rainfall as it removes pyritic oxidation products. The fresh surfaces permit regeneration of oxidation products until the next rain, at which time they are washed out again. Leachate production and runoff solute concentrations are generally highest in the first precipitation episode after dry periods. [33] Solute concentrations would also be higher as fresh coal is added to the stockpile.

The most widely recognized problem associated with coal stockpiles is the production of acidic leachate and runoff due to the oxidation of pyritic materials within the coal. High precipitation acidity also poses the potential of leaching heavy metals from the coal. This can happen through secondary reactions of sulfuric acid with minerals and organic compounds in the pile and along the runoff route. The use of natural clay barriers or liners beneath stockpile areas, runoff routes, and drainage basins would prevent groundwater quality impacts at the site.

Depending on the selected conversion option, fuel oil, coproducts, and small quantities of other chemicals would be stored onsite. All fluids would be stored above the ground and secondary containment would consist of 110% of the largest vessel. Hence, these fluids present no threat to groundwater quality.

Summary

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Appropriate testing procedures, the use of natural clay barriers and liners, and proper handling and storage/disposal of wastes should prevent any adverse impacts to groundwater quality at the site. Additionally, the Bellefonte Nuclear Plant SPCC plan (which would be updated for new facilities and activities) provides a methodology for mitigating site groundwater releases. Should a release occur, remediation methods can be employed to prevent impacts to water supplies. [32] The existing monitoring well network would be adequate for monitoring groundwater quality over the vast majority of the site.

4.2.9 Terrestrial Ecology

4.2.9.1 Impacts of Construction

Terrestrial Vegetation

The nature and significance of terrestrial vegetation at Bellefonte were described previously as a component of earlier nuclear siting activities and transmission line evaluations. The results of these assessments were presented in TVA's Final EIS for Bellefonte Nuclear Plant. [7] As a part of these earlier studies, special effort was given to assessing the potential for occurrences of rare (i.e., threatened or endangered) plants, or unique or uncommon plant communities. Based on findings from these earlier studies, as well as numerous field visits during the past 22 years, staff conclude that onsite terrestrial vegetation, and the composite vegetative communities, are typical and representative of the region.

Construction and operation of the proposed facilities would result in the loss or replacement of most vegetative communities in the areas slated for facility development. Most of these communities were established as site stabilization measures during construction of Bellefonte Nuclear Plant. Anticipated impacts of the various conversion options are not identical. Specifically, Options 3, 4, and 5 would disturb over 100 acres more than Option 2. Option 1 would disturb over 300 acres more than Option 2. However, given the past disturbance of much of this area and the abundance of such community types in the region, impacts are considered minor.

Wildlife

Because of a lack of suitable wildlife habitat on the Bellefonte Nuclear Plant site and since most new construction activities would be restricted to previously developed areas, few negative impacts to terrestrial wildlife are anticipated. Most areas to be developed are currently paved, covered with gravel, or consist of mowed areas. Some development may expand toward the western boundary of the Bellefonte Reservation, resulting in the loss of some abandoned pasture land and associated hedgerows. However, this habitat is regionally abundant and wildlife species associated with these habitats are typical of the region and have broad distribution patterns.

The construction of barge facilities would result in some reduction in foraging sites for wading birds such as great egrets, green herons, and great blue herons. However, the immediate area has an extensive network of shallow lagoons used as foraging sites by wading birds and waterfowl. Therefore, the impacts associated with these facilities are minimal.

Terrestrial Endangered and Threatened Species

The nearest occurrences for state-listed plants to the project site are *Cotinus obovatus* (smoketree) and *Nevisuia alabamensis* (Alabama snowreath), which occur approximately one mile away. Special consideration has been given to these species and other state-listed plants reported from within ten miles of the site. None of these species has been found on the Bellefonte site.

The nearest federally-listed plant species, *Sarracenia oreophila* (green pitcher plant), is reported from approximately 6.0 miles away. This federally endangered species has not been found on Bellefonte, nor has suitable habitat been seen there.

Onsite impacts of the various options are identical in terms of potential impacts to state- or federally-listed plant species. Because no state- or federally-listed plant species are known from the site, no impacts are anticipated.

The bald eagle, federally listed as threatened, occurs along the wooded shoreline on the east side of the Bellefonte plant site and along the intake canal during the winter. Use of existing barge unloading dock during plant construction activities would likely temporarily displace eagles from the immediate vicinity of the dock. This would have a negligible impact on eagles. Construction and operation of permanent barge facilities under the PC, IGCC, IGCC/C, and Combination Options, as well as construction and operation of the fuel oil storage tanks under the NGCC, IGCC, IGCC/C, and Combination Options would permanently eliminate some eagle habitat. Compared to the total amount of eagle habitat available on Guntersville Lake, however, this impact would be negligible.

Federally-endangered Indiana bats are likely to forage and roost in heavily wooded areas around Guntersville Lake. Potential impacts to the Indiana bat at Bellefonte could include reduction of foraging sites and loss of summer roosting habitat. However, most activities associated with the development of the Bellefonte Nuclear Plant do not include suitable habitat for the Indiana bat. Therefore, little reduction of forested tracts used as foraging areas are expected. Additionally, most suitable roosting habitat for this species is restricted to the hillsides and bluff areas along the river and are not likely to be impacted from activities related to this project.

Federally-endangered gray bats forage along the shoreline throughout Guntersville Lake. Gray bats forage primarily over weed beds associated with shallow water and would travel extensively in search of food. The construction of mooring cells associated with the coal handling facility for the PC, IGCC, IGCC/C, and Combination Options could impact suitable foraging sites for gray bats. However, due to the limited space required for the barge mooring facilities/activities and the local abundance of such foraging habitats, there will be no impact to this species.

4.2.9.2 Impacts of Operation

The greatest potential impacts would occur during construction and once completed, operation would have minimal impacts. However, noise is produced from operating flare stacks associated with Conversion Options 3, 4, and 5. This could impact wildlife located within the immediate vicinity. A large great blue heron colony is located approximately 2.2 miles northeast of the proposed location of the flare stacks. At this distance noise levels would be reduced, however the intermittent nature of this noise may induce stress in nesting birds. To reduce impacts to this colony, the forested buffer on the north eastern portion of Bellefonte should be maintained. Not only would this reduce noise from ash and gypsum disposal activities, it would dampen noise produced when operating the flare stacks, therefore, reducing noise related impacts to the heron colony. Operation of permanent barge facilities under the PC, IGCC, IGCC/C, and Combination Options would make the lake area covered by barges unsuitable for use by bald eagles and gray bats. The human activity associated with barge operations would also cause the area to be avoided by eagles; the area of this impact, however, would normally not extend beyond the moored barges. Compared to the total amount of bald eagle and gray bat foraging habitat available on Guntersville Lake, however, impacts to these species from barge facilities would be negligible.

4.2.10 Aquatic Ecology

4.2.10.1 Impacts of Construction

Sources of aquatic impacts associated with construction of the various Bellefonte conversion options are confined to upland activities that expose soils and have the potential for introducing additional contaminants to soils and also those activities that directly impact aquatic habitat. These activities and potential impacts are discussed below for each conversion option.

Option 1: PC

Construction activities for the PC Option that have a potential for affecting aquatic biological resources include:

- Relocation (lowering) of the existing diffuser pipe(s) five ft to allow sufficient depth for tow and barge ingress and egress for off-loading/loading of fuels, by-products, and coproducts,
- Construction of a barge terminal facility and mooring cells, and
- Storm water runoff and leaching from disturbed or contaminated areas.

Diffuser relocation and the barge terminal and mooring cells construction would require instream dredging (removal of ~ 150,000 yd^3) and is expected to result in near-field impacts on the resident aquatic communities. The diffuser would be lowered five ft and two barge docking stations and a fuel oil and coal unloading facility would be constructed. These activities would disrupt and modify aquatic habitat and communities at the dredging and barge terminal locations and increase turbidity and sediment loads in the water column. Resuspension of sediment toxins is not expected to result from in-stream dredging, based on 1994 sediment chemical data collected downstream (TRM 375.2) from the site. [34] Whole sediment chemical analysis did not identify any metals, PCBs, or DDT levels substantially above EPA Ecotox threshold screening values, or above background (upstream) concentrations. [35] Toxicity testing of sediment porewater caused no acute toxicity to daphnids or rotiers. [36] Also sediment chemical data measured just upstream from the site (TRM 396.8) in 1991 did not identify any metal or organic analyte above Ecotox Threshold screening levels. Deposition of silt loads resulting from these activities also has potential for impacting the quality and diversity of bottom habitat downstream from the construction area. Dredging could be lethal to mussels, other bottom-dwelling (benthic) macroinvertebrates, and young fish at the location and may temporarily affect movement, reproduction, and health of aquatic organisms near the disturbed area and downstream. Loss of individual mussel specimens directly in the path of active dredging would be an unavoidable impact of this action. However, a survey of the area to be impacted by dredging and relocation of the diffuser, conducted August 1995 by divers, found a low average density of approximately 0.3 mussels/m^2, which indicates this area does not support a valuable commercial mussel resource. Also, endangered and threatened species were determined to be absent in this area.

To minimize impacts, dredging and instream construction would be scheduled from late summer through winter to avoid the primary spawning season for fish, and BMPs (listed in Appendix L) would be followed in the removal of sediment. Impacts are expected to be near-field and short-term, having no significant effect on aquatic communities in Guntersville Lake. This assessment is based on the fact that the dredge material would be disposed of on land. If discharge of this material to the river is selected, impacts to the aquatic community downstream of Bellefonte are certain, to include temporary loss of habitat and the long-term loss of more permanent members of the benthic community (i. e., mussels). Further assessment would be required in the permitting process to identify the method and areas of disposal (see Chapter 5).

Onsite construction activities may increase the potential for soil erosion resulting from storm water runoff and leaching or washing of toxic chemicals from contaminated areas. Near-field effects may be lethal to some aquatic species and impede growth, reproduction, and movement of others. Spills and leaching of contaminants from onsite chemical storage (e.g., diesel fuel, cleaning solutions, solvents, etc.) and increased chemical and sediment load in storm water runoff are the primary sources of impact. To minimize the potential for washing/leaching of chemical contaminants into surface waters, all fluids would be stored above ground in containment areas 110% the size of largest vessel. Most storm water runoff would be collected and treated (primarily settling of solids) before being discharged to Guntersville Lake. Also, requirements of a BMP would be followed to avoid construction-related impacts to aquatic biological resources. More information on BMPs is given in Appendix L. Discharges must comply with construction-related requirements of the ADEM NPDES permit for Bellefonte. Under these controls, no significant impacts are expected to the aquatic biological resources from leaching or storm-related events.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Wetlands

Option 2: NGCC

No alteration in the diffuser location or construction of barge terminals would be required for this alternative. Potential impacts to the aquatic community are from leaching/washing of toxic chemicals stored onsite into the water system and storm water runoff. See storm water runoff and leaching, under Option 1, for a description of related impacts and mitigative measures that would be taken.

Option 3: IGCC

Sources of concern and potential impacts to aquatic biological resources are the same as described for Option 1.

Option 4: IGCC/C

Sources of concern are the same as for Option 1; however, an additional barge terminal and loading facility for coproducts is required, expanding the area of construction and area of impacts downstream. This expanded construction activity would increase the potential and magnitude of near-field, short-term impacts but is expected to have no significant long-term effects on aquatic communities in Guntersville Lake. Potential impacts from leaching of toxic chemicals and storm events are the same as described in Option 1. Additional acreage would be disturbed for construction of coproduction plants and storage facilities, increasing the potential for impacting surface water through surface runoff.

Option 5: Combination

Sources of concern and potential impacts to aquatic biological resources are the same as described in Option 4.

Baseline information presented in Chapter 3, Affected Environment, are adequate for describing the aquatic ecology of the site and habitat types that could be potentially impacted. However, to be in a position of evaluating specific impairments that could occur due to construction (or operation) of the facility, the aquatic data will be upgraded using methods for evaluating aquatic community health (integrity) in the immediate vicinity of the site and downstream. A 1-year study would be conducted before the commencement of construction activities that have potential for altering aquatic habitats and

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

communities. Fish community health, phytoplankton biomass, and sediment characterizations would be included in the data base upgrade.

4.2.10.2 Impacts of Operation

The magnitude and potential for aquatic impacts from operating any of the five Bellefonte conversion options depends on a variety of design and functional constraints particular to each option. Primary sources of impact to aquatic biological resources are associated with:

- **Intake of essential raw cooling water**
  - ⇒ Entrainment of aquatic organisms
  - ⇒ Impingement of fish

- **Barge loading/unloading operations**
  - ⇒ Spills of fuel (coal and oil), by-products, or coproducts into Guntersville Lake
  - ⇒ Deposition of fugitive fuel (coal) and by-products particulates into Guntersville Lake

- **Onsite storage of fuels, chemicals and by-products**
  - ⇒ Potential introduction of fuel (oil) and toxic chemicals onto soils and into water systems from spills, leaching into groundwater, and storm water runoff

- **Waste water discharges**
  - ⇒ Direct and indirect effects of **thermal** and **chemical** discharge quality.

No significant long-term, irreversible impacts are expected to aquatic communities in Guntersville Lake from any of the conversion options; however, potentials for near-field, short-term impacts are based on project features specific to each option described in Chapter 2 of this DEIS. Data and potentials for impacts are discussed in the following sections for each impact source listed above.

<u>Impacts From Intake Water</u>

Because intake demands from all five options are very small with regard to the total water-mass being transported past Bellefonte, there is little potential for significant entrainment/impingement impacts associated with any option.

Aquatic organisms entrained with plant intake water or impinged against the traveling screen by the water velocity are destroyed. Planktonic species, species having a planktonic life phase, and species attracted to current are the most likely to be affected. Impacts from entrainment and impingement of aquatic organisms are dependent on the location and design of intake and the volume and velocity of intake water. The Bellefonte intake structure entrains water through a 7.6-m wide trench connected to the original river channel; designed such that 85% of the intake demand would be withdrawn from the river channel and 15% from more productive upstream overbank habitat. [37] All conversion options would use the existing intake structure; therefore, potential impacts are proportional to the volume of intake water required.

Water intake demand varies from 18.72 mgd for the IGCC/C Option to 51.32 mgd for the IGCC (Table 4.20-1). Average river flow past Bellefonte is 25,100 mgd with an estimated 7-day 10-year minimum (7Q10) stream flow of 8,320 mgd. The worst-case conversion option (IGCC), would withdraw less than 1% of the river's flow during minimum river flow conditions. (By comparison, Widows Creek Fossil Plant which uses once-through cooling water, located on Guntersville Lake approximately 16 miles upstream from Bellefonte has a water intake demand of 1,079 mgd or 13% of the minimum river flow.) The greatest impacts of entrainment and impingement from Bellefonte would result from water withdrawn from the upstream productive overbank, although losses to the lake fish community should be minimal due to the large amounts of similar habitat near the plant (Town Creek and shallow overbanks downstream and across from the plant) and in other areas of the lake. The 0.6% of the minimum river flow entrained by Bellefonte does not have the potential for any cumulative impacts with the Widows Creek Fossil Plant based on its 316(b) assessment. [38]

Table 4.2.10-1 Estimated Daily Intake Demand and Commingled Discharge Volumes from Operation of Each Conversion Option

Conversion Option	Intake Demand (mgd)	% of River Flow Past Bellefonte		Commingled Effluent (mgd)	% of River Flow Past Bellefonte	
		Average (25,100 mgd)	Minimum (8,320 mgd)		Average (25,100 mgd)	Minimum (8,320 mgd)
PC	25.92	0.10	0.31	7.20	0.02	0.08
NGCC	28.80	0.11	0.35	6.91	0.02	0.08
IGCC	51.32	0.20	0.62	22.03	0.09	0.26
IGCC/C	18.72	0.07	0.23	10.51	0.04	0.13
Combination	37.44	0.15	0.45	15.12	0.06	0.18

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Impacts From Barge Loading and Unloading Operations

Amounts of fuels and products are shown in Table 4.2.10-2. These materials are transported to and from the site by way of barge, rail, and truck. Section 2.3.2 contains additional information about transportation modes. To minimize potential impacts, best available technology (BAT) would be used in design and operation of barge facilities.

Table 4.2.10-2 Potential Sources of Toxic Chemicals Stored Onsite for Each Option

	Conversion Option				
Source	**PC**	**NGCC**	**IGCC**	**IGCC/ C**	**Combination**
	Fluid Storage (Maximum Volume of Vessel - Million Gallons)				
Fuel Oil	0	25.6	10.4	1.3	25.6
Methanol	0	0	0	0.74	0.74
MTBE	0	0	0	0.46	0.46
Formaldehyde	0	0	0	0.44	0.44
Acetic Acid	0	0	0	0.15	0.15
Ammonia	0	0	0	0.03	0.03
UAN Solution	0	0	0	0.50	0.50
Granular Urea	0	0	0	0.16	0.16
Total	**0**	**25.6**	**10.4**	**3.78**	**28.08**
	Solid Fuels and By-Products (tons per year)				
Coal	8,240,000	0	7,446,000	3,723,000	3,723,000
Limestone	870,000	0	74,600	37,250	37,250
Slag	0	0	504,000	252,000	252,000
Fly Ash	965,300	0	40,800	20,400	20,400
Gypsum	1,865,000	0	0	0	0
Sulfur	0	0	240,000	120,000	120,000
Spent Catalyst	0	0	520	260	260
Bottom Ash	181,000	0	0	0	0
Raw Water Sludge	0	0	1,280	1,060	1,060
Gen Water Sludge	0	0	800	400	400
Sludges - Biotreatment	0	0	40	20	20
Total	**12,121,300**	**0**	**8,308,040**	**4,151,390**	**4,154,390**

Barge traffic and operation of the loading/unloading facilities has potential for impacting (degrading) aquatic habitat in the immediate area of the barge terminal. Increased water turbidity and scouring of benthic substrate may be caused by barge tow prop-wash. Deposition of fugitive coal and spills of fuel oil during unloading and by-product and/or chemical coproducts during loading could also degrade aquatic habitat. These events could result in near-field effects on survival, growth, reproduction, and movement of some aquatic species. Conservatively, assuming the majority of fuels, by-products, and coproducts would be transported to and from the site by barge, the potential for impacts varies among options depending on the volume of fuels and by-products/coproducts transported can be assessed. However, it is highly unlikely that combustion by-products would ever be moved by barge. Spills from fuels and by-product transfers between barges and the site would be mitigated by SPCC implementation.

Impacts From Onsite Storage of Fuels, Chemicals, and By-products

Greatest potential for releases to the environment from fuel (coal and fuel oil) and by-products is for the PC and IGCC Options, based on projected fuel requirements and by-product tonnage. The IGCC/C and Combination Options have the greatest potential for releasing contaminants based on maximum fluid storage volumes.

Toxic chemicals may be spilled or leaked onsite and washed into water system during storm events or leach into water system through groundwater. At Bellefonte, most storm water runoff is collected in ponds for treatment (primarily settling of solids) before being discharged to Guntersville Lake. Storm water runoff from the site could contain chemicals resulting from spills, leaks, and runoff from coal, fuel oil, and by-product storage areas. All discharges must comply with the ADEM NPDES permit limits and monitoring requirements for Bellefonte. Storm water runoff also would be managed through a Storm Water Pollution Prevention plan where appropriate controls would be implemented. BMPs also would be followed when transporting and storing chemicals onsite (Appendix L). To minimize the potential of toxic chemicals entering Guntersville Lake, all fluids stored onsite would be above ground in containment areas 110% the size of largest vessel. Potentials for impacts from storm water runoff, leaching, and direct spills of contaminants to surface waters vary among options depending on volume and characteristics of the fuels, chemicals, and by-products stored onsite. Potential sources of these contaminants are presented in Table 4.2.10-2.

Impacts From Waste Water Discharges

Options with the greatest number of contaminant sources and associated volumes (IGCC and Combination) and highest levels of contaminants in the final discharge (IGCC and IGCC/C) would have the greatest potential for impacting aquatic biological resources.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Waste water discharges can cause near-field effects on survival and movement of aquatic organisms found in the vicinity of the diffuser and far-field effects on the population dynamics (growth and reproduction) of some species. Potential impacts are associated with thermal characteristics of discharge water and with toxic chemicals (either washed into the system during storm events, generated as by-products of operation, and/or as chemicals added directly to plant water systems for controlling biofouling). Discharges can be lethal to mollusks, other benthic macroinvertebrates, and young fish in the mixing zone and can affect movement, reproduction, and health of aquatic organisms downstream. To minimize the potential impact from discharges, the exiting diffuser at Bellefonte is designed for a minimum mix of nine parts lake water to one part discharge. [37] All discharge water is commingled in holding ponds and evaluated periodically during release. Discharges must comply with the ADEM NPDES permit limits and monitoring requirements for the option selected.

Thermal impacts would be proportional to the temperature and volume of water discharged from the facility compared to temperature and volume (flow) of the receiving water (Table 4.2.10-1). Lake temperatures upstream from Bellefonte currently reach 32.2°C in August. Therefore, the maximum discharge temperature can be expected to exceed 32.2°C seasonally for all conversion options (see Tables 4.2.10-4a and -4b). The Alabama water quality standards criterion restricting the temperature rise to 2.8°C outside the mixing zone is not expected to be an issue for any of the options due to the small volume of discharges; however, the maximum temperature criterion of 30°C would likely be exceeded. Therefore, Clean Water Act, (CWA) Section 316(a) field investigations are anticipated in order to obtain an alternative thermal limit. A predictive evaluation of the effects of a 32.2°C maximum temperature limit for Bellefonte hypothesized a 32.2°C limit would assure the protection and propagation of balanced fish, shellfish, and wildlife communities in Guntersville Lake. [37] Similar investigations at Widows Creek Fossil Plant and at Sequoyah and Browns Ferry Nuclear Plants have demonstrated approach or higher thermal limits have no significant effect on lake populations or the movement and reproduction of target cool water species.[38,38,40,41]

Impacts from toxic chemicals contained in waste water discharges associated with each option (see Table 4.2.10-3) would be dependent upon characteristics and concentration of each contaminant (see Tables 4.2.10-4a and -4b), residual and cumulative effects, and discharge and river flows. Amounts and types of toxic chemicals discharged into Guntersville Lake are derived from contaminants that wash into waste water streams as a result of rainfall and surface runoff, contaminants that are generated as operational by-products, and substances that are added directly to water systems for the purpose of controlling biofouling. These contaminants would be combined when internal waste streams are comingled before being discharged to Guntersville Lake. Amounts of metals contained in coal pile runoff and ash pond discharges (PC Option) can be highly variable based on the source (mine) of coal.

Table 4.2.10-3 Sources and Volume of Discharges for Operation of Each Conversion Option

	Volume by Conversion Options (gpm)				
Source	**PC**	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
Process Water from Coproduction	-	-	-	100	100
Coal Pile Runoff & Contaminated Storm water [a]	500	-	500	500	500
Demineralizer Regeneration Waste	225	225	225	50	225
Sanitary Sewer	-	-	-	-	-
Contaminated Storm water and Plant Drains	50	30	60	30	55
Chemical Drains	15	10	20	10	15
Service Water / Pretreatment Water	100	50	102	50	75
Gasifier (Boiler) Blowdown	-	0	9,000	4,500	4,500
Cooling Tower Blowdown	3,239	3,817	4,486	1,409	4,122
Steam Cycle Blowdown	252	282	286	87	298
Non-contaminated Storm water	540	540	540	540	540
Total Comingled Effluent	5,000	4,800	15,300	7,300	10,500

[a] - includes ash pond discharge.

Table 4.2.10-4a Estimated Discharge Volume and Quality for Operation of Each Option

	Conversion Option				
Contaminant (mg/L or as noted)	**PC**	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
Discharge Volume (mgd)	**7.20**	**6.91**	**22.03**	**10.51**	**15.12**
Biological oxygen demand (BOD)	0.30	[a]	1.2	1.2	0.9
Chemical oxygen demand (COD)	1.25		3.0	3.1	2.2
Total organic carbon (TOC)	0.28		3.0	3.1	2.2
Total suspended solids (TSS)	82		5.9	6.2	4.3
Total dissolved solids (TDS)			1,108	1,159	808
Temperature °C (summer maximum)		35.9	36.1	36.1	36.2
pH S.U.			7-8	7-8	7-8
Color Pt-Co			clear	clear	clear
Ammonia (as N)	0.01		0.1	0.1	0.1
Boron	.740		126.0	131.7	91.9
Calcium	21.50		45.5	47.6	33.2
Chloride (Cl)	12.50		55.6	58.1	40.6
Cyanide (CN)	0.00		3.0	3.1	2.2
Fluoride	0.55		13.6	14.2	9.9
Formate			0.1	0.1	0.04
Magnesium	7.23		6.5	6.8	4.8
Nitrite-nitrate (as N)	0.33		76.9	80.4	56.1
Total organic nitrogen			0.1	0.1	0.1
Oil and grease µg/L			5.9	6.2	4.3
Phenols µg/L	0.5		0.1	0.1	0.04
Phosphate	0.02		1.3	1.4	1.0
Potassium	0.67		5.9	6.2	4.3
Silicon (as SiO_2)	0.30		14.2	14.8	10.4
Sodium	1.4		88.1	92.2	64.3
Sulfate	55.0		86.9	90.9	63.4
Sulfide	0.001		0.6	0.6	0.4
Sulfite			1.2	1.2	0.9
Surfactants			0.1	0.1	0.04
Thiocyanate			0.1	0.1	0.04
Thiosulfate			0.6	0.6	0.4

Table 4.2.10-4b Estimated Discharge Volume and Quality for Operation of Each Option

Contaminant	Conversion Option				
Trace Elements:	**PC** (µg/L)	**NGCC** (µg/L)	**IGCC** (µg/L)	**IGCC/C** (µg/L)	**Combination** (µg/L)
Aluminum	421.07		260	272	190
Antimony	0.77		5.9	6.2	4.3
Arsenic	1.90		42	44	31
Barium	15.33		140	147	102
Beryllium	0.10		4.1	43	30
Bromide			336	351	245
Cadmium	0.02		0.6	0.6	0.4
Chromium	4.87		3.0	3.1	2.2
Cobalt	0.27		18	19	13
Copper	1.00		12	12	8
Iron	144.67		89	93	65
Lead	0.23		0.6	0.6	0.4
Manganese	9.80		0.6	0.6	0.4
Mercury	0.252		1.2	1.2	0.9
Molybdenum	43.67		7.1	7.4	5.2
Nickel	1.33		3.0	3.1	2.2
Selenium	1.63		1,010	1,050	735
Silver	1.00		0.6	0.6	0.4
Thallium	1.80		0.6	0.6	0.4
Thorium			0.6	0.6	0.4
Tin			0.6	0.6	0.4
Titanium			83	87	60
Uranium			0.6	0.6	0.4
Vanadium	16.67		76	79	55
Zinc	1.33		16	17	12
Raw Water Chemical Treatment[b]: (Molluscicide) **H-130M** Non oxidizing biocide - Intermittent Feed (50% didecyldimethylammonium chloride, 10 % Ethanol, 40% water)	<50	<50	<50	<50	<50

[a] - Missing values indicate data are not available.
[b] - Based on Sequoyah Nuclear Plant, raw water treatment system
[c] - Respectively for the Emergency Raw Cooling Water and Raw Cooling Water systems measured as TRO.

Estimated discharge concentrations of contaminants shown in Tables 4.2.10-4a and 4.2.10-4b do not indicate a problem for meeting EPA in-stream acute and chronic aquatic life criteria. This considers the projected worst-case in-stream waste water concentration of 0.26% calculated for the mixed effluent for the IGCC Option based on effluent flow and the 7Q20 dilution available in the Tennessee River (see Table 4.2.10-1). However, modeling of acute discharge concentration would be required to determine in-stream waste concentrations at the edge of the mixing zone and for determining if individual chemical concentrations would exceed EPA's aquatic life criteria. [42,43] This determination would be especially appropriate for selenium as applied to the IGCC, IGCC/C, and Combination Options. Respective projected discharge concentrations for selenium are 1,010 µg/L, 1,050 µg/L, and 735 µg/L. Acute and chronic aquatic life criteria for selenium (selenite) are 260 µg/L and 35 µg/L, respectively. [44] Accurate aquatic life criteria for inorganic selenium have not been developed. The water quality human health criterion for selenium is 10 µg/L. [44] Projected mixed instream waste concentration of selenium, based on worst-case conditions (IGCC/C at 1,050 ug/L discharge concentration) and 378:1 dilution is 2.7 ug/L.

The discharge concentration of "Raw Water Chemical Treatment" shown in Table 4.2.10-4b, is for controlling Asiatic clams and Zebra mussels and assumes that the Calgon molluscicide, H-130M, or a molluscicide of similar chemical composition would be used. This molluscicide is a quaternary alkyl ammonium compound that is detoxified by silt or clay. Results of toxicity testing conducted by TVA to support use of this chemical is shown in Table 4.2.10-5. [45,46] Test results shown in this table are very conservative because test organisms were subjected to the entire exposure period indicated (4 to 10 days) while actual application required for biocontrol is only 48 hours per year. Results indicate the molluscicide can be discharged at the 50 µg/L residual rate without acute effects to freshwater mussels or other sediment organisms, especially if bentonite clay detoxification is conducted. Testing mussels with and without silt present indicated a strong (>6.4X) detoxification effect where mussel survival was 100% following a continuous nine-day exposure to 300 µg/L (six times the projected maximum discharge concentration). Test results also indicate that projected discharge concentrations of H-130M would not be acutely or chronically toxic to water column species with bentonite clay detoxification. Buildup of H-130M in sediments below the discharge should not be a problem due to utilization of the detoxified, long carbon-chained molecules by bacteria in the sediment (end product = CO_2).

Potential for impacts from contaminants discharged by any of the options would be lowered as a result of current NPDES requirements to measure levels of specific contaminants and also whole effluent toxicity (WET) in support of the CWA prohibition against discharging toxic chemicals in toxic amounts. Because combined impacts from comingled waste streams and numerous compounds cannot be evaluated based on single-chemical effects data, WET biomonitoring would be required to evaluate acceptability (compliance) of discharges from the option selected. Discharge WET testing would be established that would identify any acutely toxic concentrations of chemicals in the receiving water. Chronic toxicity would not be allowed outside the mixing zone. The NPDES permit for the facility would require a

Toxicity Reduction Evaluation under a mandated compliance schedule for eliminating any causes for noncompliance (chemical and/or WET) with permit conditions based on monitoring results (noncompliance is not expected to occur). Future permits also may require assessments of aquatic biological integrity (biocriteria) for potentially affected communities and also criteria for protecting sediments.

Table 4.2.10-5 Toxicity of the Molluscicide, H-130M

Test Media	Test Organisms	Toxicity Results
Synthetic Water w/o silt	*Ceriodaphnia dubia*	96-h LC_{50} = 172 µg/L 6-d IC_{25} = 139 µg/L
	Pimephales promelas	96-h LC_{50} = 172 µg/L 7-d IC_{25} = 104 µg/L
	Utterbackia imbecillis	96-h LC_{50} = 159 µg/L 9-d LC_{50} = 47 µg/L
	Selenastrum capricornutum	4-d IC25 = 7.7 µg/L
Synthetic Water W/800 mg silt/L dry wt.	*Utterbackia imbecillis*	96-h LC_{50} >300 µg/L 9-d LC_{50} >300 µg/L
Whole Formulated Sediment	*Hyalella azteca*	10-d LC_{50} >1500 µg/L 10-d IC25 = 144 µg/L
	Chironomus tentans	10-d LC_{50} >1500 µg/L 10-d IC25 >1500 µg/L
	Utterbackia imbecillis	9-d LC_{50} >1500 µg/L

To allow for assessment of operational impacts, existing, baseline aquatic communities near-field and far-field from the site would be re-evaluated one year before commencement of construction activities with potential for altering aquatic habitats and communities. This study will use focused methods for evaluating aquatic community health (integrity) and is intended to provide an updated and focused tool (data base) for evaluating impacts of operating the selected option.

4.2.11 Wetlands

4.2.11.1 Impacts of Construction

The barge handling facility would impact 4.9 hectares (ha) (12 acres) of wetlands. Construction of docking facilities and dredging for barge access would eliminate 1.7 ha (four acres) of forested wetland islands and 3.2 ha (8 acres) of rooted aquatic bed wetlands. If it is shown that there is no practicable alternative for locating the barge handling facilities along the river bank and removal of the barrier islands is necessary, then the U.S. Army Corps of Engineers (USACE) would require the development of a mitigation plan to accommodate the removal of displaced wetlands. The loss of wetland areas is required to be offset. [47-51] The determination of CWA jurisdiction is made by the USACE under the auspices of the EPA. A recommendation on whether a CWA Section 404 permit should be issued is usually made by the U.S. Fish and Wildlife Service in response to the public notice of the proposed action as part of the Section 404 permitting process. Other public agencies such as ADEM, the State Historical Preservation Officer as well as various associations and the general public frequently make recommendations to the 404 permit.

Many mitigation plans include restoration of prior converted croplands to functional wetlands, or less preferably, the enhancement of existing wetlands. Prior converted croplands is defined in Section 512.15 of the National Food Security Act Manual, August 1988, as wetlands which are both manipulated (drained or otherwise physically altered to remove excess water from the land) and cropped before December 23, 1985, to the extent that they no longer exhibit wetland values. The mitigation site would have be located as close to the lost wetlands as possible. Plans could be developed in conjunction with the Alabama Department of Conservation and Natural Resources, who operate five wildlife management areas and refuges in Jackson County. Potential projects include restoration of bottomland hardwoods and the development of waterfowl-wetlands wildlife impoundments.

4.2.11.2 Impacts of Operation

There would be no impacts to wetlands as a result of operation of any of the converted facilities.

4.2.12 Socioeconomics

4.2.12.1 Impacts of Construction

Under each of the conversion options, construction would result in a temporary increase in population and income in the area as a direct and indirect result of the increased employment at the site. About 30 to 35% of the construction workers are expected to move into the area. The percentage varies somewhat over time depending on the need at any given time for workers with specialized skills not available in the local work force as outlined in the construction descriptions for each option in Chapter 2. Of those moving into the area, about 50% are likely to buy or rent houses. An additional 25 to 30% are expected to buy or rent mobile homes. The remaining workers generally would rent apartments or sleeping rooms.

Workers who bring their families are expected to make up about 70% of all construction workers moving into the area. Most of the remaining 30% would be single or would live in the area during the week and return home on weekends. On the average, it is expected that workers who bring their families would have about 0.9 school-age children per family.

About 75% of construction workers who move are expected to live in Jackson County. Within Jackson County, at least two-thirds of the movers can be expected to live in the Scottsboro-Hollywood area, assuming housing is available. An additional one-fifth is likely to be distributed along the Valley toward Guntersville or toward Bridgeport. The remainder, approximately one-tenth, would likely be scattered around the rest of the county.

Impact analyses for all of the options are estimated on the basis of these percentages.

Income and Employment

Peak employment levels range from 550 under the NGCC Option to 3,447 under the Combination Option (Table 4.2.12-1). Total person-years of employment during the construction period also vary greatly, from 3,008 under the NGCC Option to 15,759 under the Combination Option; total wages vary proportionately. Capital expenditures, on the other hand, are lowest under the NGCC Option, at $1,315.0 million, and greatest under the IGCC Option, at $4,067.6 million.

The labor market area, in which most of the construction workers either live or would be residing while working at the site, includes the Huntsville-Decatur area and the Chattanooga area as well as Jackson County and other nearby counties. The estimated income and employment impacts on this area during the construction of the plant, including indirect effects, are shown in Table 4.2.12-2. Employment impacts range from about 11,000 person-years under the NGCC Option to about 44,000 person-years under the IGCC Option. Income impacts range from about $500 million under the NGCC Option to about $2.2 billion under the IGCC Option.

Table 4.2.12-1 Plant Construction Employment and Expenditures

Option	Peak Employment	Total Employment	Wages	Capital Expenditures
	(annual)	(Person-Years)	(millions of $)	(millions of $)
PC	1,612	11,912	833.8	3,131.2
NGCC	550	3,008	210.5	1,315.0
IGCC	2,162	15,604	1,092.2	4,067.6
IGCC/C	2,898	8,663	606.4	1,873.0
Combination	3,447	15,759	1,103.1	2,859.7

Table 4.2.12-2 Employment and Income Impacts, Labor Market Area

Option	Employment (Person-Years)	Income (Millions of $)
PC	33,711	2,001.1
NGCC	10,528	532.6
IGCC	44,159	2,195.3
IGCC/C	22,784	1,146.1
Combination	39,870	2,018.7

Population

Depending on the option, between 211 and 1,200 workers are expected to move into the local area, with most of them moving into Jackson County (Tables 4.2.12-3 and 4.2.12-4). The population increase in Jackson County is expected to range from 420 to 2,241, depending on the option selected. According to the latest population estimates by the U.S. Bureau of the Census, population increase in Jackson County has averaged about 466 persons per year since the 1990 Census of Population. Even the smallest of the estimated impacts would be a noticeable change in population growth in Jackson County; the larger increase under the last two options would be especially noticeable impacts.

Table 4.2.12-3 Population Impacts of Peak Construction

Option	Number of Workers	Number moving into area	Total population increase
PC	1,612	608	1,634
NGCC	550	211	560
IGCC	2,162	815	2,134
IGCC/C	2,898	1,016	2,543
Combination	3,447	1,200	2,988

Table 4.2.12-4 Jackson County Population Impacts

Option	Moving into Jackson County	Moving into Scottsboro-Hollywood area	Moving elsewhere in Jackson County
PC	1,226	858	368
NGCC	420	294	126
IGCC	1,600	1,120	480
IGCC/C	1,907	1,335	572
Combination	2,241	1,569	672

Housing

The demand for housing in Jackson County and surrounding areas at peak construction ranges from less than 100 to over 500 houses, depending on the option selected (Table 4.2.12-5). Given the current population and population growth rates of Jackson County, these could be important impacts, especially for those options with the highest demand. The demand for mobile home facilities is somewhat less, but could also be an important impact. While the demand for apartments and sleeping rooms is likely to be smaller, these impacts may also be noticeable under the options with the highest demand, especially if the area is experiencing a tight market at the time of construction.

Table 4.2.12-5 Estimated Housing Choice of Construction Workers Moving into the Local Area

Option	Number of Workers Moving Into Local Area	Number Buying or Renting Houses	Number Buying or Renting Mobile Homes	Apartments or Sleeping Rooms
PC	618	278	216	124
NGCC	211	95	74	42
IGCC	815	367	285	163
IGCC/C	1,016	457	356	203
Combination	1,200	540	420	240

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Air Quality**

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Transportation

Fire

As noted in Chapter 3, most of the county, with the major exception of Scottsboro, is dependent on volunteer fire fighters. The influx of population during construction may place some strain on those facilities.

Schools

As of July 1996, the projected enrollment for the two school systems in Jackson County for the 1996-97 school year is 6,181, an increase of 172 students over the 1995-96 school year. The projected impacts from construction employment at peak would be largely to Jackson County, with small impacts on surrounding counties (Table 4.2.12-6). The total impact ranges from 161 students under the NGCC Option to 965 under the Combination Option. Of these, 132 of the 161 or 767 of the 965 are expected to attend schools in Jackson County.

Table 4.2.12-6. Student Impacts at Peak Construction

Option	Total Number of Students	Jackson County School System	Scottsboro City School System	Other Counties
PC	501	128	248	125
NGCC	161	45	87	29
IGCC	611	170	328	113
IGCC/C	718	191	371	156
Combination	965	261	506	198

The schools in Jackson County currently have a capacity of 7,841 students. Even with the projected increase of 172 in 1996-97, there would be facilities available to accommodate an additional 1,660 students, more than projected under any of the options.

Regardless of the impacts associated with TVA activities, both school systems would receive the state and federal contributions for instruction based on average daily attendance, and state school funding distribution formulas and would qualify for applicable federal program funding. However, the local funds contribution would be affected by an influx of new students. The influx would increase the local operating cost under each option.

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Air Quality

Transportation services for students in the Scottsboro City School System would be adequate to accommodate a capacity of 4,080 students. With the impacts associated with the highest option, Combination, Scottsboro would have to transport an additional 506 students. The 1996-97 student projection would require that the system transport 2986 students. With the additional TVA impact, the Scottsboro City School System would have to transport a total of 3,492 students. This number could easily be handled with the existing capacity.

The Jackson County School System has a current transportation capacity of 6,269 students. The system would carry approximately 6,360 students during the 1996-97 school year. The small increase under the NGCC Option may not be important. However, those in the higher ranges, such as 261 additional students under the Combination Option, may strain the system and therefore be an important impact. Selection of the Combination Option, and perhaps the IGCC or IGCC/C Options, would likely lead to a need for one or two additional school buses and drivers.

4.2.12.2 Impact of Operation

Operation of the plant under any of the options would result in a permanent impact of employees who supervise, operate, and maintain the plant. About 45 to 55% of these are expected to move into the area. Close to 90% are expected to buy or rent houses, and at least 90% would be workers who bring their families. About 90% of those who move into the area are expected to live in Jackson County. At least two-thirds can be expected to live in the Scottsboro-Hollywood area. An additional one-fifth is likely to be distributed along the Valley toward Guntersville or toward Bridgeport. The remainder, approximately one-tenth, would likely be scattered around the rest of the county.

Table 4.2.12-7 Population Impacts of Plant Operation

Option	No. of Employees Moving into Area	No. with Families	Single/Living Alone	Population Impact
PC	290	261	29	812
NGCC	100	90	10	280
IGCC	265	239	27	742
IGCC/C	215	194	22	602
Combination	320	288	32	896

Table 4.2.12-8 Estimated Location of Population Impacts of Plant Operation

Option	Total Population Moving into Area	Moving into Jackson County	Moving into Scottsboro-Hollywood Area	Moving elsewhere in valley in Jackson County	Moving elsewhere in county
PC	812	731	512	146	73
NGCC	280	252	176	50	25
IGCC	742	668	467	134	67
IGCC/C	602	542	379	108	54
Combination	896	806	564	161	81

Total population impacts on Jackson County would range from about 252 to about 806, depending on the option selected. At the midpoint of this range, the impact is about equal to the average annual increase in population in the county, as estimated by the U.S. Bureau of the Census. While the increases at the lower levels might not be important impacts, the larger increases near or at the upper end of the range would be important.

Income and Employment

Plant employment ranges from 200 to 640 workers, depending on the option selected, with annual wages ranging from $8.8 to $28.2 million. Spending by the workers would have an additional impact on Jackson County, ranging from a total of 396 to 1,094 jobs, including those at the plant, and total income, including that of plant employees, ranging from $19.1 to $53.6 million.

Table 4.2.12-9 Plant Operation Employment and Expenditures

Option	Plant Employment	Total Employment Generated, Jackson County	Wages	Total Income Generated, Jackson County
	(annual)	(annual)	(annual, millions of $)	(annual, millions of $)
PC	580	928	25.5	46.3
NGCC	200	396	8.8	19.1
IGCC	530	943	23.3	46.1
IGCC/C	430	718	18.9	35.2
Combination	640	1,094	28.2	53.6

Housing

The population increase, projected to be from over 200 to about 900, depending on the option, would result in a housing demand ranging from fewer than 100 to about 300 houses. These, however, are in the lower end of the range; arising from peak construction and therefore should be easily accommodated as the project moves from the construction phase into operation.

Fire

The increased population would place some additional load on fire fighting facilities in Jackson County. However, the impacts are not greatly outside the current growth patterns and therefore this should not be an important impact.

Schools

The increase in school enrollment would be no greater than that generated by construction, and therefore should present no special problems to the county once the construction impacts have been accommodated.

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4.2.13 Transportation

4.2.13.1 Impacts of Construction

Traffic generated due to the construction of the selected plant facility would have various effects on the transportation system. Commuter traffic generated during the project construction phase could strain the capacity of the local road network. Transportation of materials could have noticeable effects on road, rail, or waterway networks. Generally, though, transportation effects due to construction at Bellefonte would vary according to the conversion option chosen.

Highways and Roads

The assessment of traffic effects for the project is based on the transportation planning and engineering concept of level of service (LOS). The concept addresses the quality of service, or operating conditions, provided by the roadway network, as perceived by motorists. Under this type of analysis, LOS is a qualitative measure that is described in terms of travel time, comfort, safety, and maneuvering freedom. This method of measurement incorporates various measurable factors associated with a particular segment of a roadway into the analysis. The service volume associated with a certain level of service is a maximum volume for that level. Six LOS are designated as A through F, and are defined as differing qualities of service provided by a roadway.

- *Level of service A* is defined as the highest quality of service which a particular class of highway can provide. It is a condition of free flow in which there is little or no restriction on speed or maneuverability caused by the presence of other vehicles.
- *Level of service B* is a zone of stable flow. The restriction on maneuverability is negligible and there is little probability of major reduction in speed or flow.
- *Level of service C* is a zone of stable flow but at this volume and density level most drivers are becoming restricted in their freedom to select speed, change lanes, or pass.
- *Level of service D* approaches unstable flow. Tolerable average operating speeds are maintained, but could be subject to considerable and sudden variation. This condition is tolerable for short periods of time.
- *Level of service E* is unstable with lower operating speeds and some momentary stoppages. There is little independence of speed selection and maneuverability. The upper limit of this level is the capacity of the facility.
- *Level of service F* indicates forced-flow operations at low speeds. The level of density increases to the effect of a traffic "jam."

In this analysis, level of service D can be viewed as the maximum allowable capacity of the roadway, as the conditions can be tolerable for short periods of time, or peak hour conditions.

Transportation effects due to increased traffic related to the project were determined by first estimating the existing level of service for selected key travel routes. Then projected data on additional vehicle trips, and incoming distribution of traffic routes, were used to determine the resulting levels of services with associated traffic routes. The analysis used to determine service volumes and associated levels of service is known as the Highway Capacity Analysis. [52]

Traffic analysis was conducted on five key road segments which comprise three roads that serve Bellefonte. These roads appeared to be the most likely travel routes due to their location to nearby existing population centers. By using geographic population distribution data for Jackson County, the probable percentages of incoming traffic was determined.

Except for the PC Option, approximately 31% of Bellefonte traffic would be from the north, via U.S. Highway 72 and Bellefonte Road to the plant. The remainder of traffic (69%) would come from the south with 24% traveling Jackson 33 from Scottsboro and 45% traveling U.S. Highway 72 to Jackson 33 through the old Bellefonte townsite. The traffic from the south would be using the south access road into the plant, which was constructed for temporary use during original construction of Bellefonte Nuclear Plant. The assumption of this analysis is that those traveling from the south would continue to have access from Jackson 33 into the plant via a south access road. For the PC Option, it was assumed that the incoming traffic form the north would travel into the plant via Jackson Highway 33 from U.S. Highway 72, due to the elimination of Bellefonte Road for construction of a gypsum disposal area for this option. Therefore, the traffic distribution will again be 31% from the north and 69% from the south. However, with the closure of Bellefonte Road, 76% of the traffic for this option will travel Jackson Highway 33 through the old Bellefonte townsite.

The peak work force levels at Bellefonte varies according to the five options available. Refer to the construction activities descriptions for each option in Chapter 2 for peak work force data. The transportation impacts and projected changes in levels of service were based upon peak commuter traffic during portions of the construction phase. Existing average daily traffic (ADT) counts are shown in Figure 3.1.13-1. The peak construction force is temporary; therefore, the analysis provides a conservative estimate. The conservatism can offset and compensate for unknown construction material truck deliveries and disposals of solid waste and excavated material, growth of future traffic volumes, possibility of fewer sharing rides, and possible overestimation in service capacity and variation of traffic flows on the road, without altering the final results regarding the significance of future road transportation impacts.

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Peak work force levels were calculated using certain assumptions. First, it was assumed that 80% of the peak personnel during the construction period would work the day shift and travel during peak hours. The traffic analysis also assumed an average of 1.67 workers per vehicle. This is a relatively high number compared to an urbanized area where a radial transportation pattern is produced rather than a funneling effect from fewer populated geographic centers in a rural setting. All roads except U.S. Highway 72 were analyzed assuming traffic in two directions. This accounts for the passing maneuver on rural undivided highways. The analysis specified in the Highway Capacity Manual for rural multilane divided highways is for one lane only; therefore, a directional factor of 0.67 was applied to existing ADT values on U.S. Highway 72 and used for determining the present peak-directional hour traffic. Another assumption made was that the current truck composition is 10% of the average daily traffic.

The results of the traffic analysis, based on existing and projected service levels, are presented in Table 4.2.13-1. The figures in the table indicate greater service decreases for the IGCC, IGCC/C, and Combination Options. Relatively insignificant decreases would occur on U.S. Highway 72, with a worst-case decrease from LOS A to LOS B. More significant service decreases occur on the two-lane undivided rural roads, including Bellefonte Road and Jackson 33. Bellefonte Road service level decreases from LOS C to LOS D for the IGCC and IGCC/C Options. The service level decreases to an unacceptable LOS E for the Combination Option as the peak hour traffic increases by about five times. The section of Jackson 33 from the plant to U.S. 72 decreases from LOS D to LOS E for the IGCC, IGCC/C, and Combination Options. The decrease to LOS E for the PC Option is due primarily to the elimination of Bellefonte Road. The segment of Jackson 33 south from the plant to Scottsboro is rated an existing LOS C due to its better alignment and passing zones. For the IGCC/C and Combination Options, there is a service level decrease on this segment to LOS D with an increase in peak hour traffic by approximately four times.

The projected service level decreases for the subject road segments have a moderately significant impact on transportation. The service decreases to LOS E are more significant due to the generally unacceptable operating level. The service decreases, however, are short term during the construction phase. The operations phase has a much smaller work force and would not have quite as large an impact on any of the subject roads. Most of the effect of increased traffic would be felt almost entirely by plant employees, as opposed to the entire public at large.

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Table 4.2.13-1 Projected Traffic and LOS Changes

Segment	Existing Peak Volume [a]	Existing LOS [b]	Available Capacity [c]	Additional Peak Hour Traffic (during Construction Period) [d]	Projected LOS [b]
U.S. Highway 72 (from North side)	777	A	2,499	PC- 239	A
				NGCC- 82	A
				IGCC- 321	B
				IGCC/C- 430	B
				Combination- 512	B
U.S. Highway 72 (South of Hollywood)	1,038	A	2,238	PC- 348	B
				NGCC- 119	B
				IGCC- 466	B
				IGCC/C- 625	B
				Combination- 743	B
Bellefonte Road	120	C	441	PC- Road eliminated	N/A
				NGCC- 82	C
				IGCC- 321	D
				IGCC/C- 430	D
				Combination- 512	E
Jackson 33 (to/from U.S. Highway 72)	120	D	390	PC- 587	E
				NGCC- 119	D
				IGCC- 466	E
				IGCC/C- 625	E
				Combination- 743	E
Jackson 33 (to/from Scottsboro)	120	C	579	PC- 185	C
				NGCC- 63	C
				IGCC- 249	C
				IGCC/C- 333	D
				Combination- 396	D

[a] - Volume figures represent peak hour to be 12% of the ADT values.
[b] - Estimated from existing or projected volumes and corresponding LOS from Highway Capacity Manual tables.
[c] - Estimated as the difference between existing volume and the maximum service flow rate for LOS D.
[d] - Allocated on basis of projected worker residence by county divisions.

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The traffic impacts on the local road networks may result in a need for specific site mitigation measures to improve future service levels on Bellefonte Road and Jackson 33. More detailed studies of ADT, service volumes, intersection or other potential bottleneck areas, and traffic patterns should be conducted to determine if certain mitigation measures should be adopted for the particular option chosen. Such measures that could be selected are physical improvements to the local road or road network to increase capacity. Potential capacity improvements could include construction of additional vehicle lanes throughout road segments, construction of passing lanes in certain locations, or realignment to eliminate some of the no-passing zones. The south access road is a primary area of concern for capacity improvements for mitigation. At its present condition, there are geometric deficiencies associated with the lay out of the intersection with Jackson 33, as the road was originally constructed as temporary road. It should also be recognized that increased truck traffic contributes to an increase in the pavement maintenance required as one truck, in extreme conditions, can be equivalent to five passenger cars. Employee programs that provide flexible hours could reduce road travel during peak hours, and restrictions for trucks traveling during the peak hour could be made. Also, establishing employee programs and incentives for ride-sharing could be encouraged and bus and/or vanpool programs could be initiated.

Railroads

The shipment of construction materials would occur periodically by rail during construction. Actual deliveries are not known at this time because, at this stage in project planning, transportation modes and volumes of construction materials have not yet been identified. However, the majority of rail transportation shipments would occur during operations with shipments of coproducts, by-products, and solid waste material. The railroad traffic impacts during construction would be of a smaller magnitude than during operations. Therefore, the effects on the transportation system during operations would provide a more conservative assessment of railway transportation impacts.

River Transport

Construction materials would be shipped periodically by barge during construction. Bellefonte has a construction unloading dock which was used during the construction of the nuclear plant. Actual deliveries are not currently available as the transportation modes and volumes of construction materials have not yet been identified at this stage in project planning. However, most of the additional barge traffic would occur during operations of the new plant facility. Such traffic would include fuel deliveries and shipments of coproducts. Therefore, the effects of the traffic increase due to operations would be of a greater magnitude and would support a conservative evaluation of the transportation impacts due to the increased traffic on the river.

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4.2.13.2 Impacts of Operation

Transportation impacts on existing facilities in the vicinity of Bellefonte would occur as a result of the conversion project. Operation of the selected plant facility would have various effects on the transportation system. Commuter traffic generated during operations would increase traffic on the local road network and would decrease the available capacity of the subject roads. Transportation of materials, including fuel deliveries, and shipments of solid waste, by-products and coproducts, could have noticeable effects on road, rail, or waterway networks. Generally transportation effects due to operation at Bellefonte would vary according to the conversion option.

Highways and Roads

Traffic would increase on local roads as a result of truck transportation requirements during operations and commuter traffic of plant employees. The traffic analysis contained in Section 4.2.13.1 shows the transportation effects and changes in the local roads' level of service as a result of peak construction commuter traffic. In all cases, the project traffic volumes during the operations phase and during periods when construction and operations overlap are lower than volumes during the peak construction phase and would use less of the available capacity. Therefore, the impacts of traffic during the peak construction period are more critical than during the operational phase and render a conservative estimate of traffic impacts to changes in levels of service.

Projected traffic and changes to levels of service during operations are shown in Table 4.2.13-2. Basic assumptions used for calculations for operations are the same as those used for the construction phase analysis. Operational daily truck traffic includes by-product/coproduct hauling off site and limestone delivery to the site. Deliveries are assumed to occur 50 weeks per year and 40 hours per week, evenly distributed throughout the day, except for the PC Option, at 1,200 MW, for which deliveries are assumed to occur 60 hours per week. Also, since truck travel routes are unknown, the assumption was made that all of the trucks travel the specific route being analyzed. There are no significant changes to LOS on the existing road network. U.S. Highway 72 (south of Hollywood) shows the only LOS decrease, LOS A to LOS B, for all options except for NGCC. Any mitigation efforts accomplished during the construction phase as discussed in Section 4.2.13.1, would only improve capacity levels during operations and may also account for certain unknowns, such as operational truck traffic deliveries for by-product removal off site, other unknown truck deliveries and shipments, etc.

Table 4.2.13-2 Projected Traffic and LOS Changes

Segment	Existing Peak Volume [a]	Existing LOS [b]	Available Capacity [c]	Additional Peak Hour Traffic (during Operations) [d]	Projected LOS [b]
U.S. Highway 72 (from North side)	777	A	2,499	PC- 152	A
				NGCC- 30	A
				IGCC- 92	A
				IGCC/C- 71	A
				Combination- 102	A
U.S. Highway 72 (South of Hollywood)	1,038	A	2,238	PC- 191	B
				NGCC- 43	A
				IGCC- 127	B
				IGCC/C- 100	B
				Combination- 145	B
Bellefonte Road	120	C	441	PC- Road Eliminated	N/A
				NGCC- 30	C
				IGCC- 92	C
				IGCC/C- 71	C
				Combination- 102	C
Jackson 33 (to/from U.S. Highway 72)	120	D	390	PC- 277	D
				NGCC- 43	D
				IGCC- 127	D
				IGCC/C- 100	D
				Combination- 145	D
Jackson 33 (to/from Scottsboro)	120	C	579	PC- 133	C
				NGCC- 23	C
				IGCC- 74	C
				IGCC/C- 56	C
				Combination- 81	C

[a] - Volume figures represent peak hour to be 12% of the ADT values.
[b] - Estimated from existing or projected volumes and corresponding LOS from Highway Capacity Manual tables.
[c] - Estimated as the difference between existing volume and the maximum service flow rate for LOS D.
[d] - Allocated on basis of projected worker residence by county divisions and projected daily truck traffic for operations.

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Railroads

The shipment of coproducts and by-products from the site would increase traffic on the railway system. Several materials would be shipped by rail from the site. Included would be sulfur, which would be shipped as a molten liquid in insulated rail cars. Rail transportation requirements are shown in Section 2.3.2. There are no rail transportation requirements for the PC Option due to different fuel requirements, fuel handling infrastructure, and absence of by-products, etc.

The NGCC Option shows an increase of 7,853 loaded rail car units annually to the existing network. Assuming deliveries 50 weeks out of the year and five days per week, this amounts to approximately four rail cars per day one way. The IGCC Option shows an increase of 2,400 loaded rail car units annually. This amounts to approximately ten rail cars per day one way. The IGCC/C and the Combination Options both show an increase of 10,592 loaded rail car units annually. This amounts to an additional 43 rail cars per day one way. This additional rail traffic would not place significant constraints on the capacity of the rail system. The existing Bellefonte trackage would first, however, need upgrading because this track has not seen train traffic or been maintained in years. The increase in rail traffic would not be large in the context of the rail system and is not expected to create any congestion problems.

With an increase in train traffic, potential for accidents at any on grade intersection also increases. The Bellefonte Spur Track crosses two county roads at-grade before entering the plant site. A factor that influences safety at rail crossings includes the type and degree of warning signals. The existing crossings presently have only crossbuck warning signs. If train traffic was to occur on this track, signals and gates could be warranted. The county roads being crossed do not have much daily traffic, therefore significant congestion problems on these roads should not occur.

The possibility of derailments is increased due to the additional train traffic. Derailments can occur on railroads due to inadequate maintenance, objects on tracks, mechanical failure, or sabotage. Derailments are generally not as likely with rail cars traveling at low speeds, which would be the case on these tracks. A blockage of an at-grade crossing due to a derailment could cause delay in the arrival of any emergency vehicle if a less direct route was required to be traveled.

River Transport

The movement of feedstock to the site and removal of by-products and coproducts from the site would increase river traffic. Coal, limestone, and fuel oil would, in many cases, be delivered by barge to take advantage of the low delivery prices available. In addition, shipment of coproducts may also be by barge due to typically less expensive shipping rates to markets. Barge transportation requirements for each option are shown in Chapter 2. There are fewest transportation requirements for the NGCC Option due to there being no delivery of solid fuels and no production of by-products or coproducts for sale.

Bellefonte is located upstream of Guntersville Dam and downstream of Nickajack Dam. Existing data on these locks is shown in Table 3.1.13-1. The barge traffic created due to the Bellefonte plant is assumed to be added to the existing traffic occurring downstream of Nickajack Dam. Guntersville Lock would be the first lock encountered downstream of the plant. This is the most probable scenario due to the evidence of current utilization data and less industry in the portion of the river upstream of Nickajack. The coal barges would most likely arrive at the plant in dedicated tows as opposed to mixed tows. The direct service would imply that about 15 barge tows would come off the Ohio River and/or nine barge tows would move off the Tennessee Tombigbee Waterway. The analysis, however, assumed, for conservatism, that the current average tow size for the particular lock would exist for the coal barge deliveries.

The PC Option would add 6,073 barges, or an annual tonnage of 9.1 million tons, including 8.24 million tons of coal, to the system per year. Section 2.3.2 contains these transportation mode requirements for each option. This would increase the total annual number of barges, including return trips with empty barges, to about 21,200 barges through the Guntersville Lock. The total annual number of commercial lockages would increase to about 3,300, which would be about 44% of its capacity. The total percentage of coal of the total tonnage through the lock would increase from 24%, at 1.9 million tons, to approximately 59%, at 10.2 million tons. The number of tows that would be expected in this portion of the river would increase by approximately four tows per day, two loaded barge tows upriver and two return trips downstream with empties, to seven tows per day.

The IGCC Option would add 4,970 barges, or an annual tonnage of 7.4 million tons, including 7.5 million tons of coal, to the system per year. This would increase the total annual number of barges to about 19,000 barges through the Guntersville Lock. The annual total number of commercial lockages would increase to about 3,000, which would be only about 41% of its capacity. The total percentage of coal of the total tonnage through the lock would increase from 24%, at 1.9 million tons, to approximately 61%, at 9.4 million tons. The number of tows that would be expected in this portion of the river would increase by approximately four tows per day to seven tows per day.

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The IGCC/C Option would add 2,996 barges, or an annual tonnage of 5.7 million tons, including 3.7 million tons of coal, to the system per year. This would increase the total annual number of barges to about 15,000 barges through Guntersville Lock. The annual total number of commercial lockages would increase to about 2,500, which would be only about 37% of its capacity. The total percentage of coal of the total tonnage through the lock would increase from 24%, at 1.9 million tons, to approximately 41%, at 5.6 million tons. The number of tows that would be expected in this portion of the river would increase by approximately two tows per day to five tows per day.

The Combination Option would add 2,965 barges to Guntersville Lock per year. This number is approximately equal to the additional barges added for the IGCC/C Option and the other related increases to utilization, lockages, and tows would be similar.

Coal purchased for the related conversion options would most likely be Illinois coal and would be shipped upstream through Kentucky, Pickwick, Wilson, and Wheeler locks to Bellefonte. In addition, material shipments from unknown origins and product deliveries to unknown destinations related to the conversion options, would be shipped through these locks. Therefore, Kentucky, Pickwick, Wilson, Wheeler, and Guntersville locks were evaluated for future impacts for each conversion option. Projected impacts due to the additional barge traffic through the affected locks, as a result of Bellefonte's barging needs, are shown in Table 4.2.13-3. Existing river traffic is shown in Table 3.1.13-1.

The possible addition to barge traffic would have a minor impact on the capacity of the waterway system upstream of Kentucky Lock. Barge traffic would increase, but not to the point that any significant congestion effects would be experienced. Because this stretch of the river is not fully utilized by barge traffic, the impact of increased barge traffic to existing commercial traffic could be positive. Increased traffic would most likely improve the availability of towing services in underutilized portions of the river and provide better transportation rates for existing waterway users.

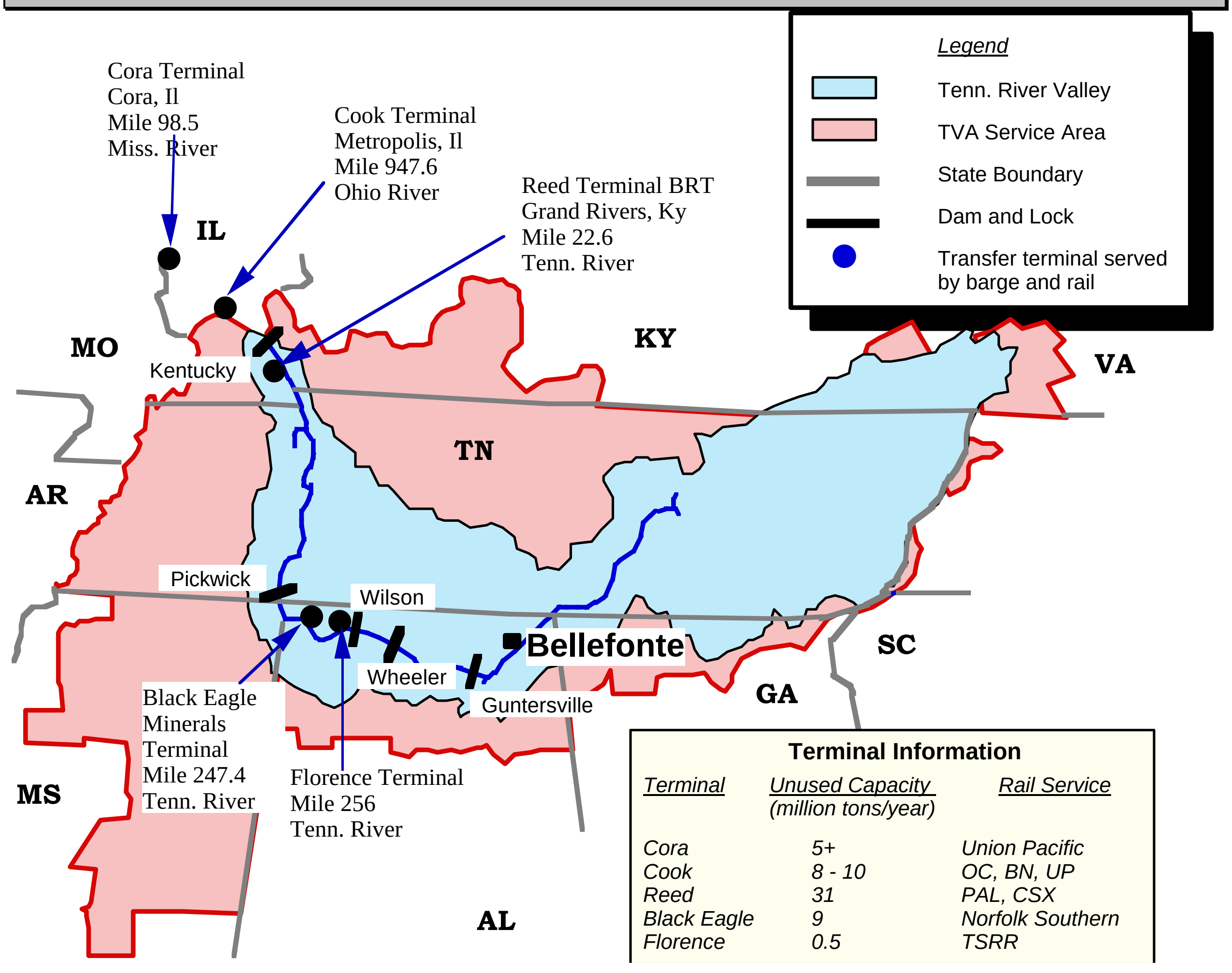
Table 4.2.13-3 Projected Impacts to Navigation System

Locks	PC	IGCC	IGCC/C	Combination	1995 - Existing Barge Traffic
Guntersville					
Total Barges	21,200	19,000	15,000	15,000	9,092
Total Commercial Lockages	3,300	3,000	2,500	2,500	1,712
Projected Utilization of Lock annually	44%	41%	37%	37%	30%
Total % of Coal of Total Tonnage	59%	61%	41%	41%	24%
Wheeler					
Total Barges	25,000	22,800	18,800	18,800	12,859
Total Commercial Lockages	4,100	3,800	3,300	3,300	2,450
Projected Utilization of Lock Annually	51%	49%	44%	44%	37%
Total % of Coal of Total Tonnage	49%	49%	32%	32%	15%
Wilson					
Total Barges	25,400	23,200	19,200	19,200	13,251
Total Commercial Lockages	4,600	4,200	3,600	3,600	2,655
Projected Utilization of Lock Annually	62%	59%	53%	53%	44%
Total % of Coal of Total Tonnage	48%	48%	32%	32%	15%
Pickwick					
Total Barges	31,400	29,200	25,100	25,100	19,208
Total Commercial Lockages	4,300	4,000	3,500	3,500	2,742
Projected Utilization of Lock Annually	54%	51%	45%	45%	37%
Total % of Coal of Total Tonnage	57%	58%	45%	45%	38%
Kentucky					
Total Barges	49,000	46,800	42,800	42,800	36,858
Total Commerical Lockages	7,400	7,200	6,700	6,700	6,067
Projected Utilization of Lock Annually	95%	93%	89%	89%	84%
Total % of Coal of Total Tonnage	51%	51%	44%	44%	41%

Coal moving from the Ohio River would have a tremendous impact on effective lock capacity of Kentucky Lock. Barge traffic is currently utilizing most of Kentucky Lock's effective capacity, and the new projections for increased usage by TVA and Trico Steel suggests that all of the lock's capacity would be exhausted, assuming that there would be no major declines by other users. The utilization capacity, which is used as the quantitative measure of capacity, is defined as the percentage of time which the lock is in use for the total time it is available for use. As the utilization rate increases, average delay times increase at a greater rate. This is due to the increase in arrivals and the time limitations which the lock can be in use, or a maximum utilization rate of 100% regardless of continued increase in river traffic. An increase in utilization capacity to 95%, as projected and shown in Table 4.2.13-3, would increase delay times to as great as 36 hours.[53] Spill-over traffic from Kentucky Lock could use Barkley Lock and Canal to move onto the Tennessee River, but this is a more expensive route that requires hydroelectric concessions to accommodate navigation.

An alternative of carrying coal by rail and transferring and loading it to barge upstream of Kentucky Lock would mitigate the congestion that would otherwise be experienced at Kentucky Lock. To gain access to the Illinois/Western Kentucky coal source, the Illinois Central, CSX, or PAL rail carriers could be used. There are several terminals downstream of Bellefonte that could be used for the coal transfer. Some of the possible sites are located in Figure 4.2.13-1. Most of these terminals have sufficient unused capacity to handle traffic generated by the conversion options.

Figure 4.2.13-1 Coal Terminal Locations



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Delivery of coal by barge, or number of barges per tow, would vary according to the direct source used. The barge switching and fleeting process has not been determined at this stage. There should be sufficient mooring capacity for loaded and unloaded barges and enough working room at the unloader for emptying loaded barges. It is possible that TVA could station a work boat at the facility to position loaded barges at the unloader and remove barges to the empty mooring cells.

The Tennessee River is approximately 1,800 feet in width at the Bellefonte site barge unloading area. The navigation channel line is located on the far side of the river from the site, approximately 35 feet off the south bank. Due to the location of the channel line, the moored barges would be well outside of the navigation channel. Since the channel is sufficiently wide at this location, and in consideration of a fairly low volume of commercial barge traffic, the fleeting and unloading operations at Bellefonte should not interfere with commercial barge traffic or create an obstruction or undue hazard to navigation.

Combustion of diesel fuel by tow boats during transit and in the vicinity of Bellefonte would result in emission of nitrogen oxides, unburned hydrocarbons, and particulate matter. These emissions are intermittent and spatially separated and should not cause significant environmental impacts either at Bellefonte or along the transit route. Other river impacts include some additional sediment suspension and bottom scouring caused by prop wash. Barge movement would create additional wave action which would contribute to bank erosion both near Bellefonte and along the transit route. Aquatic ecology impacts are discussed in Section 4.2.10

The increase in commercial traffic should not have a significant impact on recreational vehicle traffic in the vicinity of the Bellefonte site. The peak recreational usage is on weekends and holidays. Most of the plant's deliveries and shipments would not occur during these times.

The increase in barge traffic would increase the chances of an accident between vessels. The likelihood of such accidents occurring is generally small as most of the areas in the vicinity of the Bellefonte site currently have a rather low level of commercial traffic. Also, adherence of the towing industry’s safety procedures minimize the likely increase in vessel accidents.

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4.2.14 Land Use

4.2.14.1 Impacts of Construction

If the NGCC Option is chosen, there would be no impacts to forestlands. If any of the other options are adopted, several acres of forest/grass land bordered on the south by Jackson 33 and on the west by the site access road would be converted for use as rail line and related facilities. There would be little impact on other undeveloped land on the site. Construction should not impact the ability to continue hay production at most existing sites.

Under any of the options, there would be a small increase in the amount of land used for residential development to accommodate workers moving into the county. However, this effect would be muted due to the temporary nature of construction. There is likely to be some increase in the amount of land used for mobile homes for construction workers. The overall impact, however, would be a very small increase in the share of land used for residential development. This would not be an important impact in the context of the county land base and the residential growth that would occur in the county anyway. There would be little impact on the amount of land used for commercial or industrial purposes.

4.2.14.2 Impacts of Operation

Regardless of which area is selected for storage/disposal of combustion residues, other uses of the area will be precluded. The result will be loss of tree/woody areas and of grasslands, including hay production or potential for hay production.

The anticipated population increase in Jackson County ranges from about 280 persons under the PC Option to about 900 under the Combination Option, resulting in increased demand for new housing units ranging from less than 100 to close to 300. According to the latest estimates of population by the U.S. Bureau of the Census, Jackson County has averaged an increase of about 466 persons per year since the

1990 Census of Population was taken. Therefore, these population increases would be of noticeable size relative to what would otherwise happen. The result would be some increase in the amount of land used for residential development. However, this would not be an important impact in the context of the county land base.

Surface mining environmental impacts are primarily the result of changes in land use. Past impacts have included acid drainage from exposed sulfur bearing rock, erosion from disturbed mining areas and coal transport roads, loss of wildlife habitat, deforestation, stream siltation, unstable land situations, and fugitive dust. The Surface Mining Control and Reclamation Act now addresses these issues in permitting enforcement. Other land impacts can include the loss of prime farm land, encroachment on threatened or endangered species and loss of cultural and archaeological resources. Aesthetics is another potential problem. Mining operations usually clash with the surrounding landscape, but mining in southern Illinois would be more likely to involve either agricultural or forested lands. Mine reclamation, which is mandatory, requires restoration to original contour, and appropriated revegetation can mitigate long-term visual aesthetics impacts as well as impacts resulting from changes in land use.

4.2.15 Aesthetics and Recreation

4.2.15.1 Impacts of Construction

The physical changes that would be required for the conversion of Bellefonte would create some visual/aesthetic and recreational impacts. Most noticeable of plant site additions would be the combustion effluent and flare stacks, ranging in number from one to eight, and in height from 200 to just less than 600 feet. Stacks approaching 600 feet would be visible from distances of four to six miles to a variety of residents, highway travelers, and lake users.

Four of the five options would require coal handling equipment along the lake shoreline. A line of pilings is proposed to stretch between 3,500 to 4,500 feet along the shore to moor coal barges. Conversion Options 3, 4, and 5 require fuel oil storage also located just off the lake shoreline. Tank capacity would range from 1/2 to 5 million gallons. These constructed shoreline facilities, in addition to associated barge traffic, would be seen by lake users in this section of the lake. Guntersville Lake receives 7.5 million visits annually. Approximately 27% or two million of these visits are reported in Jackson County. Less than one million of these visits would likely occur in sight of Bellefonte. These facilities and activities would also be visible to the residents located along the Sand Mountain rim.

One of the wooded ridge line hills, which generally screen upstream views into the plant site, is proposed, in all of the options, for use as a borrow site. The ridge would not be excavated to the point that river users could see anything but the most elevated structures (such as chimneys). Proper reclaiming of the site should make this alteration to the ridge line less noticeable to passing river traffic and from the more distant vantage points of the Sand Mountain residents.

Other additions such as combustion turbines, settling ponds, storage tanks, fencing, coproduction equipment, and operations buildings would blend into the existing visual character of the plant site.

4.2.15.2 Impacts of Operation

Of greater aesthetic and recreational impact than the physically constructed facilities would be the resultant impacts created by their operation. The vapor plumes associated with the 477-feet cooling towers and power plant plumes would be visible from distances of up to 10 miles away. Figure 4.2.15-1 shows the view of the existing Bellefonte structures from an unobstructed point along U.S. Highway 72. These plumes would vary with atmospheric conditions being most visible during cooler months and after the passage of weather fronts. Plumes would be less visible during summer months when hazy conditions persist and when morning fog is more common. Visual presence of these fog/plume conditions would be similar to those currently associated with the operation of the Meade Paper Plant and the Widows Creek Fossil Plant located upstream.

Figure 4.2.15-1 Existing Plant Site as Seen From U.S. Highway 72

The flare would be noticeable during unit startup procedures to highway travelers, residents in the surrounding communities, and some lake users from vantage points in embayments to the north and east of the plant site. Impacts of flaring would be of most consequence to first time viewers probably creating an element of surprise and question. This would be most evident during night time hours. Views of flaring would generally be from within a three mile radius due to the 200 feet stack heights. Views of the gas flaring and associated distances would vary dependent on the flame's height above a flaring stack, screening by the cooling towers, duration and type of clean or raw gas being burned, and time of day or night. For this DEIS, flame length is assumed to be 15 to 20 feet, although actual length would depend on its ultimate design. The flare would be most noticeable at night. During the brightness of daylight hours, the flare would be either visually undetectable or slightly detectable.

While travelers on U.S. Highway 72 and other roadways near the plant site would see these vapor plumes and flaring startups with the greatest frequency, the 50 plus residences on the Town Creek Embayment would experience the closest views of these operations.

Barge delivery of coal used in four of the five conversion options would pose the greatest impact to the lake recreationist. As many as 17 coal barges per day would be required for plant operation dependent on the option selected. Fifteen barges and a tow boat make up a tow or navigable unit. Lockage time for a tow requires from two to three hours each way. Figures from 1994 for pleasure craft lockages at Guntersville Lock approached 1,800 annually and involved nearly 4,000 vessels. A definite impact would be realized at times by pleasure craft. Pleasure craft lockages involving long distant travel on the river system would not be impacted nearly as much by a 2- to 3-hour wait as would the weekend recreationist wishing to lock up from Wheeler for a boat race or other special event. Bass boats and runabouts traveling at speeds of 40 to 60 mph rounding curves in the river or entering the main channel of the lake from adjoining embayments increase chances for collisions and near misses with barge traffic. Time of day, presence of rain and fog, and other various circumstances may increase these probabilites. September 1995 figures show 25 barges per day pass through Guntersville lock. Opportunities for boater/barge water safety conflicts would also be increased.

The following is a visual aesthetics/recreation summation of impacts for each conversion option.

Option 1: PC

This option would have two stacks approximately 570 ft high and would be visible from U.S. Highway 72, the surrounding community, and from the Town Creek Embayment. The vapor fog associated with plant operation would be visible from vantage points up to 10 miles in the distance.

Plant operation would require 15 coal barges per day. Locking time would range from four to six hours for a tow to pass both directions. Some recreational impact could be experienced by pleasure boaters dependent on time of day and day of week that the lockages occur. Recreational lockage delays at Guntersville Lock would average one to two hours as a result of the locking time on one 15 barge tow This is assuming the auxiliary lock would be utilized. The existing natural character of the shoreline adjacent to the plant site would change with the addition of the barge unloading facility and a land-based 2.5 million gallon fuel oil storage tank.

As many as 48 truck deliveries per day of limestone may occur under this option but more noticeable would be a possible maximum of 330 truck loads of by-products leaving the plant site. (Numbers would probably not be this high as not all of the ash, gypsum, etc., would be of marketable quality). Visual/aesthetic impacts would be created for residents along the routes traveled as well as for motorists sharing the highways. It should be remembered that 330 truckloads per day equates to 660 one way truck trips.

During their 20-year lifetime, the ash and gypsum disposal areas would become visible at some time to residents along Town Creek Embayment and to lake users on the embayments to the north and east of the plant site. Shoreline containment berms and any existing or planted vegetation should help screen this activity until stacks reach heights generally above 30 feet. Evergreen vegetative screens planted prior to plant startup could grow at approximately the rate of material accumulation if properly placed and maintained. The impacts from visibility of disposal areas could be mitigated if these areas are utilized in rotation so that stack heights do not reach 100 feet or more in more than six years. At heights of 100 feet, disposal areas would be somewhat visible to travelers along U.S. Highway 72 and from various other vantage points. Disposal areas should not be visible to passing lane traffic on the main channel of Guntersville Lake.

Option 2: NGCC

This conversion option would have the least impacts both visually and to the recreationist. Four to five stacks less than 200 ft in height would be somewhat visible to highway travelers and the surrounding community. These stacks would be generally dwarfed by the 477-foot cooling towers. Vapor fogs would be visible from distances ranging to 10 miles away. Onsite storage for 25 million gallons of fuel oil backup would require a single storage tank approximately 150 feet in height. Multiple smaller tanks may be used. A single tank would be visible to highway travelers and the surrounding community but should blend visually with other plant structures.

Option3: IGCC

Operation of this option would most likely create the greatest amount of aesthetic and recreational impact. Site construction would include 12 stacks 325 feet in height in addition to two flaring stacks 200 feet ± in height. Flaring operations would generally be visible within a 3 mile radius. The 325-foot stacks would not rise to the height of the existing cooling towers and would be visible in distant views from four to six miles away. Vapor fog and stack emissions could be visible from distances of 10 miles or more. The burning of coal would require approximately 17 barges per day and fuel oil storage tank size would be five million gallons. Some recreational impact would result from increased barge traffic.

Truck traffic could reach a maximum of approximately 70 one way trips per day which should create minimal visual/aesthetic impacts. Rail traffic would require 2,400 railcars per year to transport by-products from the plant site. This would equate to 6.5 cars per day which would be grouped in greater numbers for transport. Actual numbers of both rail cars and trucks would be less as all products would not be of marketable quality. Resultant visual/aesthetic impacts should be insignificant.

Option 4: IGCC/C

Visual aesthetic and recreational impacts would result from the construction and operation of this conversion option. Six 325-ft high stacks visible from four to six miles away would be required with two flaring stacks 200 ft in height. Plumes from the 325 ft stacks should be visible depending on atmospheric conditions from distances up to 10 miles. Flaring would be visible from U.S. Highway 72 and some vantage points in the surrounding community. Seven or eight barges per day of coal delivery would be required and fuel storage facilities for 500,000 gallons of fuel oil. Some recreational impact would result from increased presence of barge traffic. Coproduction storage tank facilities should blend visually with other plant facilities creating no adverse visual impact.

Under this option truck traffic could reach 36 loads per day if all by-products are marketable. Only about four of these would be required of limestone incoming to the plant. This combined total of 36 trucks per day should create minimal visual/aesthetic impacts to highway traffic and the surrounding community. Rail traffic could total 29 cars per day (grouped in greater numbers making whole train totals less frequent. The occurrence of train arrivals and departures could create negative aesthetic impacts for motorists forced to wait at crossing on a somewhat regular basis.

Option 5: Combination

Aesthetic and recreational impacts from this option would be similar to IGCC/C. A total of 11 stacks 325 feet in height in addition to two flaring stacks 200± feet high would be required for this operation. Coal delivery of eight barges per day would create some recreational impact during lockages and lake passage. Vapor fog and emission plumes would be visible from distances of 10 miles. Flaring startups would be visible from various points in the surrounding community and to highway travelers. For 500,000 gallons of fuel oil in addition to coproduction storage tanks should blend visually with other plant facilities creating no adverse visual impacts.

Impacts resultant from truck and rail traffic would be the same as stated in for the IGCC/C Option.

4.2.16 Cultural Resources

4.2.16.1 Impacts of Construction

Archaeological Resources

The 1972 archaeological survey of Bellefonte identified five archaeological sites within the site reservation. Sites 1JA978 and 1JA112 were relocation efforts of previously documented sites. Sites 1JA300-302 were additional sites discovered during this reconnaissance. Mitigation of project impacts occurred at 1JA300 during 1973 and 1974. [54] The excavations revealed numerous features, including pits, structures, and nine burials.

There are no archaeological sites within any of the proposed construction zones and therefore there should be no impacts. The implementation of the conversion options do not warrant further surveys to be conducted within the original Bellefonte Nuclear Plant site boundaries. However, if site 1JA302 is adversely affected by conversion options, then measures to mitigate adverse impact must be implemented. This mitigation would require a memorandum of agreement among TVA, the Alabama State Historic Preservation Office, and the Advisory Council on Historic Preservation.

Historical Resources

Initial surface survey and documentation for the Bellefonte town site occurred in 1974 under the direction of Dr. C. Roger Nance of the University of Alabama, Birmingham. [55] It was determined then that the original town site was eligible for placement on the National Register of Historic Places. Prior to the construction of the existing facilities at Bellefonte, the Alabama State Historic Preservation Office concurred that no mitigation would be required for the designed existing Bellefonte Nuclear Plant. Since that time, all structures associated with the original town site of Bellefonte have been removed. Therefore, at this time no further action is needed regarding the impact of the conversion project on the Bellefonte town site.

4.2.16.2 Impacts of Operation

No impacts would occur from operation activities.

4.2.17 Noise Impacts

4.2.17.1 Background

Noise is of environmental concern because it can cause annoyance and adverse health effects. Noise is measured in decibels (dB). One decibel is considered the lowest audible sound to humans. Decibels increase logarithmically and reach a aural painful level around 140 dB. Sound pressure levels of separate sounds are logarithmically, not arithmetically, additive. For example, if one sound of 60 dB is added to another sound of 60 dB, the total is 63 dB, a 3-dB increase, and not 120 dB. When sound pressure levels are measured on a meter using the A-weighting filter network, they are expressed in dBA. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear.

The most common measure of environmental noise impact is the day-night average sound level or Ldn. An Ldn is the average sound measured in dBA over a 24-hour period with a 10 dBA increase added to the period of time after 10 p.m. and before 7 a.m. This weighting is to account for the increased sensitivities of residential population to night time noise. Thus, Ldns will be higher than actual dBAs averaged over a 24-hour period.

The Noise Control Act of 1972 mandated the EPA to "develop and publish criteria with respect to noise" and then "publish information on the levels of environmental noise the attainment and maintenance for which in defined areas under various conditions are requisite to protect the public health and welfare with an adequate margin of safety". [56] The referenced "levels" document represents the EPA's response to the congressional mandate. In the forward to the document, the EPA emphasized that its contents "do not constitute Agency regulations or standards." [56] The EPA also indicated that the yearly average values identified as "levels" such as Ldn $\leq$ 55dBA (see Section 3.1.17) are not regulatory goals but should be interpreted as levels below which there would be no reasonable suspicion that the general public would be at risk from identified noise impacts. [57] The results presented in the document are intended to be a starting point for determining noise criteria that fit specific local needs and situations. In general, the level of impact on human receptors resulting from changes in noise caused by a project is linked to a number of interrelated factors, including the level of existing, nonproject noise sources; people's attitudes concerning the project; the number of people exposed; and the type of human activity affected (e.g., sleep, recreation, or conversation). Table 4.2.17-1 summarizes the effects of noise on people based on day-night average sound levels (Ldn) from below 55 to 75 and above.

Table 4.2.17-1 Effects Of Noise On People (Residential Land Uses Only)

	EFFECTS [a]					
	Hearing Loss	**Speech Interference**		**Annoyance[b]**	**Average Community Reaction[d]**	**General Community Attitude Towards Area**
Day-Night Average Sound Level in Decibels Ldn	Qualitative Description	Indoor	Outdoor			
		% Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[b]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%	Moderate to Slight	Noise considered no more important than various other environmental factors.

[a] - “Speech Interference” data are drawn from the following tables in EPA’s “Levels Document” : Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report “Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise.”
[b] - Depends on attitudes and other factors.
[c] - The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being “highly annoyed” even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.
[d] - Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.
NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.

Also, as discussed in Section 3.1.17, HUD has established noise impact guidelines for residential areas based on Ldns. Levels below 65 Ldn are considered normally acceptable; levels between 65 and 75 Ldn are normally unacceptable; while levels above 75 Ldn are always unacceptable.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Determination of Substantial Noise Increase and Significant Adverse Noise Impact

To determine what constitutes a "significant adverse impact" from noise one must take into account local land use, existing noise ordinances, existing noise levels, the anticipated increase in noise levels from the proposed action, and the resulting noise level after the plant is in operation. The Federal Interagency Committee on Noise has determined that project-related increases of 1.5 dBA or 3 dBA are considered "substantial" depending upon whether the existing (i.e., baseline) noise level is greater or less than than 65 Ldn respectively. [58] In comments received by TVA from EPA Region IV staff on an unrelated EIS, 1.5 dBA was identified as an appropriate level of significance. However, noise measurements and predicted estimates are not expressed to this level of precision, i.e., data are expressed as whole dBA, in this report. Consequently, the 1.5 dBA threshold was rounded to 2 dBA. The baseline noise level around Bellefonte ranges from 50 to 55 Ldn which would suggest that a 2 dBA noise increase from the proposed action would be considered "substantial" (i.e., clearly discernible). However, given that the Bellefonte site has been developed as a large power plant for more than 20 years (giving nearby residents an opportunity to adjust their expectations to future noise impacts), TVA has elected to define a "significant impact" as one where sensitive off site receptors are projected to experience noise levels of 65 Ldn or greater. This is the threshold used by HUD for community noise impacts on residential areas. Nevertheless, the 2 dBA increase will be used for purposes of noting where "substantial" noise increases are likely to occur.

In addition to the routine noises associated with power plant construction and operation, there are sometimes sudden, infrequent, short-term blasts of noise that may be disruptive to sleep or have a “startle effect” on humans and wildlife. Steam releases and flare noises are examples of power plant operation related noises that have been known to have a startle effect resulting in significant annoyance to the surrounding community. For purposes of this analysis, short-term noises from power plant operation that exceed 75 dBA (since this is the level that hearing loss may begin to occur) will be considered significant with respect to its startle effect. It is important to recognize that this level is still far below the 85 to 90 dBA level where long-term exposure can cause hearing loss. The issue is annoyance and sleep disturbance rather than auditory health. [61]

Sensitive Receptors and Noise Source Locations Used in Noise Impact Modeling

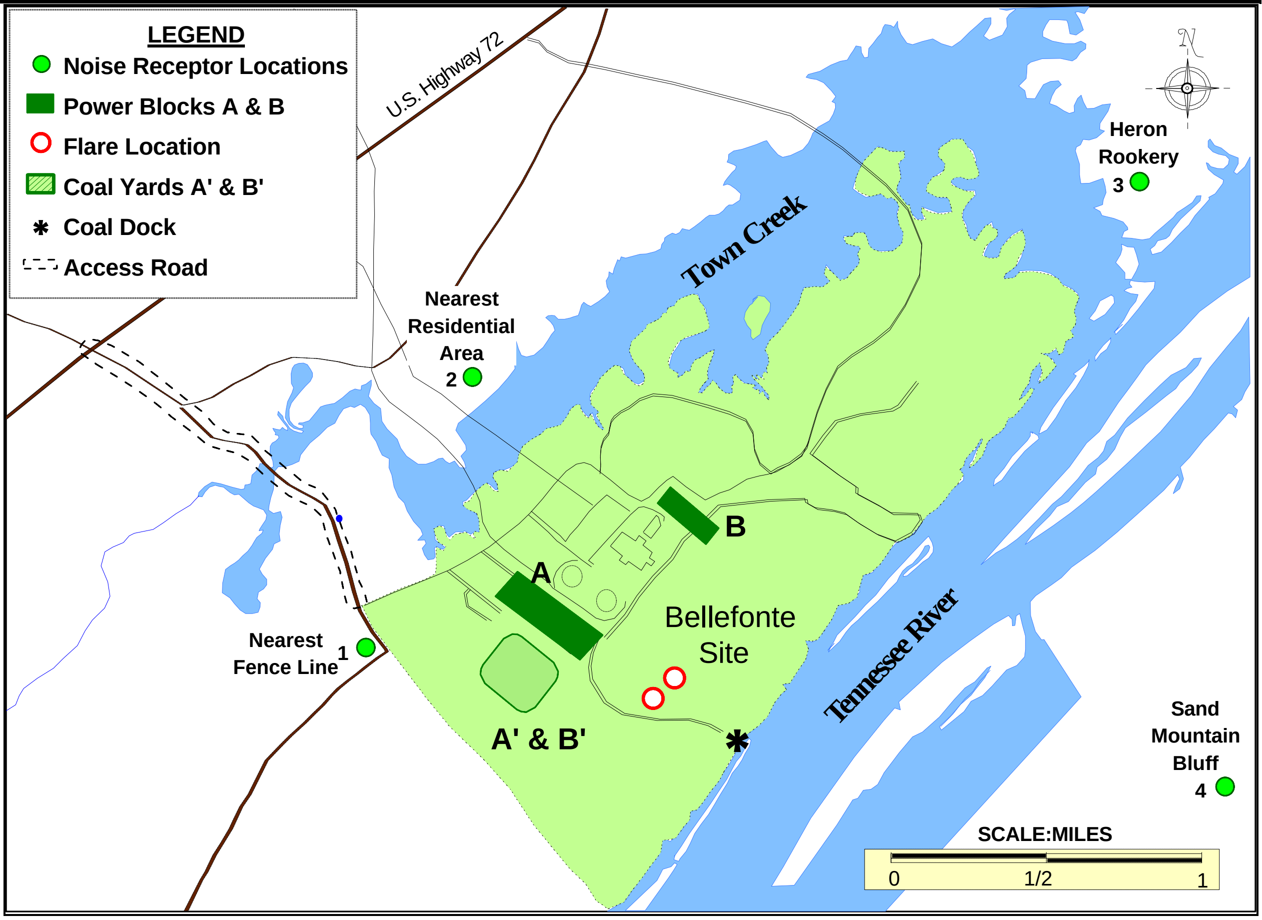
To assess the noise impacts of the various conversion options on the environment, a noise analysis was conducted. The methodology, general assumptions, and inputs used to predict future noise impacts are described in Appendix N. To simplify the analysis, noise impact predictions were made for four off site "sensitive receptors." The locations of these receptors are shown in Figure 4.2.17-1.

- Receptor No. 1 is intended to represent the closest property line to the proposed new noise sources. This "fence line receptor" is the nearest site where a future home, business, or public facility could be located absent TVA purchase of additional property.
- Receptor No. 2 is the nearest existing residential area to the proposed noise sources.
- Receptor No. 3 is the nearest sensitive ecological area--a heron rookery near the confluence of Town Creek and the Tennessee River.
- Finally, Receptor No. 4 is atop the high bluffs on Sand Mountain on the opposite side of the Tennessee River. It was established to evaluate worst-case impacts of any future residence or other receptor that might locate in this vicinity.

Figure 4.2.17-1 also shows the location of the power blocks where most of the noise generating equipment will be located. The power block location for Options 2 through 5 are similar; however, the power block location for the PC Option is further southeast. Power block location A on Figure 4.2.17-1 is for Options 2 through 5; power block location B is for the Option 1, PC. In addition, to the power block, there are four other sources of noise generation that have been accounted for in this noise analysis and are also shown in Figure 4.2.17-1. These other noise sources include the coal yard where coal moving and coal crushing equipment are located. Other sources included in the modeling are the coal unloading equipment at the coal dock; the flares which would be used during gasification upset, emergency, and shutdown modes; and the plant access road which would experience an increase in large truck and passenger car traffic.

As discussed in Section 3.1.17, sound levels measured at several locations near the boundaries of the site ranged from 50 Ldn to 55 Ldn. For purposes of the noise modeling conducted, it was assumed that the baseline sound levels at sensitive receptors outside of the TVA property is 50 Ldn. This is typical of low density residential and rural areas.

Figure 4.2.17-1 Noise Modeling Locations



4.2.17.2 Impacts of Construction

The amount of impact construction noise has on the surrounding environment depends on many factors (e.g., sound intensity, duration, and frequency; number of noise sources; time of day; time of year; etc.). Most construction activities will generate temporary shifts in noise levels that will generally occur during normal daylight hours between the hours of 7 a. m. to 5 p. m. Table 4.2.17-2 lists the noise ranges of construction equipment that may have an impact during construction activities.

Table 4.2.17-2 Construction Equipment Noise

			Noise Level (dBA) at 50 Feet					
			60	**70**	**80**	**90**	**100**	**110**
Equipment Powered By Internal Combustion Engines	Earthmoving	Compacters		↔				
		Front Loaders		↔	↔			
		Backhoes		↔	↔	↔		
		Tractors		↔	↔	↔		
		Scrapers, Graders			↔	↔		
		Pavers			↔			
		Trucks			↔	↔		
	Materials Handling	Concrete Mixers		↔	↔			
		Concrete Pumps			↔			
		Cranes (Moveable)		↔	↔			
		Cranes (Derrick)			↔			
	Stationary	Pumps		↔				
		Generators		↔	↔			
		Compressors		↔	↔			
Impact Equipment		Pneumatic Wrenches			↔			
		Jack Hammers and Rock Drills			↔	↔		
		Pile Drivers (Peaks)					↔	↔
Other		Vibrator	↔	↔				
		Saws		↔	↔			

Source: Miller, Richard K., and Associates; "Construction Noise Control"; Southeast Acoustics Institute, Madison, Georgia, December 1979.

Under all conversion options, construction activities will occur in phases spread out over several years as different units are constructed and brought on line. The shortest period of construction is five years for the IGCC/C Option; the longest is ten years for the Combination Option; the NGCC Option requires eight years of construction while the PC and IGCC Options each require nine years. During the initial construction, the principal noise source is heavy diesel-powered earthmoving equipment associated with site preparation. Following site preparation, the primary noise sources associated with construction are cranes, concrete trucks, pile drivers and air compressors. The last stage of construction is generally quieter with the exception of the short periods of time when steam lines are cleaned out with high-pressure steam. The steam blows occur for up to several minutes at a time several times per day for a period of less than one week for each unit. The maximum sound pressure level of 131 dBA at 50 ft may be reached during these periods.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Composite noise construction levels based on several power plant construction projects have been developed to estimate off site impacts of these various construction sources. [59] Based on these data, the typical construction noise impacts and the maximum steam clean out impacts for the four sensitive receptor sites near Bellefonte are shown below. Because the location of the power block for Option 1 (PC) is different than for Options 2 through 5, the impacts at the receptors will differ slightly as shown in Table 4.2.17-3 below. (These data assume that construction does not occur during the night which is why the data are expressed in Leq, direct averaging, rather than Ldn.) In addition to showing the typical construction-related noise, Table 4.2.17-3 also includes the maximum noise impacts associated with steam line clean out events.

Table 4.2.17-3 Construction Noise Impacts at Four Off Site Sensitive Receptors

	Typical Daytime Leq (8)[a]		Maximum Leq (steam clean out)	
Receptor Location	**Option 1**	**Options 2-5**	**Option 1**	**Options 2-5**
1 (fence line)	50	54	89	97
2 (nearest residences)	50	50	92	94
3 (heron rookery)	50	50	77	76
4 (Sand Mtn summit)	50	50	77	76

[a] - Existing baseline is 50 Leq (8)

From these data it is obvious that the typical construction related noise would be substantially increased at one of the four sensitive receptor sites (the nearest fence line) for Options 2 through 5 but would not be obvious at the other receptor locations (assuming that background sound levels from existing sources are 50 to 55 Ldn which would approximate 50 dBA Leq (8) during daylight hours).

However, steam clean outs would create very loud sounds at the fence line and at the nearest residential area (Receptors 1 and 2) and would also be clearly heard at the two more remote receptors. The estimated impacts at the nearest residential areas, amounting to greater than 90 dBA, suggest that TVA should provide warning to all area residents and workers prior to the steam blow outs to avoid the startle and other effects for those who might be closer to the power block.

In summary, for Options 2 through 5 typical construction-related noise levels will not be “significant” at any of the four sensitive receptor sites. Nevertheless, there will be a few short periods of time when steam lines are blown out prior to putting the unit into service when there will be unavoidable short term but significant impacts--especially with regard to the startle effect. This impact can be reduced through notification of employees and nearby residents of the planned times for these activities. Other possible mitigation includes issuance of hearing protection to employees and to nearby residents during steam cleaning events.

4.2.17.3 Impacts of Operation

Routine Operations

Table 4.2.17-4 presents the results of the noise dispersion modeling analyses for each of the five conversion options for routine plant operations assuming all units are in operation and at maximum capacity. All modeling results are resultant levels that include the projected new noises plus the existing baseline level assumed to be 50 Ldn. Appendix N contains an explanation of assumptions, methods, and modeling inputs.

Table 4.2.17-4 Routine Operational Noise Impacts at Four Off Site Sensitive Receptors

	Conversion Options Ldn Value[a]				
Receptor Location	**PC**	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
1 (fence line)	57	50	55	55	55
2 (nearest residences)	52	50	50	50	50
3 (heron rookery)	50	50	50	50	50
4 (Sand Mtn summit)	57	50	57	50	54

[a] - (Existing baseline is 50 Ldn)

Because the existing sound levels in the vicinity of Bellefonte have been measured at 50 to 55 Ldn, the baseline for this analysis is conservatively assumed to be 50 Ldn. Thus, where any of the noise impacts are predicted to exceed 50 Ldn in Table 4.2.17-4, it can be assumed that the proposed action will result in routine operational noise impacts. Where the predicted noise levels exceed 52 Ldn, the noise increases are considered to be substantial (i.e., the observer will be able to detect that the location is noisier than before the plant was constructed). Thus, an observer at the crest of the Sand Mountain bluff overlooking the plant would experience a substantial increase in sound level for PC, IGCC, and Combination Options. However, once that observer were to step back away from the crest of the bluff, the sound level would drop to background levels because of the shielding effect of the topography; therefore, no adverse noise impacts are anticipated for current residents atop Sand Mountain.

Receptors No. 2 and 3, the nearest residences and the heron rookery, should not be impacted by the plant operations except that PC operations would be audible at the Receptor No. 2. The nearest off site Receptor No. 1 (fence line receptor) would experience significant (as judged by the 3 dBA criterion) noise level increases for all but the NGCC Option.

Noise levels are attenuated with distance from the acoustic center of a noise source, dependent primarily on the nature of the surrounding terrain and weather conditions. This phenomenon is illustrated by the impact estimates shown in Table 4.2.17-4 for NGCC, which has single acoustic center (power block). Note that noise levels drop from 43 to 35, 24 and 21 Ldn as distance from the source increases (Receptor No. 3 is more distant than No. 4). Noise attenuation with distance is also demonstrated in the graphic presented for flaring noise (Figure 4.2.17-2) in the next section for Options 3, 4, and 5.

Flaring Noise Impacts

As with construction noise impacts, there will be occasions when there will be sudden loud noises during operation that will create a startle effect on humans and wildlife. These noises are associated with the operation of the flares for the gasification process in Options 3, 4, and 5. The level of the flare related noises in Leq are shown in Table 4.2.17-5 and in Figure 4.2.17-2. (Leq levels are shown because the noises are infrequent and therefore do not represent continuous or near continuous sound levels which are best expressed in Ldn.)

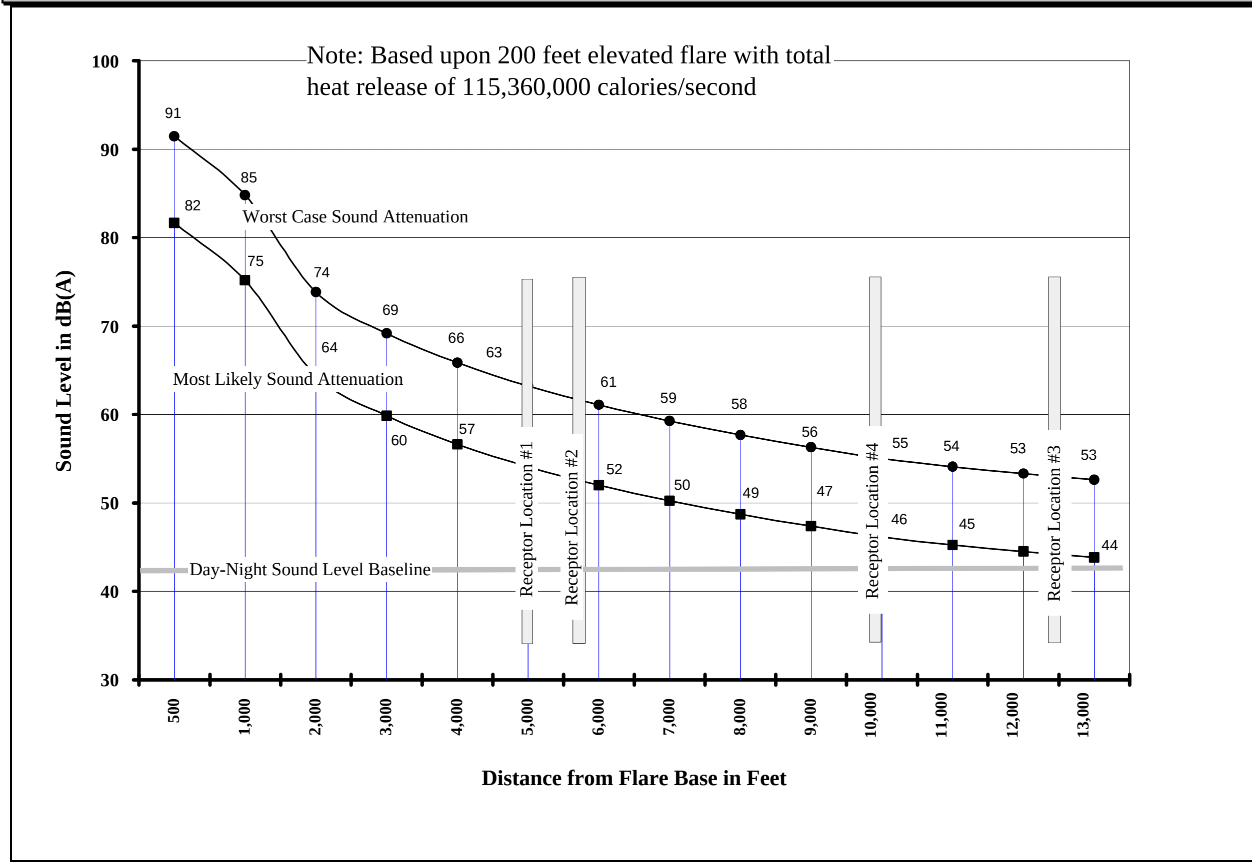
Table 4.2.17-5 Emergency Flare Noise Impacts at Four Off site Sensitive Receptors

	Leq Value by Option				
Receptor Location	**PC**	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
1 (fence line)	none	none	63	63	63
2 (nearest residences)	none	none	61	61	61
3 (heron rookery)	none	none	53	53	53
4 (Sand Mtn summit)	none	none	56	55	56

Thus, the flare noises, which are expected no more than 90 times per year and for no more than one hour per episode, will be audible at all receptor locations. Because the flares will raise noise levels from 3 to 10 Leq, they will create “substantial” sound level increases at all receptor locations. However, the flare noises would be well below the 75 dBA Leq threshold of significance for the startle effect at any of the receptors.

This would be especially true during daylight hours but could be an annoyance at night. A possible mitigation measure would be for TVA to schedule gasification startups and shutdowns during daylight hours and this would address all but the emergency events and therefore reduce the impact of flare noises.

Figure 4.2.17-2 Prediction of Range of Sound Levels at Increasing Distances from Flare Base



Traffic Noise Impacts

Finally, the noise analysis looked at the traffic related noises along the access road connecting U. S. Highway 72 and the Bellefonte Plant entrance. The construction and operation work force traffic and especially the passage of the large trucks carrying coal ash and other solid by products will impose noise impacts for receptors along the access road which has been relatively quiet since the initial construction of Bellefonte 20 years ago. Table 4.2.17-6 shows the distance in feet from the road where significant (i.e., resulting in greater than 65 Ldn) impacts are predicted to occur based on the number, size, speed, and time of day that the traffic will occur. The numbers of homes located within this zone of traffic noise impacts are also shown in the table.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Table 4.2.17-6 Distance From Access Road where Significant Adverse Traffic Noise Impacts are Predicted to Occur and the Number of Impacted Residences

	Conversion Option				
	PC	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
Feet from road where 65 Ldn or greater impacts are predicted to occur	1,000	125	500	300	300
Number of homes within the area of significant traffic impact	6	5	10	5	5

The truck traffic noise impacts of the PC Option are predicted to result in Ldns greater than 65 at up to 1,000 feet from the access road compared to half this distance for the IGCC Option and less than a third for the others. This is clearly a worst-case scenario for the PC Option because it assumes that all of the fly ash, gypsum, and bottom ash would be trucked off the property during both day and night time hours. The NGCC Option would not result in any trucking of solids; the predicted 125-foot impact zone is based entirely upon construction and operation workforce commuting.

Summary of Operations Noise Impacts

In summary, under routine operations none of the conversion options result in significant adverse noise impacts. However, there will be detectable noise level increases at several receptors for most options. Option 2, NGCC, is the least impactive of the options while Option 1, PC, is the most. Only the PC Option is likely to be heard during routine operations at the nearest residential area.

Three of the five conversion options result in the use of syngas flares (there is no flaring for Options 1 and 2). During flaring, noise increases will be above the 65 Ldn level of significance at all locations but would not result in significant adverse impacts because of the infrequency of the flaring operations and because none of the sensitive receptor sites are predicted to exceed the 75 Leq threshold. These levels could be much more discernible at night but could be mitigated by scheduling shutdown and startups during the day so as to reduce the night time flare noise to emergencies only.

Finally, it is estimated that up to 10 homes would be subjected to noise impacts above 65 Ldn from truck and vehicle traffic along the road connecting Bellefonte to U.S. Highway 72.

4.2.18 Safety and Health

4.2.18.1 Safety

Site Safety and Health Plan

The TVA work force rate of recordable injuries is one of the lowest in the nation. This is a direct reflection of the TVA work force (employees and contractors) commitment to safety. Employees are trained in the safe handling of chemicals they are exposed to in their work environment. Construction and operation equipment are required to meet all applicable safety design and inspection requirements, and personal protective equipment should meet regulatory and consensus standards for adequacy. Emergency response procedures would be outlined in the Site Safety and Health Plan for the implemented conversion option, a comprehensive health and safety document required of all work projects. [62] Included in the Site Safety and Health Plan would be provisions for:

- Personal protective equipment,
- Safety training requirements,
- Accident reporting and investigation procedures,
- Chemical hazard information (material handling, material safety data sheets, hazard communication program),
- Emergency response procedures,
- Industrial hygiene program,
- Medical program, and
- Engineering safety procedures.

Employees would be trained in safety procedures prior to working in the facility. Refresher training would also be provided.

TVA's Employee Safety Program

There exists the potential for workers to be exposed to health and safety hazards while constructing and operating the facilities. During construction, OSHA Construction Industry standards would be used to minimize these hazards. [63] Although TVA is not subject to OSHA, it is required to have a safety program that is equivalent to the standards cited in OSHA General Industry standards. [64] These standards establish practices, chemical and physical exposure limits, and equipment specifications to preserve employees' health and safety. Standards and requirements also apply to TVA contractors and vendors. Contractor operations are monitored to ensure operations are conducted in a safe and healthful manner and that they meet contract requirements.

The TVA Hazard Communication Program ensures that Material Safety Data Sheets (MSDSs) are available and appropriate labels are visible to employees for all products to which they might be exposed in the course of their work day.

TVA's safety and occupational hygiene program is designed to help the agency conduct its operations in a manner which protects the safety and health of employees. The safety and occupational hygiene program headed by a Designated Agency Safety and Health Official (DASHO) defines the activities necessary to prevent on-the-job accidents and occupational illnesses and diseases. This program is implemented by a joint effort among TVA's managers, labor organizations, and employees with guidance and assistance from the DASHO and a professional staff. The program's highlights include:

Workplace Standards

Standards, work rules, and other practices developed by regulatory agencies and by TVA provide employees direction on safe work practices and working conditions.

Job Safety Planning

All jobs undertaken are planned by those involved in sufficient detail to ensure that hazards are identified and eliminated or controlled to an acceptable level.

Training

Each organization provides for job training to improve the safety knowledge and skills of employees and enable them to perform their jobs in a safe and healthful manner.

Employee Involvement

TVA's success in protecting people and property from accidental harm depends on the involvement of all employees in its safety program. Employees are actively involved in the development and implementation of workplace standards and other program activities to minimize unsafe acts and conditions through participation on safety and health committees and through interaction with management and fellow employees.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Workplace Inspection, Monitoring, and Audits

Workplaces are regularly inspected and monitored to ensure that they meet regulatory and agency requirements. Regular audits assess the effectiveness of inspection and monitoring programs as well as activities to prevent accidents and illnesses. These audits provide the feedback necessary to ensure control of workplace hazards and keep efforts focused on continuous improvement.

Accident Reporting and Investigation

All accidents are reported and investigated by management. Investigations address the following elements:

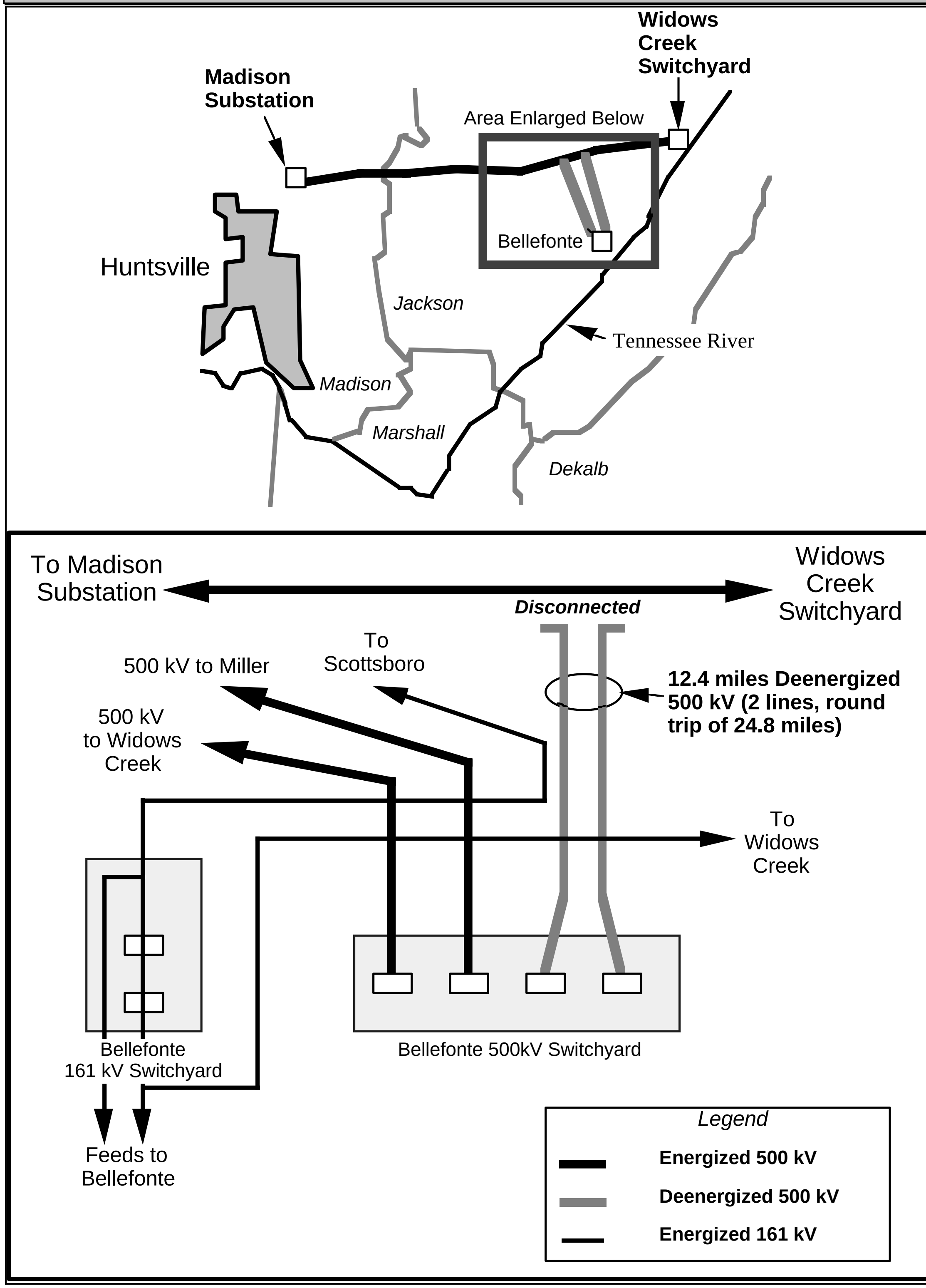
- Root causes are identified,
- Corrective action to prevent future accidents is recommended,
- Accident data is analyzed for trends to help direct future safety program efforts, and
- Information is shared throughout TVA to support the accident prevention efforts to other organizations.

4.2.18.2 Health

Electric and Magnetic Fields

The production of power at Bellefonte would result in energizing about 24.8 miles of existing 500 kV transmission line. The currently unenergized 500 kV transmision line is a loop, two lines on one right-of-way, that extends 12.4 miles westward from the Bellefonte switchyard to a tap point on the Widows Creek-Madison 500 kV line. At present, part of the 500 kV switchyard at Bellefonte is energized from the Widows Creek and Miller 500 kV lines. The 161 kV switchyard at Bellefonte is energized and provides power to the plant. Figure 4.2.18-1 shows a schematic of the pertinent transmission lines and identifies the portion of the system not currently in use.

Figure 4.2.18-1 Unenergized Transmission Lines



TVA recognizes there is public concern about whether any adverse health effects are caused by electric and magnetic fields (EMF) that result from generation, transmission, distribution, and use of electricity. Many scientific research efforts and other studies examining the potential health and other effects of EMF have been and are being done. TVA is aware of, and ensures that it stays aware of, published research and study results and directly supports some of the research and study efforts.

Studies, interpretations, and research to date are not conclusive about potential associations between electric or magnetic fields and possible health impacts. A few studies have been interpreted by some as suggesting a weak statistical relationship between magnetic or electric fields and some form of rare cancer. However, equal numbers of similar studies show no association. The present weight of this type of evidence does not allow any conclusion and does not indicate a cause and effect relationship between fields and health effects. No laboratory research has found such a cause and effect adverse health impact from EMF, and no concept of how these fields could cause health effects has achieved scientific consensus.

TVA's standard for siting transmission lines has the effect of minimizing public exposures to EMF. The transmission line route selection team used a constraint model that placed a 300-feet radius (91.4 m) buffer around occupied buildings. For schools, a 1,200-foot (366 m) buffer was used. The purpose of these buffers was to reduce potential land use conflicts with yard trees, outbuildings and ancillary facilities, and to reduce potential visual impacts and possible EMF-related controversy. Though not absolute location constraints, these buffers weigh heavily in location decisions, influencing selection of route options and alignments. Because EMF diminishes so quickly with distance, the routing of transmission lines using constraint buffers effectively reduces potential public exposure to EMF.

Health Effects of the Fuel Cycle

The fuel cycle consists of four somewhat discrete phases, each of which provide the potential for health impacts to the work force or the public. The four phases discussed in this section are:

- Acquisition
- Transportation

- Combustion
- Residue disposal

Acquisition applies to the actions, methods, and processes used to remove the fossil fuel from its original point of origin, such as the mine (for coal) or well (for oil or gas). Transportation covers the loading, hauling, barging, piping, unloading or other handling of the fuel between the point of origin and the point of use. Combustion is the extraction of energy from the fuel, to include gasification. Residue disposal would be the use, storage, and/or ultimate disposal of by products resulting from combustion or other use of the energy in the coal. The impacts of fuel cycles are discussed in additional detail in Energy Vision 2020.[65]

Acquisition

The manner in which coal, petroleum coke, distillate oil, or natural gas are mined or otherwise extracted from the earth could result in impacts to the human environment. The impact effects associated with extraction would probably be most pronounced for mining of coal, regardless of the point of origin (Illinois No. 6 is the basis for coal-burning options in this EIS). This conclusion is somewhat intuitive, considering that petroleum coke and distillate oil production are the indirect result of the petroleum industry's efforts to provide heating fuel and gasoline for the public consumption or feedstocks for the petrochemical industry.

Petroleum coke was until recently a discardable material from the petroleum refining industry, and believed to have properties unsuitable or contain insignificant heating value for use by the utility industry. Its use would therefore not cause any more oil extraction from the earth and not result in incremental impacts over nonuse. This use would in fact provide a means for safely and economically disposing of an unwanted material. Distillate fuel is not a primary fuel for any of the options; its use is considered to be incidental or supplemental to other fuels.

Natural gas would be the primary fuel for the NGCC and Combination Options. Natural gas extraction is technologically simpler and less labor intensive than coal mining, consequently, health effects are fewer and less pronounced.

Coal mining was raised as an issue of concern at the public meeting. While a direct correlation between coal for this site versus additional injuries at coal mining facilities cannot be made, there is some additional risk involved.[65] However, significant reductions in rates of mining deaths per number of employee hours worked have been achieved over the last few years in the mining industry. A combination of factors has been responsible for the dramatic safety gains in the U.S. mining industry since the turn of the century. The major elements of these accomplishments have been the following:

- Congressional creation in 1910 of the U.S. Bureau of Mines, whose primary roles were to investigate accidents, advise industry, do production and safety research and teach courses in accident prevention, first aid and mine rescue;
- Federal and state laws to better advise and regulate the mining industry, to extend coverage to all types of miners, to require or encourage use of successful safety procedures and technology, to provide effective miner training, and to focus on reducing or elimination the most serious hazards. The most far-reaching laws were the Federal Coal Mine Health and Safety Act of 1969 and the more comprehensive Federal Mine Safety and Health Act of 1977;
- Creation in 1973 of the new Mining Enforcement and Safety Administration in the Interior Department, which assumed safety and health enforcement responsibilities from the Bureau of Mines. And five years later, following passage of the 1977 Act, creation of the present Mine Safety and Health Administration (MSHA), which was moved to the Labor Department.
- Introduction of vastly safer and more productive mining machines and systems, ever-safer mining methods, a growing awareness of the importance of effective accident prevention programs among both management and miners, and a more cooperative attitude towards safety issues by the mining industry, labor and government.

The rate of coal mining deaths decreased from about 0.20 fatalities per 200,000 hours worked by miners (or one death per million production hours) in 1970 to about 0.07 fatalities in 1977 and an average of 0.04 fatalities for the 1990-94 period.

Coal mining techniques, whether surface or underground mine, vary by state and have differing environmental effects. Energy Vision 2020 contained information about TVA's coal procurement by state and linked purchases to conditions of operation and coal quality.[65] Most of TVA's fossil plants are located in the southern Appalachian region which consume about 7.1% of the eastern U.S. coal production.

The acquisition of low-sulfur western coal (primarily Colorado, Utah and Wyoming) is an important component of TVA's sulfur dioxide reductions under the Clean Air Act amendments of 1990. In fiscal year 1994, 4.2% of TVA's coal procurements were from western states. In this same year, 17.2% of the coal procurements were from surface mines and 45% were from underground mines (the remainder was either surface or underground). Additional information about coal procurements and environmental impacts generally associated with both surface and underground mining are presented in Energy Vision

2020 (Volume 2, Section 5, Land Resources, page T1.116). As noted above, Illinois No. 6 is assumed for the evaluations in this EIS, which is produced primarily at surface mines in southern Illinois.

Transportation

Health effects of transporting fuel to Bellefonte have been addressed in Section 4.2.1, Air Quality and Section 4.2.13, Transportation, which discuss the societal, environmental, and human health effects of transporting fuel on the Tennessee River to Bellefonte.

Coal purchased for the various conversion options would most likely be Illinois coal and would be shipped upstream through Kentucky, Pickwick, Wilson, Wheeler, and Guntersville Locks to Bellefonte. The impact of this coal movement on the capacity of the waterway system is discussed in Section 4.2.13.

This additional coal movement would have some air quality impact due to the emissions resulting from the combustion of fuels in powering the barges. The impact of these emissions is expected to be insignificant since they would be dispersed along the length of the river. Further, since the coal carried on the barges would be wet, no fugitive coal emissions are expected to emanate from the barges as they move along the river. The increase in navigation activity is expected to result in some increase in the turbidity of the water, as a result of wave action from the barge movement. However, these increases would be temporary and insignificant.

Combustion

The environmental and health effects of gasifying or combusting coal or petroleum coke, or of burning oil or natural gas at Bellefonte have been addressed in Section 4, Air Quality, which discusses the effects of various equipment and fuel combinations on health and the environment.

Disposal

The environmental and health effects of storage, disposal, and/or marketing and transportation of combustion residues and by-products have been addressed in several Chapter 4 sections by resource, including water quality, transportation, groundwater, terrestrial habitat, threatened or endangered species and cultural resources.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

4.2.18.3 Impacts Due to Accidents

Impacts to public health and welfare associated with construction and operation of the new facilities at Bellefonte are described by resource earlier in this chapter. This section provides information about possible impacts to residents living near Bellefonte which may be caused by equipment malfunctions, emergency shutdowns, and/or accidents. For convenience, these events are grouped as possible accidents. An accident is defined here as a rare occurrence that is unexpected and/or unintentional but with attendant possible effects to persons living in the vicinity.

The approach used in this section is to identify reasonably foreseeable accident scenarios and, using guidance provided by pertinent regulations which affect the operation of facilities like those described herein, develop information which would provide residents living near Bellefonte with a better understanding of possible health risks. The remainder of this section is organized in four parts:

- Development of typical accident scenarios,
- Evaluation of selected accident scenarios,
- Planning requirements and accident response programs, and
- Summary of findings.

Applicable regulations are promulgated pursuant to the Emergency Planning and Community Right-to-Know Act of 1986 (EPRCA), Occupational Safety and Health Act, (codified in 29 CFR Part 1910), and the accidental release prevention program of the Clean Air Act (codified in 40 CFR Part 68) and the spill prevention program of the CWA (codified in 40 CFR Part 112). [22,64,66] These regulations are described in further detail later in this section; however, they provide conservative tools for identifying and assessing possible accidents. TVA is committed to complying with these regulations to protect public health and worker safety.

<u>Development of Typical Accident Scenarios</u>

It was necessary to identify reasonable accident scenarios having at least a small probability of occurring. To accomplish this, the following criteria were used to consider the relevance and representativeness of scenarios which could be evaluated:

- Could public exposure occur during the accident?
- Would short-term impact to human health be possible?
- Could there be a disruption of community commerce?
- Is it likely that the accident would be reported according to regulations?
- Would the off site consequences of the accident be addressed by Clean Air Act 112r?

Based on these criteria and information contained in Chapter 2 of this DEIS about the proposed conversion options, four accident scenarios were selected for evaluation (Table 4.2.18-1). Evaluations are based on realistic worst-case conditions, similar to those that would be required in a site hazard assessment.

Table 4.2.18-1 Potential Accidents

Scenario	PC	NGCC	IGCC	IGCC/C	Combination
Gas Pipeline Loss Of Integrity		X			X
Chemical Release				X	X
Gasifier Rupture			X	X	X
Rail Car Accident			X	X	X

The potential causes of these accidents are speculative and will not be addressed. The following contains the results of worst-case evaluations of these accidents. This approach is consistent with RMP (Risk Management Program) Guidance provided by the EPA in a report entitled "RMP Offsite Consequence Analysis Guidance," which is the cornerstone for off site hazard assessments required by 40 CFR Part 68. [66]

<u>Evaluation of Selected Accident Scenarios</u>

Gas Pipeline Loss of Integrity

If a natural gas pipeline is used (necessary for Options 2 and 5), there would be an increased risk to the public during operation of the facility both on and off TVA property. Any pipeline that would be constructed to provide natural gas to Bellefonte would be designed, constructed, operated, and maintained in accordance with DOT Minimum Federal Safety Standards at 49 CFR Part 192. [67] These regulations are intended to ensure adequate protection for the public from natural gas pipeline failures.

The U.S. DOT Office of Pipeline Safety regulates natural gas pipeline safety and maintains data on gas pipeline safety. Risk to the public from natural gas pipelines occur as a result of the failure of the pipeline coupled with the ignition of the escaping gas resulting in an explosion or fire. Most of the pipeline failures are the result of either of two causes: damage to the pipeline from outside force (such as someone digging in the pipeline right of way with a backhoe) or corrosion of the pipeline. [68]

DOT defines a pipeline “incident” as any property damage (including gas loss) of $50,000 or more, a death, or personal injury requiring hospitalization. For the years 1990 through 1994 there were 0.00027 incidents per mile of pipeline per year. [69] If this rate were to hold true for an assumed 50-mile natural gas pipeline that would be built to serve Bellefonte, over the 40-year lifetime of the pipeline, there would be a probability of 50% that a single incident would occur somewhere along the line.

However, the record for pipeline safety is improving given new technology for preventing corrosion and monitoring for leaks, and given the increased emphasis on preventing construction on pipeline right-of-ways. The number of incidents per mile of natural gas pipeline has been reduced by a factor of two from the 1980s when the rate was 0.0005 incidents per mile. [70] The safety of a new line is likely to be even better given recent advances in pipeline safety.

Chemical Release

The IGCC/C and Combination Options involve the production of chemicals. If an option involving coproduction of chemicals is selected, there would be an increased risk to the public during operation of the facility both on and off TVA property. The facilities would be designed, constructed, operated, and maintained in order to minimize public exposure to potential hazards. TVA would comply with local, state, and federal standards and regulations (discussed later) to ensure adequate protection for the public from chemical releases.

The chemical products most likely to be produced are listed in Table 4.2.18-2. The table presents selected chemical and physical properties of each chemical, and quantities potentially produced. Carbon dioxide is not included because of its benign properties.

For the chemical production quantities being considered at Bellefonte, it is likely that Threshold Planning Quantities (TPQ) as defined in 40 CFR Part 68 would be exceeded. [66] EPA would require a Risk Management Program be developed for substances whose quantities exceed TPQ. EPA guidance for developing this program lists criteria for determining worst-case scenarios and can be found in the RMP Guidance. [72] "EPA has defined worst-case scenario as the release of the largest quantity of a regulated substance from a vessel or process line failure that results in the greatest distance to a specified endpoint. The largest quantity stored onsite should be determined taking into account administrative controls." [72]

Four chemical release events were evaluated:

- Tank failure - acute effects,
- Tank failure - explosion,
- Tank failure - radiant heat, and
- Pipe rupture or spill - acute effects.

Tank Failure - Acute Effects

Probably the worst type of accident, in terms of amount of chemical released, would be a loss of containment for a storage tank. Based on RMP Guidance and information about the properties and relative toxicity of the seven chemicals, an ammonia release from the proposed production storage facilities would be the worst-case scenario for evaluating potential impacts to the public. In this event, liquid ammonia would flow to the secondary containment where it would be quickly recovered and reprocessed. However, while the liquid chemical surface is exposed to the ambient air, evaporation would take place at a rate dependent on ambient temperature, vapor pressure of the liquid, the surface area exposed to ambient air, and a number of other factors. The duration of the event would depend on the effectiveness of the spill response effort but it is highly unlikely that an event would last more than a few hours. Information used to devise an ammonia tank rupture accident scenario for evaluation is contained in Table 4.2.18-2.

Table 4.2.18-2 Chemical Products and Descriptions

Chemical Name	Methanol	MTBE	Formaldehyde	Acetic Acid	Granular Urea	Urea Ammonium Nitrate	Ammonia, Anhydrous
State	Liquid	Liquid	37% soln w/water	Glacial	Solid	Liquid	Liquid
Chemical Formula	CH_3OH	$(CH_3)_3$-$C)OCH_3)$	HCHO	CH_3COOH	$NH_2C{=}ONH_2$	$NH_2C{=}ONH_2$; NH_2NO_3; H_2O	NH_3
CAS No. Listing [a]	67-56-1	1634-04-4	50-00-0	64-19-7	57-13-6	57-13-6	7664-41-7
Production Rate							
tons/yr	740,000	462,000	444,000	148,000	155,000	496,000	31,000
mmgal/yr	225	150	94	11		45,091	12
Storage Quantities	4.4 mmgal	2.74 mmgal	0.9 mmgal	0.5 mmgal	7,493 ton	23,981 ton	0.40mmgal
Physical Description	colorless, pungent odor	colorless, distinct odor, flammable liquid and vapor	colorless, pungent odor	colorless, sour vinegar like odor	white crystals or powder, almost odorless, saline taste	Colorless, pungent odor	colorless gas, pungent odor - easily liquefied under pressure
Heat of Combustion (kj/kgm)	1,294	2,183	1,066	NA	NA	NA	NA
Flash Point (°F)	52	52	185°F	120	NA	NA	NA
Uses and Descriptions	Antifreeze, solvent, denaturant for ethanol, dehydrator for natural gas, fuel cell	Octane booster for unleaded gasoline	Resin, ethylene glycol, embalming fluids, preservative, durable press treatment of textile fabrics, foam insulation particle board, plywood	Acetic anhydride, cellulose acetate, plastics, pharmaceuticals, dyes, insecticides, photographic chemicals, latex coagulant, textile printing, vinegar	Fertilizer, animal feed, plastics, chemical intermediate, stabilizer in explosives, medicine (diuretic), adhesives, pharmaceuticals, cosmetics	Fertilizer, explosives, pyrotechnics, herbicides nitrous plastics, chemical intermediate, stabilizer in explosives, medicine (diuretic), adhesives, pharmaceuticals, cosmetics	Fertilizer, Nitric acid, urethane acrylonitrile, refrigerant, synthetic fibers dyeing latex preservatives, explosives, fuel cells, rocked fur; yeast nutrient.
Target Organs	Eyes, skin, resp. sys. GI tract	eyes	eyes, resp. sys.,(nasal cancer)	eyes, resp. sys., teeth	skin, resp, sys.	none	eyes, resp. sys.,

Sources: NIOSH Pocket Guide to Chemical Hazards, June 1994, Hawley's Condensed Chemical Dictionary, 1987.
[a] - CAS is the Chemical Abstract Service registry number, which is unique for each chemical and allows efficient searching on computerized databases.

EPA screening models were used to calculate the ambient air concentrations downwind of the release point. Hazard assessment guidance indicates that the SCREEN3 air dispersion model would be the best choice for estimating ambient concentrations for this release situation. [72] Predicted ambient concentrations were computed for several likely ammonia storage scenarios. The predicted concentrations were compared with toxic endpoint concentrations to determine distances from the storage area that significant concentrations could be expected to occur under worst-case meteorological conditions (one meter per second wind speed). Toxic endpoint concentrations are defined in RMP Guidance in order of preference, as the "Emergency Response Planning Guidance 2" level (ERPG-2), developed by the American Industrial Hygiene Association or a "Level of Concern" level (LOC) for chemicals regulated under Section 302 of the Emergency Planning and Community Right-to-Know Act. The ERPG-2 level is defined as "the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health efforts or symptoms that could impair an individual's ability to take protective action." [66] If no ERPG-2 level has been established, the second choice of a concentration to compare with concentration estimates is the LOC level. LOCs are based on the NIOSH Pocket Guide to Chemical Hazards. [72] LOCs are conservatively derived from and are much lower than concentrations that are "Immediately Dangerous to Life and Health" or IDLH. IDLHs "are intended to ensure that workers can escape from a given contaminated environment in the event of failure of the respiratory protection equipment." The LOCs are conservatively set to be one-tenth of IDLHs. The toxic endpoint for ammonia, as stated in 40 CFR Part 68, is 0.14 mg/L (approximately 200 ppm). [66]

To evaluate the impacts from an ammonia release due to storage tank failure, five storage cases were examined. The following general conditions were assumed for modeling purposes:

1.	Chemical	Anhydrous ammonia
2.	Storage temperature	28.5°F (refrigerated)
3.	Storage pressure	106972.3 Pascals (1070 millibars)
4.	Ambient Temperature	68°F
5.	Ambient pressure	101325 Pascals (1013 millibars)
6.	Ammonia Boiling Temperature	-28.3°F
7.	Latent Heat of Vaporization	13.672E5 Joules/kg
8.	Molecular Weight	17.030 kg/kmol
9.	Tank Dimensions	Basis shown below
10.	Worst-case wind speed	1 m/s
11.	Distance from Property Boundary	~1 km

Five storage tank configurations were modeled (Table 4.2.18-3). These configurations feature different combinations of accumulated chemical storage, numbers of tanks and secondary containment wall height. The constructed configuration is expected to be contained within the range of cases described.

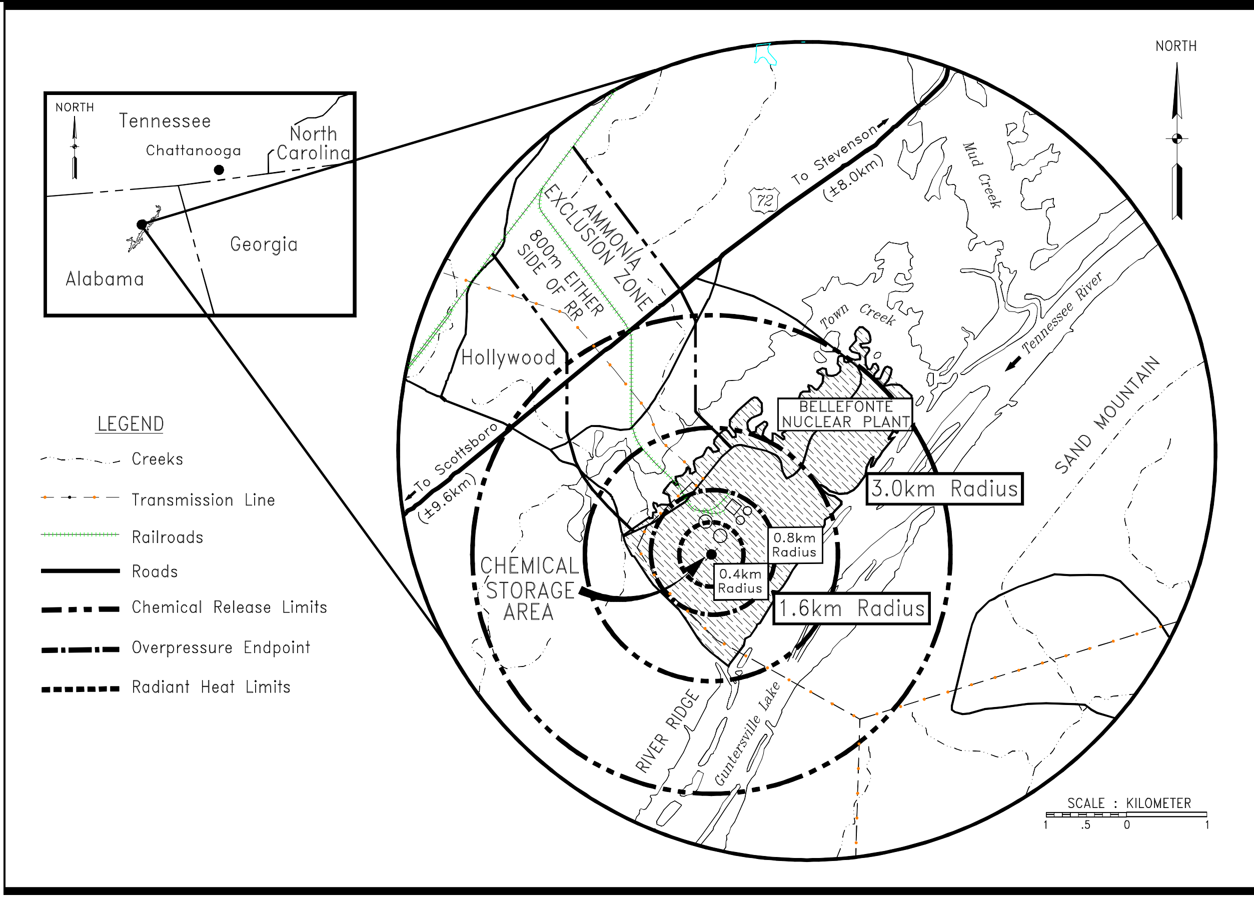
Table 4.2.18-3 Specifics for Modeling Cases

	Case #1	Case #2	Case #3	Case #4	Case #5
No. of days storage capacity	6	6	6	8	10
Total gallons onsite	237,903	237,903	237,903	317,205	396,506
No. of tanks	4	4	4	4	4
Volume of each tank (gal)	59,476	59,476	59,476	79,301	99,126
Containment wall height (ft)	15	12	10	10	10
Toxic endpoint concentration distance [a]	1.59 km 1.0 mi	1.84 km 1.1 mi	2.07 km 1.3 mi	2.53 km 1.6 mi	2.95 km 1.8 mi

[a] - Toxic endpoint concentration is 0.14 mg/L.

Distances to toxic endpoints should represent a reasonable delineation of the areas that may need to be evacuated in the event of a chemical release due to tank failure. The distances for all cases are less than 3.0 km (1.8 miles) from the tank location (Shown in Figure 4.2.18-2). Approximately 70 houses are located within this 3-km radius. It should be noted that the cases evaluated are for illustration only, but should represent a range of situations that will be considered in the development of the chemical response plan that is required for new chemical plants by 1999. Chemical plant design and operating specifications will minimize risks to practicable levels.

Figure 4.2.18-2 Endpoint Distances from Air Modeling Results for Chemical Storage Tank Structural Failure and the Initial Isolation Zone for Rail Accident



<u>Tank Failure - Explosion</u>

Guidance for estimating the distance to overpressure endpoint for flammable substances is also given in the RMP Guidance. "For the worst-case scenario involving a release of flammable gases and volatile flammable liquids, the total quantity of the flammable substance is assumed to form a vapor cloud within the upper and lower flammability limits, and the cloud is assumed to detonate." [72] The guidance suggests assuming that 10% of the flammable vapor in the cloud is assumed to participate in the explosion and identifies an overpressure level of one pound per square inch (psi) caused by an explosion as an end point significance level. One psi is considered to be a level below which damage to houses (i.e., shattering of glass) would be avoided. RMP Guidance recommends that the "consequence distance," (i.e., distance to an overpressure level below one psi) be estimated using a compound's heat of combustion. The formula shown below is recommended by RMP Guidance:

$$D = 17 \times \left(0.1 \times W_f \times \frac{HC_f}{HC_{TNT}} \right)^{1/3}$$

where:

D	=	Distance to overpressure of one psi (meters)
W_f	=	Weight of flammable substance (kg)
HC_f	=	Heat of combustion of flammable substance (kJ/kgm)
HC_{TNT}	=	Heat of combustion of trinitrotoluene (TNT) (4,680 kJ/kgm)

None of the compounds being considered for production at Bellefonte appear in the RMP Guidance list of regulated flammable substances, suggesting that they are not among the compounds commonly associated with explosions. However, based on information about each chemical's heat of combustion and flash point, it was concluded that MTBE would be the most likely chemical to be associated with this type of event. Flash point is the temperature at which the liquid phase gives off enough vapor to flash when exposed to an external ignition source. Heat of combustion is defined as the amount of heat evolved when a quantity of a substance is completely oxidized. MTBE had the lowest flash point and highest heat of combustion of the chemicals produced under Scenario B (see Section 2.3.7). The assumptions for the calculation are shown below:

1. Chemical	Methyl *tert*- butyl ether
2. Tank dimensions	6 days - 4 tanks
3. Heat of combustion	2,183.64 kJ/kg
4. Mass of flammable substance	1,917,808.22 kg

Using the equation shown above for calculating distance to an overpressure level of one psi, a distance of 800 m was determined, which would be confined to the plant site. This distance is plotted on Figure 4.2.18-1.

Tank Failure - Radiant Heat

The final effort to define impacts due to tank ruptures was to look at the potential for second degree burns caused by radiant heat from chemical vapor combustion. RMP Guidance provides an empirical formula for estimating an endpoint distance based on a substance's chemical properties, intensity of the radiation (i.e., mass of fuel and heat of combustion), and the duration of the exposure. The types of chemicals being addressed in this DEIS are not of the type to yield high energy vapor cloud explosions that produce a fireball, but the calculation is useful to establish a conservative boundary beyond which impacts in the form of burns are not significant. The formula shown below was recommended in the RMP Guidance:

$$L = \sqrt{\frac{2.2 t_a R H_c mf^{\ 0.67}}{4p\left[\frac{3{,}420{,}000}{t}\right]^{3/4}}}$$

where: L = Distance to receptor (meters)
m_f = Mass of fuel (kg)
t_a = Atmospheric transmissivity (1)
H_c = Heat of combustion (J/kg)
R = Radiative fraction of heat of combustion (assumed to be 0.4)
t = Duration of the fireball (seconds); assumed to be duration of exposure

Inputs used in the calculation are as follows:

1. Chemical	MTBE
2. Mass	1,917,803 kg
3. Heat of Combustion	2,183.64 kJ/kg
4. Time	5.02 s
5. Minimum Dose	3,420,000 $(W/m^2)^{4/3}$ s (estimated thermal dose by RMP Guidance)

Estimates were calculated for MTBE, methanol, and formaldehyde. The largest distance to endpoint was for MTBE, 400 m, which would be confined to the plant site. The largest time of exposure was 5.4 seconds, for methanol.

Pipe Rupture and Spills - Acute Effects

Because of their similarity in terms of the way that material is released to the atmosphere, it is convenient to consider these two types of events at the same time. In terms of the amount of chemical released, this event would be somewhat less important than a full loss of containment. In a typical event involving liquid loss, liquid chemical product flowing through a pipe either during production or transfer would be exposed because of a pipe failure or a accidental disconnection. In this case, the chemical lost would flow to the secondary containment where the liquid would be immediately recovered or cleaned up in accordance with decontamination procedures. However, while cleanup is proceeding, the liquid surface is exposed to the ambient air, and evaporation of the chemical is taking place at a rate dependent on ambient temperature, vapor pressure of the liquid, the area exposed, and a number of other factors. The volume of the liquid lost is likely to be much smaller than that of the tank rupture because transfer piping is normally designed to automatically isolate tanks, thereby risking the loss of only the volume contained in the pipe. The impacts of this scenario would be lower than for the Tank Failure - Acute Effects scenario.

<u>Summary</u>

If the IGCC/C or Combination Option is selected, there would be an increased risk of exposure to the public due to a chemical release within a three kilometer radius of the source. Administrative controls used in the design and construction of the chemical plant will include considerations that minimize impacts, such as the reduction of storage volumes of individual tanks. Air dispersion modeling indicates the use of four or more tanks with higher secondary containment walls to reduce the surface area of a spill, can significantly reduce the size of the affected area. In addition process design changes can reduce impacts. For example, check valves in all piping would allow only the release of the gas in the pipe. Protection from overhead accidents (cranes) could minimize impacts to storage tanks. Safety programs would be developed and implemented to minimize risks posed by accidents.

Gasifier Rupture

Hydrogen sulfide (H_2S) is produced in the gasification process which, for entrained-flow gasifiers, operates at 2500°F and 900 psig. Should a gasifier fail, H_2S could be released in the form of a gas. H_2S, also known as hydrosulfuric acid, sewer gas, or sulfuretted hydrogen, is a colorless chemical with a strong odor of rotten eggs and is toxic. EPA approved screening models were used to calculate the ambient concentrations downwind of a likley release point. Hazard assessment guidance indicates that the EPA approved TSCREEN air dispersion model would be the best choice for estimating ambient concentrations for this release situation. [72]

The total amount of H_2S that could be released in this event is approximately 12.7 pounds. This is based on the maximum amount and composition of syngas in the gasifier and piping that would be produced with the feedrates given in Chapter 2. Modeling results indicate that the maximum short-term (instantaneous and 1-minute average) concentrations may be problematic within the plant boundary, but that instantaneous concentrations beyond the property line are below the suggested toxic endpoint level of 0.042 mg/L (approximately 30 ppm). The maximum 5-minute, 15-minute, and 1-hour concentrations do not exceed the endpoint level at any distance from the gasifier. Therefore, a release of H_2S resulting from a gasifier or piping rupture should not pose any threat to the public. Any threat to employee safety within the plant boundary would be mitigated in accordance with OSHA regulations.

Rail Accident Involving Chemicals

Chemical products and molten sulfur would be shipped mainly by rail. The current rail spur is serviced by the CSX Railway line north of U.S. Highway 72. The rail scenario used for evaluation of impacts was a derailment with spillage of ammonia from a tank car. (Ammonia was used because it has the largest isolation zone for spills - the night time protective action zone.) Table 4.2.18-4 lists the types of substances and the number of rail cars per year for each conversion option that would utilize the spur line from the plant to the CSX Railway line. Also included are the initial isolation zones which define the areas surrounding the incident in which persons may be exposed to dangerous or life threatening levels. [73] Initial isolation zones (distances) for the railroad spur from the Plant to the CSX Railway line (based on ammonia) are shown in Figure 4.2.18-1. Initial isolation zones are defined in the 1996 North American Emergency Response Handbook. The information presented in Table 4. 2.18-4 is for large spills.

Table 4.2.18-4 Number of Rail Cars per Coproduct

Material	Initial Isolation Zone for large spills (meters)	Initial Isolation Zone for fires (meters)	Rail Car (Units/Year)				
			PC	NGCC	IGCC	IGCC/C	Combination
Sulfur	100	800	—	—	2,400	1,200	1,200
Methanol	200	800	—	—	—	1,493	1,493
Formaldehyde	100	800	—	—	—	1,903	1,903
Acetic Acid	100	800	—	—	—	338	338
Granular Urea	100	800	—	—	—	310	310
UAN Solution	—	800	—	—	—	4,960	4,960
Ammonia	95 (800[a])	1,600	—	—	—	388	388
TOTAL	—		—	—	2,400	10,592	10,592

Source: 1996 North American Emergency Response Guidebook
[a] - Downwind protection zone for night time spills

If the IGCC/C or Combination Option is selected, there would be an increased risk to the public along the spur line to the CSX Railway line. Table 4.2.18-5 lists statistical data from the Federal Railroad Administration on total train accidents and accidents involving hazardous materials. [74] In 1994, Alabama had one accident which involved a release resulting in the evacuation of 2,135 people. In 1995, Alabama again had one accident involving a release which resulted in the evacuation of 150 people. [74]

Table 4.2.18-5 Train Accidents Involving Hazardous Materials, 1990 - 1995

	Accidents		No. of Accidents Involving Hazardous Materials	Accidents Where A Hazardous Material Car Was Damaged Or Derailed		Accidents Where Hazardous Materials Were Released	
Year	**Total**	**per Million Train Miles**	**Total**	**Total**	**per Million Train Miles**	**Total**	**per Million Train Miles**
1990	3,045	5.00	466	236	0.39	35	0.06
1991	2,814	4.88	525	293	0.51	47	0.08
1992	2,531	4.26	482	230	0.39	27	0.05
1993	2,785	4.54	559	262	0.43	29	0.05
1994	2,669	4.07	537	266	0.41	36	0.05
1995	2,619	3.91	561	295	0.44	27	0.04

Source: Federal Railroad Administration, Office of Safety, Accident/Incident Bulletin, 1995.

Maximum track speeds on the spur line from Bellefonte to the CSX line would likely be set to less than 35 mph which would significantly reduce the possibility for derailment. These data suggest that rail accident frequency is very small on an event per million miles traveled but do not rule out the possibility of an accident involving chemicals produced at Bellefonte which might require evacuation of residents living near rail lines.

Planning Requirements and Accident Response Programs

There are a number of federal regulations intended to protect public health that would require the development of plans for responding to accidents. Emergency response plans, spill prevention plans, and public warning systems and procedures must be completed, approved, and implemented before industrial operations at Bellefonte could commence. Some regulations also have design requirements and specifications which minimize the possibility of accidents and impacts and that contain or mitigate effects during accidents. Some of these regulations briefly summarized below are:

40 CFR Part 355	Emergency Planning and Notification
40 CFR Part 370	Hazardous Chemical Reporting: Community Right-to-Know
40 CFR Part 68	EPA's Risk Management Programs Regulation
29 CFR Part 1910.38	OSHA's Emergency Action Plan Regulation
40 CFR Part 112.7	EPA's Oil Pollution Prevention Regulation (SPCC and Facility Response Plan Requirements)
40 CFR Part 372	Toxic Chemical Release Reporting: Community Right-to-Know

40 CFR Part 355 Emergency Planning and Notification

The Emergency Planning and Community Right-to-Know Act, (EPRCA), establishes requirements for federal, state, and local governments and industry regarding emergency planning and "community right-to-know" reporting on hazardous and toxic chemicals." [75] These provisions have four major sections:

- Emergency Planning (Sections 301-303),
- Emergency Release Notification (Section 304),
- Community Right-to-Know (Sections 311,312), and
- Toxic Chemical Release Reporting Emissions Inventory (Section 313). [76]

EPRCA required the governor of each state to designate a state emergency response commission. This state commission must also have designated local emergency planning districts and appointed local emergency planning committees for each district. The local emergency planning committees must include, at a minimum, elected state and local officials, police, fire, civil defense, public health professionals, environmental, hospital, and transportation officials as well as representatives of facilities subject to the emergency planning requirements, community groups, and the media. The local committee's primary responsibility is to develop an emergency response plan and review it annually thereafter. [75]

The emergency plan should be comprehensive, addressing all hazardous materials of concern and transportation as well as fixed facilities. The plan must:

- Identify facilities and transportation routes of extremely hazardous substances,
- Describe emergency response procedures, onsite and off site,
- Designate a community coordinator and facility coordinator(s) to implement the plan,
- Outline emergency notification procedures,

- Describe methods for determining the occurrence of a release and probable affected area and population,
- Describe community and industry equipment and facilities and the identity of the persons responsible for them,
- Outline evacuation plans,
- Describe a training program for emergency response personnel, and
- Present methods and schedules for exercising emergency response plans.

40 CFR Part 370 Hazardous Chemical Reporting: Community Right-to-Know

These regulations establish reporting requirements which provide the public with important information about the hazardous chemicals in their communities for the purpose of enhancing community awareness of chemical hazards and facilitating development of state and local emergency response plans. [77]

40 CFR Part 68 EPA's Risk Management Programs Regulation

The owner or operator of a stationary source subject to the risk management program rule shall submit a single Risk Management Plan (RMP) that includes the information required in §§68.155 for all covered processes. A covered process is defined as a process that has a regulated substance present in more than a threshold quantity as determined under §68.115 of the rule. The RMP requires:

- Accidental release prevention and emergency response policies at the stationary source,
- Regulated substances (use and quantities),
- Primary activities,
- Worst-case scenarios and end points,
- Alternative release scenario(s), including administrative controls and mitigation measures,
- Accidental release prevention program,
- Chemical-specific prevention steps,
- Five-year accident history,
- Emergency response program, and
- Planned changes to improve safety.

The RMP would build on existing programs and standards, to include OSHA and DOT regulations. EPA encourages the use of existing facility emergency response programs, rather than develop a separate and duplicative program under this rule. [78]

29 CFR Part 1910 Occupational Safety and Health Standards

Provisions range from general safety and health provisions (Subpart C) to hazardous materials (Subpart H), to materials handling and storage (Subpart N), to special industries (Subpart R). These regulations have provisions for minimizing and reducing accidents to protect employees, subsequently reducing and minimizing impacts on the public.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

Summary of Findings

The accident scenarios evaluated in this section are considered to be rare occurrences. As a federal agency, TVA is not subject to EPCRA or OSHA. However, TVA is committed to complying with regulations established so as to protect public health and worker safety. As a matter of policy, and consistent with Executive Order 12856, TVA complies with EPCRA to the same extent as other utilities. TVA must internally comply with OSHA's substantive requirements as these are incorporated in its own occupational health and safety manuals. All facilities would be designed and constructed to prevent hazards from affecting the environment. In addition, TVA would develop and implement safety programs with the primary goals of minimizing potential for accidents and protection of the environment.

Impacts to the Environment From Each of the Five Bellefonte Conversion Options
Air Quality

4.3 Impacts to the Environment Associated with Natural Gas Pipeline Construction and Operation

4.3.1 Discussion of Impacts by Impact Category

Pipeline construction and operation in any of the three corridors described in Section 2.3.1 would result in a variety of site-specific impacts. The impacts of pipeline construction and operation of typical large diameter natural gas pipelines constructed in the southeast U.S. are summarized in Table 4.3.1-1. These impacts were drawn primarily from a recently completed draft environmental report for a proposed natural gas pipeline in northern Alabama. [79]

Most of the impacts listed in Table 4.3.1-1 are associated with the construction of the pipeline. Typically, once a natural gas pipeline has been placed in service, its presence results in relatively few impacts. The "permanent" or on-going impacts are associated with the maintenance of a cleared right-of-way (ROW) (chemical or mechanical elimination of trees and the prohibition of construction of structures on the ROW). Although rare, catastrophic accidents can occur when the pipeline is damaged and the natural gas escapes and is ignited.

Most of the routine long-term affects from a proposed new gas pipeline are associated with compressor stations which occur at 50- to 100-mile intervals along the pipeline. The main impacts from compressor stations are air quality and noise from the compressors.

Given the pressures and volumes required to transport the natural gas from one of the three hypothetical supply points to Bellefonte, it was estimated that a single compressor station would be required. A reasonable “worst-case scenario” would be five reciprocating engine-powered stations with 2,250 horsepower each. Although the flow would require only three or four of these engines, five would be required to account for emergency standby and maintenance needs. Emissions of air pollutants from these engines and ancilliary equipment (i.e., emergency generator, hot water boiler, lube oil tanks, ethylene glycol tanks, and fugitive and blowdowns) are estimated as follows:

Volatile organic compounds (VOC)	48 tons per year (tpy)
Carbon monoxide (CO)	220 tpy
Oxides of nitrogen (NO_x)	225 tpy

An alternative mode of gas compression would use electrically driven turbines. Electric turbines would have even less emissions (although the increased consumption of electricity could create additional CO, NO_x, and sulfur dioxide emissions elsewhere, depending upon the power plant fuel source). The five reciprocating engine scenario was used because it represents a worst-case air quality scenario and is a reasonable choice for engineering and cost purposes. Noise impacts from the compressor stations can be significant for off site receptors unless the compressors are enclosed and equipped with exhaust silencers and other sound attenuating controls. Typically, compressor stations also have enough land to serve as a buffer to further attenuate noise from compressors such that fence line impacts are acceptable (i.e., less than 55 to 65 A-weighted decibels averaged over a 24-hour period).

Table 4.3.1-1 also presents various mitigation measures that could be used to avoid, reduce, or compensate for impacts. Many of these mitigation measures have been suggested by regulatory agencies or are considered as good engineering and operating practice by the pipeline industry.

Table 4.3.1-1 Potential Impacts and Associated Mitigation Measures		
Category	**Impact**	**Potential Mitigation Measures**
Groundwater	Temporary reduction in quality of near surface groundwater as a result of removal of groundcover which acts as a filter in forested areas.	Revegetation would restore filtration process.
	Near surface compaction of soil can reduce absorption of moisture and thereby reduce recharge.	Although soil would naturally recover from some of the compaction, compaction can be reduced through use of pads or timbers for heavy equipment.
Surface Water	Stream bed and bank alterations could result in siltation.	Directional drilling would allow for passage below the streambed to avoid impacts.
	Streambed and bank alterations could result in destruction of aquatic and riparin vegetation possibly affecting fisheries.	Restore disturbed areas to original contour and revegetate with grasses that would provide rapid stabilization.
	Disturbance of banks and bed from movement of heavy equipment.	Use of temporary portable equipment bridges to keep equipment out of streams and stream margins. Conduct stream crossings at low-flow.
	Discharge of water used in hydrostatic testing can result in siltation or sedimentation.	Use only clean water in test and discharge water at a state-approved location where no erosion can occur. Use splash boards and other energy dissipation devices and erosion control devices at outfalls.
	Grading of ROW can result in pushing sediments into streams.	Grading should be directed away from streams so that material is not pushed into stream courses.
	Runoff from disturbed areas can result in stream siltation and sedimentation from erosion.	Use of hay bales and silt fences on stream banks and steep areas.
	Discharges of water from trench (prior to backfill) can result in sedimentation and siltation of surface water. Discharges can occur through dewatering activities of flow trench to waterbody.	Discharges can be controlled through trench plugs, or silt curtains.
	Use of fuels, lubricating oil, and hazardous chemicals during construction could result in contamination from spills.	Store and use chemicals and conduct refueling in upland areas at least 100 ft from water bodies.
	Runoff from trench spoil can pollute water bodies.	Surround trench spoil areas with hay bales or silt fences.

Table 4.3.1-1 Potential Impacts and Associated Mitigation Measures (cont'd)		
Category	**Impact**	**Potential Mitigation Measures**
Wetlands	Destruction of wetland soils and vegetation and loss of habitat for aquatic wildlife and other wetland values (such as flood control, water quality, enhancement, aesthetics).	In wetlands with standing water, the wetlands can be directionally drilled to avoid disturbing surface.
		Where trenching is used in seasonally dry wetlands the following methods can be used to mitigate impacts: 1 segregate and replace topsoil. 2 restoration to original contour 3 revegetation with native vegetation 4 use of timbers and preconstructed pads for heavy equipment to minimize soil compaction. 5 compensatory mitigation through wetland enhancement or creation where forested wetlands must be permanently removed for ROW maintenance. 6 realignment to minimize areas affected.
Fisheries and aquatic life	Loss of habitat and reduced water quality can result in increased mortality through oxygen depletion and in destruction of spawning areas.	Same as mitigation measures deployed to protect surface water quality.
	Direct destruction by dredging (of minor perennial streams) of phytoplankton, rooted aquatic vegetations, fish zooplankton, and benthos.	For this and other unavoidable incidental losses, payment to wildlife agencies for compensation.
	Entrainment of fish through hydrotesting.	Use screens on water intake to avoid fish entrainment.
Forested areas	Permanent loss of woodlands where 70 to 90-ft ROW traverses existing forested areas.	Use more narrow ROW clear zones through forested areas.
Wildlife	Grading activities would result in deaths of immobile animals.	Trap and relocate animals unliklely to escape grading equipment.
	Temporary disturbance of habitat for most wildlife who can escape to nearby areas.	None
	Permanent loss of habitat for wildlife where ROW removes woody vegetation. Fragmentation of woodlands habitats.	Use more narrow ROW clear zones through forested areas.
	Use of herbicides to remove woods vegetation from ROW could contaminate aquatic areas from runoff.	Use only mechanical vegetation cutting and removal, no chemicals.

Table 4.3.1-1 Potential Impacts and Associated Mitigation Measures (cont'd)

Category	Impact	Potential Mitigation Measures
Socioeconomic	Temporary stimulus from spending by construction workers on housing, food, and recreation. Wages for workers hired locally would boost area incomes. Sales tax revenues to help local governments	None required.
	Annual ad volarem taxes to local governments should amount to several thousand to a few tens of thousands of dollars per year.	
	Little to no impact on community infrastructure (e.g., housing, schools) and services (e.g., police) because construction workers would not relocate to local communities but would commute to worksite. No permanent impacts.	None required.
	Minor, temporary disruption of highway traffic from equipment movement and pipe transport, and from construction near highways and through smaller roads.	Boring or directional drilling can be used on railroads and all paved roads.
		Use of metal plates for all vehicles to pass over open trench.
		Block roads when traffic is at lowest volumes.
	Agricultural losses can occur as pipeline takes cropland or marketable timber out of production.	Farmers can be compensated directly with cash payment for lost crops and lost timber sales.
	Homes and businesses may have to be moved to accommodate pipeline.	Pipeline can make alignment shifts and bends to avoid most developed areas.
		Purchase of structures and additional cash compensation for relocation expenses and inconvenience.
Geology and land resources	Where bedrock is at grade or within trench depth, blasting may be required to remove rock for trenching. Blasting can disrupt groundwater wells; can frighten humans, animals, and livestock; and poses safety risks.	Alternative means of excavating should be used to the maximum extent possible. There are strict federal and state codes that govern blasting. When followed, these address notification, safety, monitoring, and techniques to ensure that the minimum amount of explosives are used to accomplish the bedrock fracturing.
	Pipelines can interfere with mineral recovery or preclude future mining.	Most mineral extraction activities can coexist with pipeline construction with planning and coordination between pipeline operator and mining/development firms.

Table 4.3.1-1 Potential Impacts and Associated Mitigation Measures (cont'd)

Category	Impact	Potential Mitigation Measures
Geology and land resources (cont'd)	Geologic hazards such as earthquakes and sink holes can affect integrity of pipeline and could result in catastrophic breaks with subsequent risk of fires and explosions.	Seismic hazards are low in this part of the U.S. Although there is karst topography, sinkholes that could cause problems would be large and slo developing/
	Primes and unique farmland soils can be permanently disturbed through pipeline construction.	By segregating and replacing top soils, no permanent loss of soils can be achieved. Typically, farming can continue following construction.
	Soil erosion can occur as a result of construction on steep slopes.	Restoration of soils to original contour and rapid revegetation would reduce long-term impacts. Temporary erosion control measures such as silt fences, terracing, diversion ditches, and hay bale filters can reduce erosion until vegetation is reestablished.
	Soil compaction from use of heavy equipment during wet periods can cause medium-term adverse impacts to soil.	Avoiding construction during rainy periods and use of timber mats or layers of mulch can reduce compaction. Also, post construction tillage can break up compacted soils.
	Soil contamination from accidental spills of fuels or lubricants.	Immediate cleanup and disposal of affected soil would reduce contamination dispersal.
Land use and aesthetics	Pipeline ROW and maintenance would create permanent land use changes. Woodlands would be permanently prevented above ROW as would residential and retail uses. Some recreational uses, such as swimming pools, would be precluded.	Use of existing ROW corridors would minimize land use and aesthetic impacts.
	Pipeline ROW can be a visual "eye sore" in residential or scenic settings such as parks.	Planting of trees to form visual screens along ROW edge can reduce visual impacts.
		Use of directional drilling can avoid disturbance to vegetation along scenic stretches of rivers and creeks.
		Avoidance of sensitive scenic areas may be necessary. Realignment or directional drills can entirely avoid these areas.
Air Quality	Short-term and minor impacts from construction. Fugitive emissions from disturbed soils and exhausts from vehicles and heavy equipment are the primary sources.	Fugitive emissions can be reduced through dust suppression techniques such as watering the ROW.
	Long-term impacts can occur from methane losses from improper maintenance of valves, flanges, and pipeline integrity. Methane contributes to global warming and ozone depletion.	Modern equipment on new lines results in substantially less methane loss than do older pipelines. Periodic maintenance of valves and flanges can further reduce methane loses.

Table 4.3.1-1 Potential Impacts and Associated Mitigation Measures (cont'd)		
Category	**Impact**	**Potential Mitigation Measures**
Air Quality (cont'd)	Operation of compressor stations can create major sources of nitrogen oxides (NO_x) and other criteria air pollutants. (See text for specific discussion of compressor stations impacts).	Use of electric compressors avoids most of the emissions associated with natural gas-fired or oil-fired compressor stations.
		Use of low emitting turbines reduces NO_x and other air pollution emissions.
Noise	Short-term impacts of construction noise on residential neighborhoods result in disturbed sleep and annoyance.	Use of construction equipment can be confined to daylight hours to avoid more sensitive nighttime periods.
	Long-term impacts of noise from compressor stations can adversely affect sensitive receptors (e.g., homes, schools, churches, wildlife).	Compressor stations can use mufflers and enclosures to reduce source noise and can purchase land as buffer to avoid siting of sensitive receptors near the sources.
Safety	Accidents resulting in pipeline leaks can result in explosions and fires if the gas is ignited.	• Avoidance of urban areas reduces the opportunity for damage to lines from third parties and the consequences of any fires or explosions. • Avoidance of corrosion can prevent leaks. Corrosion is prevented through factory coating, field coating, and cathodic protection measures
Archaeological and Historic Resources	Pipeline construction can destroy or damage undiscovered archaeological sites and historic structures.	Conduct survey to identify archaeological sites and historic resources. Make changes to alignments where possible or excavate and recover resources. Stop construction and report any archaeological finds.
Protected Species	Pipeline construction can result in direct taking of species or can destroy or render unusable habitat used by protected species. Loss of habitat may result in reduction in population or cause migration to other suitable areas.	• Avoidance of sensitive habitats supporting protected species. • Restoration of disturbed habitat to original conditions through revegetation and planned ecological development of alternative habitats. • Relocation of affected species to alternative suitable locations with wildlife management programs.

4.3.2 Overall Comparison of Impacts by Corridor

Table 4.3.2-1 presents a relative ranking for each of the corridors of the resource and sensitive areas discussed above. For example, under the first category (urban land use) Corridor A has the least potential impact, Corridor C has the most, and Corridor B has a “medium” impact relative to the other two. It appears that Corridor A would have the most environmental impacts in part because of its length. Corridor B would be the environmentally preferred corridor because it has no “high” impact designations and is tied with Corridor C for the most “low” impact designations. The primary virtue of Corridor B lies in the potential for a future pipeline to share ROW existing electric transmission lines or rail or highway ROWs. To the extent that a future pipeline could share parts or all of an existing ROW, environmental impacts for most of the resource and sensitive area parameters would be significantly reduced.

One problem with sharing ROW with electricity transmission lines is electrically induced magnetic fields interfere with cathodic protection used to avoid corrosion. At this juncture, it is not possible to predict the extent to which ROW sharing would be economical or permissible.

Table 4.3.2-1 Comparison of Corridors by Resource or Sensitive Area Impact Potential

Resource or Sensitive Area	Corridor		
	A	B	C
Urban Areas	Low	Medium	High
Cultivated Areas	High	Low	Medium
Forested Areas	High	Low	Medium
Roads and Railroads	High	Medium	Low
Lack of Common ROW	Medium	Low	High
Steep Slope Crossings	Medium	Low	High
Cemeteries (Cultural resource)	High	Medium	Medium
Mines	High	Medium	Medium
Surface Water	High	Medium	Low
Flood Zones	High	Medium	Low
Wetlands	High	Medium	Low
Protected Species/Sensitive Habitat	High	Low	Medium
Historic and Archeologic Sites	Low	Low	Low
Parks, Recreational, and Natural Areas	Low	Medium	Low

4.4 Indirect and Cumulative Impacts

Indirect impacts are defined by NEPA regulations as "reasonably foreseeable" effects that are caused by the proposed action but occur "later in time" and are "farther removed in distance" from the more obvious direct impacts. [80] Indirect impacts are also known as induced impacts. Cumulative impacts "result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions.” [80] This section identifies potential indirect and cumulative impacts of the proposed action--the conversion of Bellefonte to a fossil fuel fired power plant. The focus of the assessment of indirect impacts is on induced population growth and impacts from potential new "spin-off" industries. The focus of the cumulative impacts is on air and water discharges of the proposed action when added to air and water discharges from existing and planned new industrial facilities.

4.4.1 Indirect Impacts Associated with Each Bellefonte Conversion Option

Induced population growth can occur as a result of jobs created in response to the demands of the new residents that would fill plant administrative, operation, and maintenance activities positions. An example would be the additional teachers hired to accommodate increased student enrollment (which results from the influx of new workers and their families). Another example would be food service employees hired at new fast food restaurants that would be built to serve construction and permanent employees at Bellefonte. Indirect impacts can also occur from other industries and businesses that may be attracted to the Bellefonte area to take advantage of the availability of products and by products. These "spin-off" industries may be sources of air, water, and solid waste discharges and would also induce additional population growth.

4.4.1.1 Impacts from Induced Population Growth

There would be a direct "permanent" employment of from 160 to 640 persons depending upon the conversion option. The population growth resulting from these direct hires is estimated to range from less than 500 to nearly 1,800. In turn, this population may induce additional population growth but growth is expected to be negligible to account for the indirect job creation. The total population growth as a result of direct job creation, indirect job creation, and the family members of employees are presented by conversion option in Table 4.4.1-1.

Table 4.4.1-1 Population Increases Resulting from Indirect Job Creation

Conversion Option	Direct Employment	Indirect Employment	Total Population (Direct and Indirect)
PC	160	517	677
NGCC	200	812	1,012
IGCC	530	1,885	2,415
IGCC/C	430	1,437	1,867
Combination	640	2,162	2,802

The "Combination" conversion option would have the greatest amount of induced population growth. Thus, it represents a maximum probable impact. As shown in Table 4.4.1-1 above, the additional population is estimated to be 2,802 when Bellefonte is converted.

Rapid increases in population growth for largely small town and rural regions such as northeast Alabama, can have both positive and negative impacts. Some current residents of the area would gain from the population growth while others would be adversely affected. For example, retirees on fixed incomes who have moved to the immediate area to enjoy quiet, rustic surroundings would view an influx of new residents in a different light than young couples who look forward to more and better job opportunities. The former may detect a loss in the quality of their lives and higher taxes, labor and other service costs. The latter would benefit from an improved standard of living as their wages increase.

Some of the effects, both positive and negative, of induced population growth from the construction and operations-related employment at Bellefonte are qualitatively described below.

<u>Air quality</u>--Increased automobile emissions would result in higher levels of hydrocarbons, No_x and CO emissions.

<u>Soils</u>--Increased demands for housing and retail establishments may result in some conversion of prime agricultural soils to nonfarming uses.

<u>Waste disposal</u>--Increased population would generate increased quantities of solid wastes that would more rapidly increase demand for new waste disposal sites.

Surface water quality--Increased population would result in greater sanitary sewage treatment and discharges. Increased runoff from new home sites, roads, and other land development would adversely affect water quality.

Terrestrial biological resources--Increased land development would displace animal populations and could result in greater habitat pressures on areas not affected directly by the land development. Similarly, the conversion of wooded areas to paved surfaces and exotic landscapes would result in reduced quantities of native vegetation although not necessarily reduced biodiversity.

Aquatic biological resources--To the extent that surface water quality is adversely affected by increased land development and population growth, aquatic life may also be impacted.

Incomes--Typically, salaries for industrial workers are higher than those in the service sectors. Therefore, income levels in the community would probably be slightly higher even as a result of indirect effects as more affluent employees have more disposal income to spend on services and as businesses are forced to compete with higher wages in the labor market.

Transportation--Highway use would increase thereby causing slight increases in safety risk. Use of mass transit systems, i.e., bus and carpooling, would increase.

Housing--The cost of land and housing would increase, but new jobs would be created to serve in moving workers and their families.

Taxes--While new residents and higher paid employees generate greater tax revenues, their demand for new services such as schools, police, hospitals, fire protection, roads, water and sewer, and other infrastructure often results in short-term increases in tax rates to all citizens. The demand for services occurs immediately while the revenues to pay for the services occurs over a longer period of time. Similarly, as property values increase, taxes on a given parcel of land would increase even without an increase in the tax rates.

Aesthetics--Many would find the urbanization and suburbanization of a historically rural area as aesthetically unappealing. To some degree, this is an inevitable effect of increased population growth. As the manmade environment encroaches upon the natural environment, there would be a loss of aesthetic values.

4.4.1.2 Indirect Impacts from Spin-Off Industries Attracted to Bellefonte Area

Even greater job creation, and thus population growth, would occur if "spin-off" industries were to locate near Bellefonte to take advantage of proximity to products or by-products. Because electricity can be easily transported by way of high voltage transmission lines, new power plants do not usually attract other industries. The exception is in cogeneration configurations where the steam is used to generate power and for some other industrial heating or process need. While cogeneration is not contemplated under the conversion options being considered, coproduction of electric power and chemicals is one of the options. Historically, chemical production often results in the collocation of other chemical plants that use some or all of the original suite of chemicals as feedstocks for other chemicals or products. Given that there is considerable uncertainty regarding the suite of chemicals that might be produced in a coproduction option, it is even more speculative to identify what other industrial facilities might be attracted to the immediate area.

However, it is reasonable to conclude that the coproduction option is the most likely one to result in spin-off industries in the form of either an unplanned complex of manufacturing firms or an adjacent industrial park. Existing laws and regulations are designed to limit the discharge of pollutants beyond limits that would result in significantly adverse levels of contaminants in the air and water. Indirect impacts from such a development would likely include:

- Increased emissions of criteria and possibly hazardous air pollutants,
- Increased emissions of odors,
- Increased discharges of water pollutants and increased thermal impacts,
- Increased likelihood of accidental releases of hazardous substances, and
- Increased population growth with impacts noted in the previous section.

Should the conversion of Bellefonte involve an option which requires natural gas as a fuel or feedstock, a high pressure natural gas pipeline would have to be constructed to connect Bellefonte to adequate supplies. If gas pipeline construction occurs as a result of the conversion of Bellefonte, the availability of large new gas supplies in Northeast Alabama could spur the growth of industries that use this material as a feedstock. The growth rate for industries which might use natural gas as an alternative to electricity or propane would not be as noticeable because of their close competitiveness for such applications as space heating.

4.4.1.3 Mitigation of Indirect Impacts

The mitigation for the impacts from induced growth is planning--both land use planning and fiscal planning. It is most effectively conducted by the affected jurisdictions, which in this case is Jackson County and the communities of Hollywood and Scottsboro. When TVA begins to finalize its decisions regarding whether to proceed with the proposed action and which conversion option to pursue, meetings with local government officials can facilitate the planning process. For example, industrial growth can be more easily managed in an industrial park. Scottsboro's current industrial park, west of the city, has committed almost 90% of the current 240-acre tract. A new industrial park near Bellefonte may be necessary to accommodate spin-off industries resulting from the coproduction conversion options.

The mitigation for the impacts of increased industrial air, water, and solid waste discharges are similar to those identified elsewhere in this EIS for the direct impacts of the conversion options.

4.4.2 Cumulative Impacts

An assessment of cumulative impacts takes into account other past, present, and reasonably foreseeable future actions that would add to the impacts of the proposed facility. A list of announced industrial expansions and new industries for Jackson County is presented in Table 4.4.2-1 below. This table indicates that industrial expansion would occur in Jackson County and that additional population growth would occur even in the absence of any developments at Bellefonte.

Table 4.4.2-1 Announced Major Recent and Future Expansions and New Industrial Facilities for Jackson County (As of February 1997)

Nature of Business	Size of Expansion/Facility	Location
Mfr. exhaust system gaskets for automobiles (NCI)	New facility--30 new jobs	Scottsboro Industrial Park
Pulp and paper (Mead Container board)	Expansion --Doubling in capacity to 805,000 tpy. Addition of wood fired boiler and two dryers; $224 million	Stevenson
Industrial air handling systems (McQuay International)	Expansion--125 jobs 50% increase in capacity.	Scottsboro
Mfr of coaxial cable for electronics (CommScope)	Expansion--60 jobs	Scottsboro Industrial Park
Textile mill (Willstown Apparel)	Expansion--140 jobs	Section
Wallboard manufacturer (U.S. Gypsum) would use scrubber sludge from several power plants as a feedstock	New--300 to 400 jobs	Bridgeport

Source: Sheila Bryant, Jackson County Economic Development Authority

The remainder of this section addresses the likelihood that the Bellefonte conversion would add to the air and water quality impacts that would result from these and other nearby proposed industrial sources in the area.

4.4.2.1 Cumulative Impacts of Proposed Action on Air Quality

Criteria Pollutants

The cumulative impact of proposed Bellefonte conversion options and variants on ambient air quality standards was assessed by combining the ISC3/RTDM PSD modeling results with PSD monitoring observations. The maximum modeled concentration for each pollutant was added to the maximum observed concentration measured from February 1, 1990, through January 31, 1991, at the Bellefonte PSD monitoring station. The Bellefonte monitoring station was located on the Sand Mountain escarpment about 3.8 km east of the proposed plant site. The potential impacts estimated by this assessment method are inherently conservative in that “worst-case” monitoring and modeling conditions are assumed to coincide in time and space (Tables 4.4.2-2a, -2b, -2c, and -2d). As discussed below, this assessment serves more to bound the upper end of potential impacts than to provide a realistic estimate of typical cumulative impacts. To the extent that the selected Bellefonte conversion option contributes additional air pollution to the region, a decline in air quality and air quality related values would be anticipated. If, however, the operation of the selected conversion option allows retirement of older, less-well-controlled sources, a net decline in regional pollution emissions would prove environmentally beneficial.

Sulfur Dioxide - Primary SO_2 emissions from any Bellefonte conversion option or variant would not likely result in a violation of the current annual, 24-hour, or 3-hour SO_2 national ambient air quality standards. Measurements from the monitoring station indicate that SO_2 levels are less than 20% of the ambient standard levels. Quantitatively, SO_2 emissions from the PC option and PFBC variant emit more than four times as much SO_2 as any other option and, consequently, would have the greatest potential environmental impact on SO_2 ambient air quality and secondary pollution concerns related to SO_2 emissions including particulate matter less than 2.5 microns (PM2.5), acidic deposition, and visibility impairment. The secondary production of PM2.5 from primary SO_2 emissions is of particular concern because of the recent revision to the particulate matter standard.

Nitrogen Oxides - Primary NO_x emissions from any Bellefonte conversion option or variant should not result in a violation of the annual NO_2 national ambient air quality standard. Measurements from the monitoring station indicate that background NO_2 levels are only about 1% of the ambient standard. Quantitatively, NO_x emissions from the PC Option are nearly double those for any other option and would have the greatest impact on secondary pollution issues including O_3, PM2.5, plume blight, regional haze, and acidic deposition. The secondary production of O_3, in particular, is of significant concern because of the recent revision to the O_3 standard.

Ozone **-** Secondary O_3 will be produced as a consequence of primary NO_x emissions from the selected Bellefonte conversion alternative. The secondary production of O_3 is a significant concern because of the recent revision to the O_3 standard. The revised standard, in turn, will lead to a major reevaluation of NO_x control strategies. While attainment status for the revised O_3 standard will not be established until the year 2000, it is expected that the south-central U.S. will have difficulty in attaining and maintaining the revised standard for a number of reasons including:

- a high frequency of stagnating summertime weather conditions conducive to the production and accumulation of O_3,
- high emissions levels of natural reactive volatile organic compounds (VOCs)–an important class of O_3 precursors, and,
- continuing population growth/economic expansion placing additional demands on fossil-fuel use which will lead to a corresponding increase in manmade NO_x and VOC emissions.

Recent research on power plant plume chemistry suggests that the maximum O_3 production in above-ground plumes from large power plants (with a range of NO_x emission rates similar to all but one of the Bellefonte options and variants [IGCC/C] is on the order of 0.020 to 0.030 ppm (40 to 60 ug/m^3) and occurs 20 to 80 km downwind of the source. [81] Nearer the source, plume O_3 levels are actually lower than the ambient background due to O_3 titration by nitric oxide (NO). All other factors being equal, the potential for excess O_3 production is a function of NO_x emissions. Therefore, Bellefonte conversion options with lower NO_x emission rates such as the preferred NGCC option, would, in general, contribute to less O_3 production occurring closer to the source and affecting smaller areas than those with higher NO_x emission rates such as the PC option.

These field observations are further supported by recent Urban Airshed Model V runs with Plume-in-Grid treatment (UAMV-PIG) conducted by TVA for the Ozone Transport Assessment Group (OTAG). The episodic analysis of “worst-case” O_3 conditions by UAMV-PIG also predicted hourly maximums of incremental O_3 (plume-produced O_3) due to power plant NO_x emissions on the order of 0.020 to 0.030 ppm (40 to 60 ug/m^3). Ozone production of this magnitude is of concern since maximum regional hourly O_3 levels during the summer already approach the 1-hour national standard (235 μg/m^3) as observed at the Bellefonte PSD monitoring station (204 μg/m^3) and elsewhere.

Carbon Monoxide - Primary CO emissions from any Bellefonte conversion option would not likely result in a violation of either the 8-hour or 1-hour CO national ambient air quality standards. Measurements from the monitoring station indicate that maximum background CO levels are less than 20% of the ambient standard levels. Quantitatively, CO emissions from the IGCC/C Option would have the greatest potential environmental impact on ambient air quality but the magnitude of this impact is minimal. Since maximum 8-hour averages for CO were not modeled, the more conservative maximum 1-hour model results were used for the 8-hour assessment in Table 4.4.2-2.

Particulate Matter - PM10 emissions from any Bellefonte conversion option should not result in a violation of either the annual or 24-hour PM10 national ambient air quality standards. Measurements from the monitoring station indicate that maximum background PM10 levels are less than half of the ambient standard levels.

As mentioned above, the greatest cumulative impact of proposed operations on particulate matter pertain to the secondary production of fine particulates (PM2.5). The secondary production of PM2.5 is a significant concern because of the recent revision to the PM standard. This revised standard, in turn, will lead to a major reevaluation of primary SO_2 emission control strategies in particular and, perhaps, NO_x and PM control strategies as well. While attainment status regarding the revised PM standard will not be established until 2005, it is anticipated that the south-central U.S. will likely have difficulty in attaining and maintaining the revised PM2.5 standard for a number of natural and manmade factors including:

- a high frequency of stagnating summer and fall weather conducive to the production and accumulation of secondary PM2.5,
- high emission levels of natural reactive volatile organic compounds (VOCs)–an important class of PM2.5 precursors, and,
- continuing population growth/economic expansion placing additional demands on fossil-fuel use leading to a corresponding increase in manmade PM2.5 precursor emissions.

All other factors being equal, the potential for manmade PM2.5 production for the selected Bellefonte alternative is a function of SO_2 and, to a lesser extent, NO_x emissions. Therefore, Bellefonte alternatives with lower SO_2 and NO_x emission rates such as the preferred NGCC option, would contribute to lower PM2.5 production than those with higher emissions rates such as the PC or PFBC alternatives.

Lead - Primary lead (Pb) emissions from any Bellefonte conversion option should not result in a violation of the quarterly national ambient air quality standard. Measurements from the PSD station indicate that maximum background lead levels are less than 2% of the ambient standard. Given the low emissions rates, Pb emissions were not modeled using the ICS3/RTDM protocol but were estimated with the SCREEN3 model. The resultant 1-hour maximum concentration was added to the quarterly lead monitoring estimates for assessment purposes.

Table 4.4.2-2a Cumulative Impacts on Ambient Air Quality

PC Option						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	5.4	18.8	80.0	23.5
	24-Hour	61.4	111.1	172.5	365.0	47.3
	3-Hour	213.6	573.1	786.7	1,300.0	60.5
NO_2	Annual	1.0	7.8	8.8	100.0	8.8
PM10	Annual	24.0	0.6	24.6	50.0	49.2
	24-Hour	46.0	12.0	58.0	150.0	38.7
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1,782.0	91.5	1,873.5	10,000.0	18.7
	1-Hour	3,246.0	91.5	3,337.5	40,000.0	8.3
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.00	0.03	1.50	2.0
PFBC Option						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	3.7	17.1	80.0	21.4
	24-Hour	61.4	126.6	188.0	365.0	51.5
	3-Hour	213.6	623	836.9	1,300.0	64.4
NO_2	Annual	1.0	2.7	3.7	100.0	3.7
PM10	Annual	24.0	0.4	24.4	50.0	48.8
	24-Hour	46.0	13.7	59.7	150.0	39.8
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1,782.0	0.0	1,782.0	10,000.0	17.8
	1-Hour	3,246.0	0.0	3,246.0	40,000.0	8.1
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.01	0.04	1.50	2.7

Table 4.4.2-2b Cumulative Impacts on Ambient Air Quality

NGCC Option						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	0.1	13.5	80.0	16.8
	24-Hour	61.4	1.8	63.2	365.0	17.3
	3-Hour	213.6	7.3	220.9	1300.0	17.0
NO	Annual	1.0	8.6	9.6	100.0	9.6
PM10	Annual	24.0	1.0	25.0	50.0	50.0
	24-Hour	46.0	25.0	71.0	150.0	47.3
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1,782.0	1,241.6	3,023.6	10,000.0	30.2
	1-Hour	3,246.0	1,241.6	4,487.6	40,000.0	11.2
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.00	0.03	1.50	2.0
NGCC Bypass Variant						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	0.03	13.43	80.0	16.8
	24-Hour	61.4	0.9	62.3	365.0	17.1
	3-Hour	213.6	3.8	217.4	1300.0	16.7
NO	Annual	1.0	3.5	4.5	100.0	4.5
PM10	Annual	24.0	0.4	24.4	50.0	48.8
	24-Hour	46.0	8.2	54.2	150.0	36.1
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1782.0	574.3	2356.3	10000.0	23.6
	1-Hour	3246.0	574.3	3820.3	40000.0	9.6
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.00	0.03	1.50	2.0

Table 4.4.2-2c Cumulative Impacts on Ambient Air Quality

NGCC Oil Variant						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	1.1	14.5	80.0	18.1
	24-Hour	61.4	28.1	89.5	365.0	24.5
	3-Hour	213.6	114.0	327.6	1300.0	25.5
NO_2	Annual	1.0	3.5	4.5	100.0	4.5
PM10	Annual	24.0	1.3	25.3	50.0	50.6
	24-Hour	46.0	33.1	79.1	150.0	52.7
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1782.0	1241.6	3023.6	10000.0	30.2
	1-Hour	3246.0	1241.6	4487.6	40000.0	11.2
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.00	0.03	1.50	2.0
NGCC Oil Bypass Variant						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	0.5	13.9	80.0	17.4
	24-Hour	61.4	13.7	75.1	365.0	20.6
	3-Hour	213.6	59.5	273.1	1300.0	21.0
NO_2	Annual	1.0	3.5	4.5	100.0	4.5
PM10	Annual	24.0	0.6	24.6	50.0	49.2
	24-Hour	46.0	16.2	62.2	150.0	41.5
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1782.0	574.3	2356.3	10000.0	23.6
	1-Hour	3246.0	574.3	3820.3	40000.0	9.6
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.06	0.09	1.50	6.0

Table 4.4.2-2d Cumulative Impacts on Ambient Air Quality

IGCC Option						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	5.2	18.6	80.0	23.3
	24-Hour	61.4	127.8	189.2	365.0	51.8
	3-Hour	213.6	591.6	805.2	1300.0	61.9
NO_2	Annual	1.0	14.0	15.0	100.0	15.0
PM10	Annual	24.0	1.5	25.5	50.0	51.0
	24-Hour	46.0	30.5	76.5	150.0	51.0
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1,782.0	400.0	2,182.0	10,000.0	21.8
	1-Hour	3,246.0	400.0	3,646.0	40,000.0	9.1
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.06	0.09	1.50	6.0
IGCC Bypass Variant						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	3.6	17.0	80.0	21.3
	24-Hour	61.4	83.4	144.8	365.0	39.7
	3-Hour	213.6	297.1	510.7	1,300.0	39.3
NO_2	Annual	1.0	5.7	6.7	100.0	6.7
PM10	Annual	24.0	1.3	25.3	50.0	50.6
	24-Hour	46.0	24.2	70.2	150.0	46.8
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1,782.0	170.6	1,952.6	10,000.0	19.5
	1-Hour	3,246.0	170.6	3,416.6	40,000.0	8.5
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.06	0.09	1.50	6.0

Table 4.4.2-2e Cumulative Impacts on Ambient Air Quality

Pollutant	Avg. Period	Observed Maximum	Modeled Maximum	Sum	Standard [a]	% of Std.
IGCC/C Option						
SO_2	Annual	13.4	1.8	15.2	80.0	19.0
	24-Hour	61.4	40.0	101.4	365.0	27.8
	3-Hour	213.6	181.4	395.0	1,300.0	30.4
NO_2	Annual	1.0	3.7	4.7	100.0	4.7
PM10	Annual	24.0	1.0	25.0	50.0	50.0
	24-Hour	46.0	19.2	65.2	150.0	43.5
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1,782.0	92.4	1,874.4	10,000.0	18.7
	1-Hour	3,246.0		3,348.4	40,000.0	8.3
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.00	0.03	1.50	2.0
Combination Option						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	1.9	15.3	80.0	19.1
	24-Hour	61.4	41.2	102.6	365.0	28.1
	3-Hour	213.6	189.9	398.6	1300.0	30.7
NO_2	Annual	1.0	8.7	9.7	100.0	9.7
PM10	Annual	24.0	1.2	25.2	50.0	50.4
	24-Hour	46.0	25.2	71.2	150.0	47.5
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1782.0	976.1	2758.1	10000.0	27.6
	1-Hour	3246.0	976.1	4222.1	40000.0	10.6
Ozone[b]	1-Hour	204.0	NA.	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.00	0.03	1.50	2.0

Table 4.4.2-2f Cumulative Impacts on Ambient Air Quality

Combination Bypass Variant						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	1.5	14.9	80.0	18.6
	24-Hour	61.4	28.1	89.5	365.0	24.5
	3-Hour	213.6	109.4	323.0	1300.0	24.8
NO_2	Annual	1.0	5.0	6.0	100.0	6.0
PM10	Annual	24.0	1.4	25.4	50.0	50.8
	24-Hour	46.0	30.3	76.3	150.0	50.9
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1782.0	605.6	2387.6	10000.0	23.9
	1-Hour	3246.0	605.6	3851.6	40000.0	9.6
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.01	0.04	1.50	2.7
Combination Oil Variant						
Pollutant	**Avg. Period**	**Observed Maximum**	**Modeled Maximum**	**Sum**	**Standard [a]**	**% of Std.**
SO_2	Annual	13.4	2.8	16.2	80.0	20.3
	24-Hour	61.4	67.5	128.9	365.0	35.3
	3-Hour	213.6	286.6	500.2	1300.0	38.5
NO_2	Annual	1.0	8.7	9.7	100.0	9.7
PM10	Annual	24.0	1.7	25.7	50.0	51.4
	24-Hour	46.0	40.5	86.5	150.0	57.7
PM2.5	Annual	NA	NA	NA	NA	NA
	24-Hour	NA	NA	NA	NA	NA
CO	8-Hour	1782.0	976.1	2758.1	10000.0	27.6
	1-Hour	3246.0	976.1	4222.1	40000.0	10.6
Ozone[b]	1-Hour	204.0	NA	NA	235.0	86.8
	8-Hour	NA	NA	NA	NA	NA
Lead	Quarter	0.03	0.01	0.04	1.50	2.7

[a] - National ambient air quality standard.
[b] - Ozone is a secondary air pollutant, an appropriate modeled increment cannot be determined. See above discussion.

Air Quality Related Values

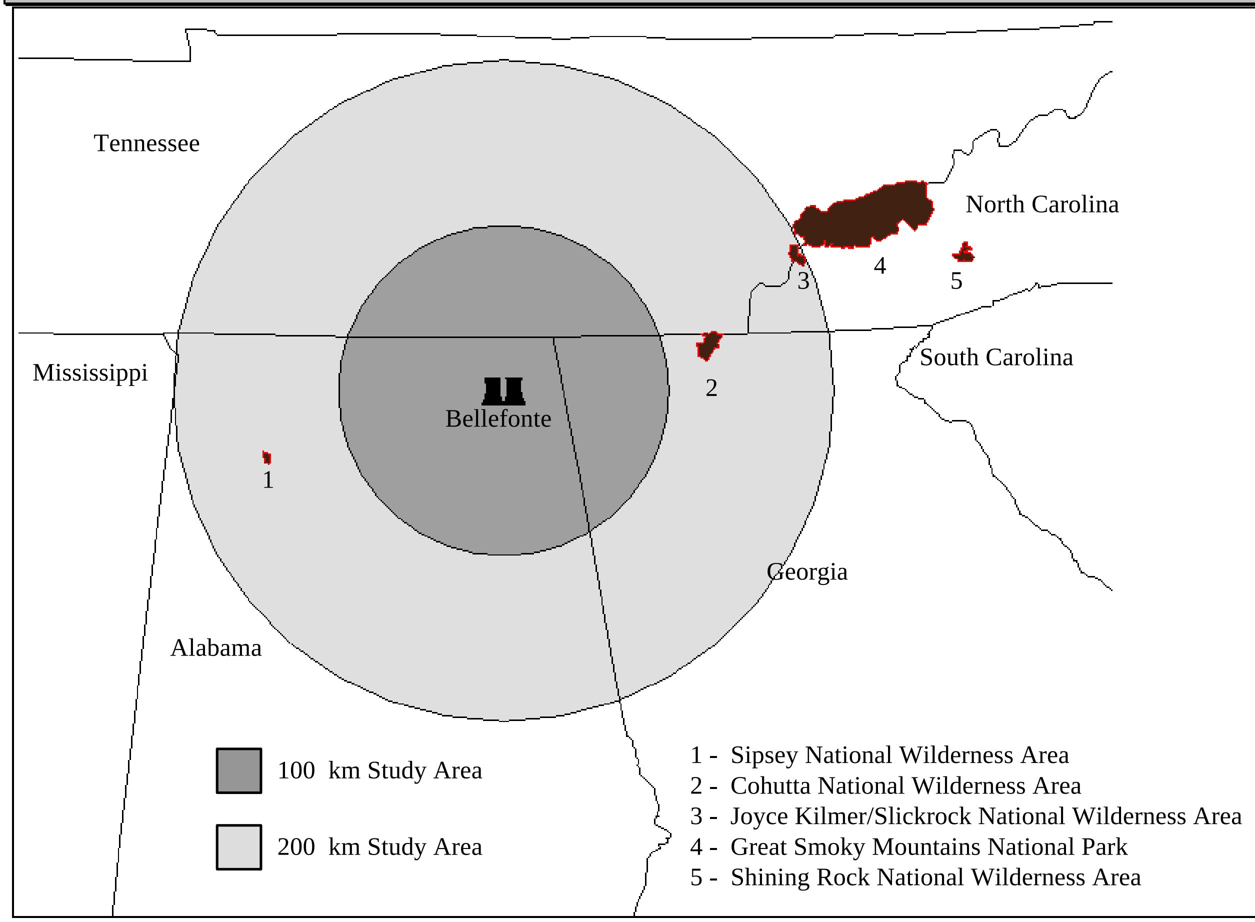
The Prevention of Significant Deterioration section (40 CFR 52.21) of the Clean Air Act (CAA) provides special protection for air quality and air quality-related values (AQRVs) in certain national parks and wilderness areas, designated as Class I areas. Air pollution effects have been interpreted to constitute an unacceptable adverse impact in Class I Areas if they meet any of the following criteria:

- Diminish the national significance of the area,
- Impair the quality of the visitor experience, or
- Impair the structure and function of the ecosystem. (Federal Register 47 30223, July 12, 1982).

There are no Class I areas within 100 km of Bellefonte site but there are several within 200 km, including the Great Smoky Mountains National Park and the Joyce Kilmer/Slickrock, Cohutta, and Sipsey National Wilderness Areas (Figure 4.4.2-1).

Federal Land Managers (FLMs) have the authority to review state permit requests for new or expanding sources whose air emissions might impact air quality and AQRVs in a Class I area. These AQRVs may include, but are not limited to, visibility, flora, fauna, surface waters, ecosystems, and geological, cultural, and historical resources. The CAA also requires reasonable progress towards a defined national goal of preventing visibility impairment by anthropogenic air pollutants. [82] If FLMs determine that emissions from a proposed source might cause an adverse impact to AQRVs, they can recommend that the state deny or require modification to the permit application to further restrict emissions or offset impacts. The burden of proof to demonstrate these source-specific impacts falls on the FLM. Each of the proposed Bellefonte fossil-fuel re-powering alternatives emit regulatorily significant quantities of one or more pollutants which have been implicated in impacting AQRVs including visibility, soil and stream acidification, and vegetation injury.

Figure 4.4.2-1 Class I Areas Within 100 km and 200 km Radius of Bellefonte



Visibility

Viewing scenery is one of the most often cited reasons for visiting forests and parks. In addition to being an important component of the recreational experience, visibility is protected by the CAA. The CAA declared as a national goal "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I federal areas where impairment results from manmade air pollution."

The visibility screening described in Section 4.2.1, the air quality section, pertains to the potential impact of discreet plumes on the nearest PSD Class I areas, the Cohutta Wilderness about 120 km east of the Bellefonte site. In this section, however, both plume blight and regional haze are considered.

Plume blight is defined as the adverse impact of a discrete plume on visual aesthetics. Plume blight is caused by manmade emissions of PM, NO_x, and SO_2. While the primary emissions of PM and NO_x can contribute to visibility impairment near the source, it is the secondary transformation products (NO_2 and particulate nitrates and sulfates) that have the greatest impact on visibility impairment. Under unusual transport conditions individual plumes may remain intact for hundreds of kilometers. In these cases, secondary transformation products contribute significantly to plume blight. More often, however, transport conditions quickly blend individual plumes into the regional background where the secondary transformation products affect regional haze.

Regional haze, a more homogenous form of visibility impairment, is primarily caused by five particulate substances (and associated water vapor) including sulfates, organics, elemental carbon (soot), nitrates, and fine soil dust. Each of these substances has a significant manmade component. Sulfate particles alone are thought to cause between half and two-thirds of the persistent regional haze found in the eastern U.S., particularly during the summer months when the sulfate fraction of fine particulate aerosol is at its greatest. [85] The production of regional haze is enhanced by several meteorological factors. Principal among these factors in the south-central U.S. are relative humidity and the frequency of stagnating weather patterns. High relative humidities increase the size of hydroscopic particles, such as aerosol sulfates, which are particularly effective in absorbing and scattering light. Stagnating weather patterns which enhance the production and accumulation of visibility-impairing secondary air pollutants are also more frequent. Nationally, the greatest frequency of persistent stagnation events occur in northwest Georgia near the Bellefonte site. [86]

A wide variety of emissions result from daily activities that include driving, generation of electricity, producing consumer goods, and waste incineration. Depending on the location, time of the year, and atmospheric conditions, each of these human-caused sources can contribute significantly to visibility impairment. Table 4.4.2-3 shows the proportional contribution of electric utilities and other sources that may affect visibility.

Table 4.4.2-3 Contribution (%), By Source Category, Of Emissions Affecting Visibility in the Eastern U. S.

Sources Category	**SO_2**	**Organic Particles**	**VOC**	**Elemental Carbon**	**Suspended Dust**	**Ammonia**	**NO_x**
Electric utilities	78						39
Diesel combustion	2			47			16
Gasoline combustion	1	34	31	29			26
Petro-chemical industries	5		11				
Industrial coal combustion	7						
Residential wood burning		20	13	15			
Fugitive dust (on/off road traffic)					100		
Feedlots & livestock waste						66	
Miscellaneous	8	46	45	9		34	19

Source: National Research Council 1993

In the eastern U. S., annual average natural background visibility is considered to be 93 $\pm$ 30 miles (150 $\pm$ 45 kilometers).[87] This "background" visibility is defined as the visibility condition without the addition of anthropogenic (human-caused) air pollution. Airport visual range data collected over the past 40 years shows that regional haze has intensified over a large contiguous region east of the Mississippi River.[88] During this time, Southeastern visibility declined between the 1950s and 1970s, improved between the 1970s and 1980s, and has not changed much since. Current visibility data show that the standard visual range (approximately 25 miles or 40 km) is well below the estimated natural background.

These historic visibility trends closely follow the trends in regional SO_2 emissions. Both SO_2 and light extinction increased from the late 1940s through the early 1970s and slightly decreased or leveled off in the late 1970s and early 1980s. While the Tennessee Valley region's SO_2 emissions have declined by more than 50 percent since the late 1970s, Southeastern SO_2 emissions overall have remained relatively steady due to regional industrial and population growth.[89]

Poor regional visibility during the summer is also related to the weather. In the summer, slow-moving stagnant air masses often dominate southeastern weather, enhancing the production and accumulation of secondary air pollutants. Humidity also has a significant impact on visibility. Elevated concentrations of these pollutants interact with high humidity to increase regional haze. At the relative humidities typical of the southeastern U. S., hydroscopic aerosols grow to a size most likely to cause haziness.

National SO_2 emissions will continue to decrease in the years ahead as a consequence of the implementation of the Title IV control program. Nationally, SO_2 emissions will be reduced by 10 million tons below the 1980 level, and there will be a cap on emissions from utilities and industrial sources. Once fully implemented, Title IV controls should improve average visibility by roughly 4 miles (or 6.5 kilometers) in the summertime in the southern mountains. [90]

Since particulate sulfate and, to a lesser extent, nitrate contribute to regional haze, projected Bellefonte SO_2 and NO_x emissions conversion alternatives will contribute to plume blight and regional haze in proportion to their emissions. All but the preferred NGCC option would emit significant amounts of SO_2. The relatively high-SO_2 emitting PFBC or PC alternatives would have the greatest impact on visibility impairment whereas the NGCC or IGCC/C alternatives would have the least impact. If the operation of the selected Bellefonte facility resulted in the retirement of older, less-well controlled facilities, an overall improvement in regional visibility conditions would be expected.

Acidic Deposition

"Acid deposition," "acidic precipitation," or, most commonly, "acid rain," are all terms used to collectively describe the atmospheric transport and deposition of acidic substances. Manmade emissions of acid-forming gases, including SO_2 and NO_x, increase the acidity of wet (rain, fog, snow, cloud water) and dry (fine particulates) deposition which may cause significant ecological damage to susceptible terrestrial and aquatic ecosystems. This deposition also contributes to enhanced weathering of paint, limestone, and metals including culturally important resources such as historic buildings, monuments, and tombstones. The National Acid Precipitation Assessment Program (NAPAP) indicates that Southeastern acidic precipitation is associated with damage to sensitive, high-elevation soils and aquatic systems. [91]

In the absence of manmade pollution, natural rain is slightly acidic. This natural acidity is caused by carbon dioxide (CO_2) and naturally emitted acid gases. For temperate, mid-continental areas like the Tennessee Valley, this would translate to a pH of 5.2 (lower pH measurements indicate higher acidity). Manmade emissions from fossil-fuel combustion contribute to excess acidity. Long-term regional rain observations are four to eight times more acidic (pH of 4.3 to 4.6) than natural rain. [83]

The primary acidifying compounds in rainfall are sulfates and nitrates. The sulfur in acidic deposition is not thought to have adverse impacts on vegetation and may actually have slight positive benefits as a nutrient for soils low in native sulfur. For crops and forests growing on nitrogen-deficient soils, nitrate in deposition has positive benefits. However, some of the highest deposition loadings of sulfur, nitrogen, and acidity in the U.S. have been measured in the high elevations in the Southeast. The analysis done for the Southern Appalachian Assessment indicated that the highest loadings of sulfur and nitrogen wet, dry, and cloud deposition are found in upland regions and high-elevation watersheds, coincident with a number of Class I parks and wilderness areas (including Cohutta Wilderness, Joyce Kilmer/Slickrock Wilderness, and the Great Smoky Mountains National Park). [90]

Sulfate deposition is greatest at the higher elevations of the Southern Appalachians. Modeled mean wet sulfate loadings range from 20 to 30+ kilograms per hectare per year. [90] Portions of streams at high elevations are probably least able to neutralize or "buffer" incoming acidity. Precipitation pH over a recent 13 year period was static, reflecting a general decline in both the acidic sulfate and basic cation loadings.

Nitrate deposition has greater impact than sulfate on high-elevation spruce-fir ecosystems, which are located more than 200 km distant from the Bellefonte site. Biological processes that use nitrogen are slower at high elevation. When nitrogen deposition exceeds the biological demand for nitrogen, nitrates in soil water may remove nutrients such as calcium and magnesium that are essential for plant growth. Acidic deposition to sensitive watersheds can result in

(1) soil acidification,
(2) leaching of base cations from soils, and
(3) surface water acidification.

In some watershed soils, sulfate in rain is absorbed by the soils until the soils are saturated. Then the sulfate begins to leach out into the stream waters, resulting in “delayed” acidification of streams. Even if sulfates in deposition is significantly reduced, stream recovery from acidification may not be immediate.[90]

In this region the two major processes influencing the response of surface waters to acid deposition are sulfate/nitrate retention and base cation mobilization. The amount of watershed sulfate/nitrate retention determines how much of the incoming anions from deposition reach ground or surface waters. The degree of base cation mobilization controls the cation composition entering surface waters. If the entering anions are all balanced by base cations, there is little effect on the acid-base status of the water and consequently little effect on aquatic biota. However, if the anions are balanced by significant concentrations of acid cations (H^+, aluminum), surface water acidity increases and there can be significant adverse effects on some aquatic species. Base cation mobilization is primarily determined by the composition of the watershed bedrock and soils.

Streams in upland areas are least able to buffer the incoming acidity, especially during storm-generated episodes. In some of these sensitive streams, aquatic biota (fish and invertebrates) are being affected by both chronic and episodic acidification. Occasional or chronic acidification of streams by sulfates and nitrates can lead to elevated levels of dissolved aluminum, which can reduce survival and diversity of macro-invertebrate and fish populations in sensitive streams. High elevation sites typically have soils which are derived from materials that have a low buffering capacity. [90]

There is some evidence of chronic and episodic acidification by nitrogen saturation (or excess supply of nitrogen that cannot be used by biota). In streams monitored in the Northeast and mid-Appalachians, nitrate is now observed at high concentrations during hydrologic episodes and during baseflow periods, indicating that the supply of nitrogen has exceeded the capacity of the soils and vegetation to absorb it. [93] There are a number of explanations for this nitrogen "leakage," including the maturation of forests, effects of insect infestation, and excess nitrogen supply in deposition. [92] Fixed nitrogen is an important nutrient for plant growth, but as forests mature, a balance is reached between plant use and recycling back into the system by decaying plant materials. Insect defoliation causes rapid recycling of nitrogen, so insect infestations such as a gypsy moth defoliation could add to the problem as this exotic insect forest infestation moves southward from Virginia. [90]

Nitrate can also acidify soil waters, possibly leading to aluminum toxicity for sensitive plants. Increased nitrates can also result in increased aluminum and acidity in ground and surface waters which can degrade stream habitat for fish and other aquatic life.

Since the late 1970s, SO_2 emissions have significantly declined across the eastern U.S. and Canada in order to meet ambient SO_2 standards and to control acidic deposition. [84] Recent assessments of long-term trends in rainfall chemistry have documented a corresponding significant decline in precipitation sulfate, a slight, less significant decline (increased pH) in rainfall acidity, and a slight increase in precipitation nitrate. [83] It appears that an overall increase in NO_x emissions, and NO_x-related acidity, during the same time has partially offset the improvements from SO_2 emissions reductions. A further decrease in acid deposition is expected as the Title IV program of the 1990 CAA Amendments is fully implemented. Those regulations will decrease emissions of both sulfates and nitrates from fossil-fuel electricity-generating plants. Vehicle emissions, a second major source of nitrogen compounds, is expected to grow in importance as the population of the region increases.

Each of the proposed Bellefonte conversion options emit regulatory-level significant quantities of NO_x, and all but the NGCC Option would emit significant quantities of SO_2 as well. All options will be subject to the application of new-source, best-available-emission-control technology (BACT) requirements to minimize SO_2- and NO_x-related emissions. BACT requirements are at least as stringent as new source performance standards. Notwithstanding these controls, emissions from any selected option will add to the total atmospheric loading of acidifying gases unless, at the same time, older, less-controlled sources are retired. From an emissions minimization perspective, the most desirable option is the preferred NGCC and the least desirable is PC. Also, in terms of acidifying emissions per megawatt of production, the most desirable option is NGCC and the least desirable is PC (Table 4.4.2-4).

Table 4.4.2-4 Estimated Annual SO_2 and NO_x Emissions

	Emissions [a]			
	SO_2	**NO_x**	**SO_2/MW**	**NO_x/MW**
PC	25,040	36,266	10.43	15.11
PFBC	22,264	16,394	9.28	6.83
NGCC	78	9,142	0.03	3.69
NGCC Bypass	78	9,142	0.05	5.57
NGCC Oil	1,209	9,142	0.49	3.69
NGCC Oil Bypass	1,209	9,142	0.74	5.57
IGCC	5,771	19,108	2.12	7.03
IGCC Bypass	5,771	19,108	3.22	10.65
IGCC/C	1,783	5,161	3.96	11.47
Combination	1,834	11,256	0.71	4.39
Combination Bypass	1,834	11,256	0.71	4.39
Combination Oil	2,966	11,256	1.16	4.39

[a] - Metric Tons Per Year (mtpy)

Ozone

Ozone is a strong oxidizing agent capable of damaging living tissues. Several crop and forest species in the Tennessee Valley are sensitive to ozone and when exposed exhibit foliar injury and reduced productivity. Some ozone occurs naturally, but elevated ground-level concentrations are formed primarily through the photochemical interaction of manmade and natural emissions of NO_x and VOCs under appropriate meteorological conditions.

Nationally, the largest NO_x sources, motor vehicles and fossil-fuel industrial and utility plants, represent about 80% of total NO_x emissions. Motor vehicles and fossil fuel plants have approximately equal magnitude annual emissions. [89] Initially emitted primarily as nitric oxide (NO), fresh NO_x emissions quickly react with reactive VOCs to form nitrogen dioxide (NO_2), which then photolyzes to form ozone and regenerate NO.

In the eastern U. S., natural vegetation, motor vehicles, and industry are the largest VOC sources and represent about 90% of total VOC emissions with vegetation accounting for about 60% and motor vehicles and industry accounting for 30 percent. In the Great Smoky Mountains National Park, for example, nearby industrial sources emit only a small fraction (9%) of the total reactive VOCs. Trees and other vegetation sources predominate (87%) with motor vehicles ranking a distant second (4%). [94] Manmade VOC emission levels in the Southern Appalachians are projected to increase as vehicle miles traveled increase with an increasing population. [90]

Ozone can be damaging to tissues inside of plant leaves, which it enters through small pores call stomates. Symptoms of ozone injury on foliar tissue have been observed on the leaves of sensitive species throughout the Southeast. Species and even individual plants within a species vary widely in their ozone sensitivity and extent of foliar injury reported in natural stands is less than that reported from controlled studies. No published reports or data document the amount of growth loss (damage) caused by exposure of trees to ambient ozone in the Southern Appalachians. However, the National Park Service has documented foliar injury to several sensitive species in natural forest stands and in controlled chamber exposure studies. [90,95,96] While foliar injury does not necessarily indicate that plant growth has been reduced, it is an indicator of plant sensitivity. Ambient ozone levels in some parts of the Tennessee Valley have exceeded levels at which some species have documented biomass losses in controlled chamber studies.[94] Cumulative ozone exposure in the mountainous regions of the Valley are generally greater than in other areas because high-elevation ozone levels do not decline as quickly in the late afternoon and evening hours as generally occurs at lower elevations.

Predictions of ozone impacts on forests are still subject to considerable scientific uncertainty. The ozone dose (uptake) received by a plant is not always a function of the ambient concentration because interactions with moisture and fertility can limit stomatal function and ozone uptake. Consequently, damage from drought and ozone exposure are believed to be inversely related. Drought minimizes ozone effects because it causes stomates to close to conserve water and, thus, prevents ozone from entering the leaves. Ozone uptake and plant response to ozone exposures occurring in late afternoon and evening are not well understood. Also, the majority of information on tree response to ozone is based on controlled exposures of potted seedlings, and little work has been done on mature plants growing in natural conditions.

Title IV of the 1990 CAA Amendments requires a reduction in NO_x emissions from utility boilers by 2 million tons by 2010. Nevertheless, NO_x emissions in the Southern Appalachian region are projected to increase as vehicle miles traveled increase and as electrical power demand rises with an increasing population.

Each of the proposed Bellefonte conversion options emit regulatorily significant quantities of NO_x and will be subject to the application of new-source best-available-emission-control technology (BACT) requirements to minimize these emissions. BACT requirements are at least as stringent as new source performance standards. Notwithstanding these controls, emissions from any selected option will add to the total atmospheric loading of precursors of tropospheric ozone unless older, less-controlled sources are retired.

4.4.2.2 Cumulative Impacts of Proposed Action on Surface Water

Surface Water Availability

The water removed from the river for any of the five conversion options should have a negligible effect on the water availability downstream of the site. IGCC, which involves the largest water intake rate, requires only 0.21% of the average river flow or 0.64% of the 7-day, 10-year minimum flow of the river at this site.

Surface Water Quality

Cumulative impacts of the project on surface water quality were estimated by considering the existing water quality immediately upstream of the plant, which represents the impact of all industries upstream, and adding the predicted impact of the Bellefonte conversion options. Section 3.1.6.3 Surface Water Quality, provided the current surface water quality characteristics of Guntersville Lake near Bellefonte. Tables 4.4.2-5 and 4.4.2-6 contain lists of existing NPDES permits in the proximity of Bellefonte. In general, the industrial permits cover Jackson, Dekalb, and Marshall counties upstream of Guntersville Dam. A majority of the permits cover the discharge of cooling water and/or storm water.

Table 4.4.2-5 Existing Industrial NPDES Permits in the Proximity of Bellefonte

Permittee	Facility Location	Permit Number	Receiving Waters
AMOCO Oil Company	Guntersville, AL	AL0045381	Lake Guntersville
Applied Ind. Materials	Jackson County		
Cargill Inc.		ALG150102	Lake Guntersville
Cargill Inc.-Soybean Processing		ALG150103	Lake Guntersville
Hercules Rubber Company, Inc.	Guntersville, AL	AL0055310	Tennessee River
Mead Containerboard	Stevenson, AL	AL0022314	Tennessee River
Mead Hardwoods-Stevenson	Stevenson, AL	ALG060084	Unnamed Tributary to Crow Creek
Norandal USA, Inc.	Scottsboro, AL	AL0000451	Roseberry Creek and Tennessee River
Scottsboro Dev. Corp.	Jackson County		
Shaw Industries	Jackson County		
Stevenson Landfill	Jackson County		
TOPFLIGHT Rubber Company	Guntersville, AL	AL0000523	Pole Cat Branch
TVA Bellefonte NP	Hollywood, AL	AL0024635	Tennessee River and Town Creek
TVA, Fabius Mines		AL0042404	
TVA, Widows Creek	Stevenson, AL	AL0003875	Tennessee River and Widow's Creek

Source: Telephone conversation with ADEM, Permit Writer, Clay Wood, July 1997.

Table 4.4.2-6 Existing Municipal NPDES Permits Within the Proximity of Bellefonte

Permittee [a]	Facility Location	Permit Number	Receiving Waters
Albertville Eastside	Albertville, AL	AL0020192	Turkey Creek
Albertville Westside	Albertville, AL	AL0020184	Drum Creek-East Fork
Bridgeport Lagoon	Bridgeport, AL	AL0020991	Tennessee River
Grant	Grant, AL	AL0061905	Little Paint Creek
Guntersville	Guntersville, AL	AL0020150	Lake Guntersville
Henagar	Henagar, AL	AL0056057	South Sauty Creek
Hollywood Lagoon	Hollywood, AL	AL0062944	Tennessee River
Rainsville	Rainsville, AL	AL0042765	Piney Creek
Scottsboro Southside	Scottsboro, AL	AL0031372	Tennessee River
Scottsoro Goosepond	Scottsboro, AL	AL0054461	Tennessee River
Section	Section, AL	AL0053619	Unnamed Tributary to Tennessee River
Stevenson	Stevenson, AL	Al0021351	Crow Creek
Woodville	Woodville, AL	AL0060526	Yellow Branch

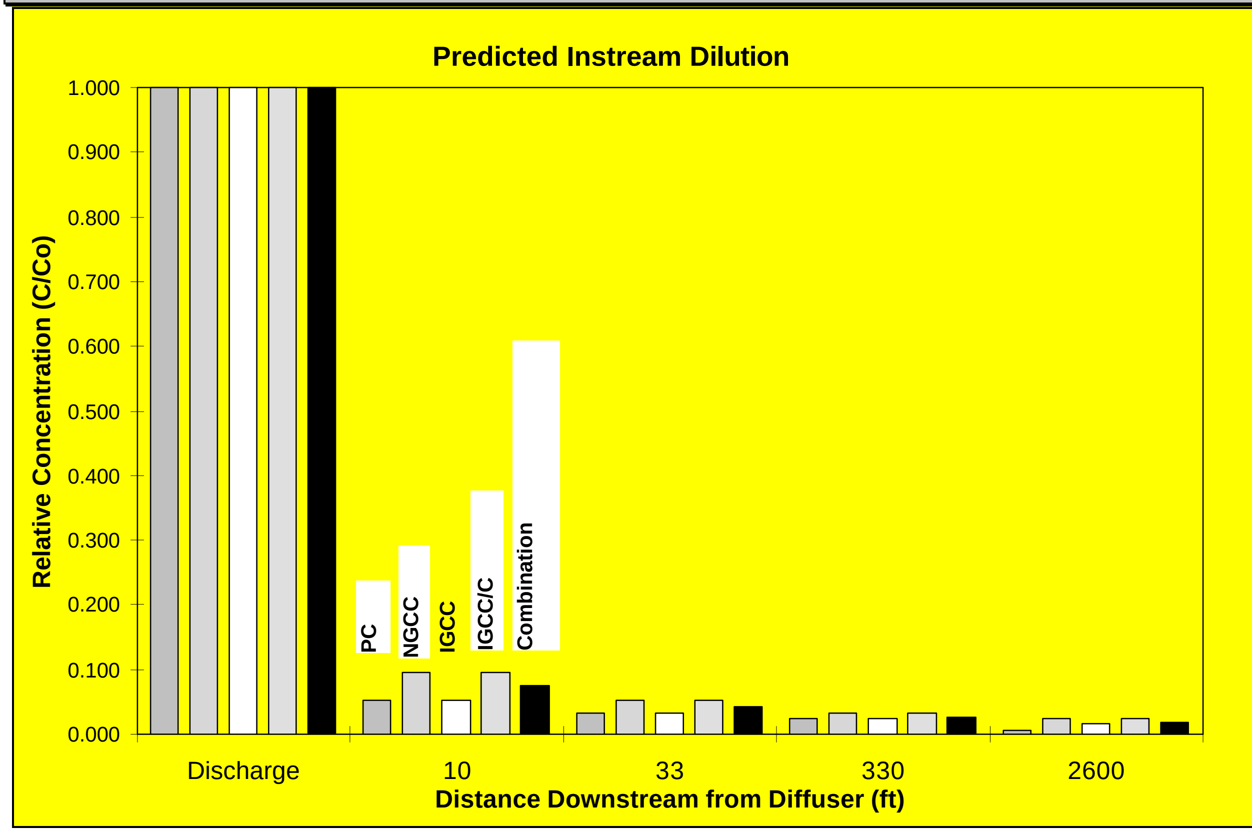
[a] - Waste Water Treatment Plants, except for the Bridgeport and Hollywood Lagoons.
Source: ADEM, Inventory or Municipal Wastewater Systems in Alabama, November 1995

Cumulative impacts were assessed by adding the concentrations of various water pollutants already in the receiving body (ambient background) to the concentrations of water pollutants contributed to the stream by each conversion option. The concentrations of pollutants added by a conversion option were determined with the Cornell Mixing Zone Expert System (CORMIX), used to evaluate local direct thermal impacts in Section 4.2.6.[28] The subsystem used, CORMIX2, predicts the dilution of effluent from a submerged multi-port diffuser. The model neglects the details of the individual jets discharging from the diffuser ports, and assumes the flow emerges from a long slot discharge with equivalent characteristics. Based on cross-sectional data from TRM 391.06, the river channel is assumed to be rectangular, 23 feet deep and 175 feet wide, with uniform ambient velocity and steady-state conditions.[29] The following conservative assumptions were made to simplify modeling:

- Constituents undergo no decay or growth processes; biological oxygen demand, chemical oxygen demand, and pH were not modeled since their magnitudes are not a function of dilution only.
- Manning's n, a measure of the channel roughness, was assumed to be 0.025,
- The river was assumed to be at low flow. (The 3-day low flow over a 20 year period of 9,560 cfs was used).
- The buoyancy characteristics of a summer plume were considered by setting the river and discharge temperatures equal to the maximum predicted summer values (see Table 4.2.6-6 and Section 4.2.6, Surface Water Temperature).

The CORMIX yields information about "relative concentrations" at different distances downstream of the discharge point. The "relative concentration" indicator ranges from a value of one at the discharge point to a value approaching zero at large dilutions, which represents background concentrations and provides a tool for determining concentrations of any pollutant downstream of the discharge point if the concentration is known at the discharge point. Figure 4.4.2-2 shows this information for each conversion option. Another way to view the vertical axis of Figure 4.4.2-2 is as a dilution rate (for example, a relative concentration of 0.5 is equal to 50% dilution). The ambient water quality characteristics were taken from the mean values measured at TRM 392.2. Appendix Table G-1: Average Water Quality Characteristics, and Section 3.1.6 contain additional information used to support modeling.

Figure 4.4.2-2 Predicted Instream Dilution



Predicted concentrations are compared, where possible, with concentrations considered safe by EPA for the nation's finished drinking water. Drinking water standards are either primary (health related) or secondary (aesthetics related) and are intended to protect the consumers of public water supplies.

Drinking water standards provide conservative but realistic metrics for assessing the magnitude of the modeled predictions; however, wastewater effluent is NOT required to meet drinking water standards. In several instances, the background concentrations of a contaminant in the river are already above the maximum contaminant levels (MCLs) for drinking water. In such cases, no amount of downstream dilution will cause concentrations to recede to a level below the MCL.

Predicted concentrations could have been compared with effluent limits established under the New Source Performance Standards (40 CFR Part 423) for Steam Electric Power Generating point sources. Permit limits can be either technology based or water quality based and are outlined in the NPDES permit issued to an applicant. However, such limits are typically negotiated with the state water quality regulating agency and are not readily available for comingled streams (cooling tower blowdown and other in-plant treated streams) such as the diffuser outfall.

Also, the NSPS one-day maximum limits for each of the 126 priority pollutants for cooling tower blowdown are "no detectable amounts," which are dependent on a very detailed assessment process involving a wide variety of analytical methods. In a practical sense, the NSPS limits serve only as a "floor" to begin the process of negotiating appropriate effluent limits for various outfalls. Consequently, no practical "effluent limits" exist for comparison with predicted cumulative surface water pollutant concentrations.

Background upstream water quality is better than primary MCLs with the exception of mercury (discussed in Section 3.1.6.3). The background water quality is generally better than secondary MCLs with the exception of aluminum, iron, manganese, and thallium. Note that where no ambient background data were available for a compound, predicted downstream concentrations are presented and allowed to approach zero as dilution occurs.

<u>Option 1: PC</u>

The combined water effluent is predicted to be estimated as 5,000 gpm (Table 4.2.10-3). To accommodate barge traffic, the diffuser would be lowered by five feet. The measured upstream concentrations, estimated discharge concentrations and predicted downstream concentrations are shown in Table 4.4.2-7. Background water quality (mg/L) is the average of measurements taken at TRM 392.2.

Table 4.4.2-7a Surface Water Quality, PC

	Finished Drinking Water Standards (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
Aluminum,Total	0.2	S	**0.430**	**0.421**	**0.470**	**0.452**	**0.444**	**0.439**
Antimony,Total	0.006	P	0.0024	0.0008	0.0025	0.0025	0.0025	0.0024
Arsenic,Total	0.050	P	0.001	0.002	0.001	0.001	0.001	0.001
Barium,Total	1.000	P	0.022	0.015	0.023	0.023	0.023	0.022
Beryllium,Total	0.004	P	**0.001**	**0.100**	**0.011**	**0.006**	0.004	0.003
BOD 5 Day	-		1.2	0.3				
Boron,Total	-		0.15	0.74	0.22	0.18	0.17	0.16
Bromide, Total	-		0.1					
Cadmium, Total	0.001	P	**0.00014**	0.0000	**0.0002**	**0.0002**	**0.0002**	**0.0002**
Calcium,Total	-		20.8	21.5	22.8	21.9	21.5	21.3
Carbon, Total Organic	-		1.38	0.28	1.40	1.39	1.39	1.38
Chemical Oxygen Demand	-		5.5	1.25				
Chloride, Total	250	S	7.6	12.5	8.8	8.3	8.0	7.9
Chromium,Total	0.100	P	0.002	0.0049	0.002	0.002	0.002	0.002
Cobalt,Total	-		0.0012	0.00027	0.0012	0.0012	0.0012	0.0012
Copper,Total	1.3	P	0.011	0.001	0.012	0.011	0.011	0.011
Cyanide,Total	0.200	P	0.02	0.00	0.02	0.02	0.02	0.02
Fluoride,Total	4.0	P	0.2	0.0006	0.1501	0.1500	0.1500	0.1500
Iron,Total	0.300	S	**0.53**	0.14467	**0.54**	**0.54**	**0.53**	**0.53**
Lead,Total	0.015	P	0.0021	0.0002	0.0021	0.0021	0.0021	0.0021
Magnesium, Total	-		5.5					
Manganese,Total	0.050	S	**0.062**	0.0098	**0.063**	**0.062**	**0.062**	**0.062**
Mercury,Total	0.002	P	0.0002	0.000252	0.0002	0.0002	0.0002	0.0002
Molybdenum,Total	-		0.02	0.04367	0.02	0.02	0.02	0.02
NH_3+NH_4-N, Total	-		0.04	0.01	0.05	0.04	0.04	0.04
Nickel,Total	0.100	P	0.0017	0.00133	0.0018	0.0017	0.0017	0.0017
Nitrogen, Total Organic	-		0.145					
NO_2&NO_3-N, Total	10	P	0.33	0.33	0.36	0.35	0.34	0.34
Phosphorus,Total	-		0.06	0.013	0.06	0.06	0.06	0.06
Potassium,Total	-		1.46	0.67	1.53	1.50	1.49	1.48
Selenium,Total	0.050	P	0.001	0.00163	0.00	0.00	0.00	0.00
Silicon,Total	-		2.645	0.30	2.674	2.661	2.655	2.652
Silver,Total	0.100	S	0.010	0.00100	0.010	0.010	0.010	0.010
Sodium,Total	-		6.83	1.4	6.96	6.90	6.88	6.86
Solids, Total Dissolved	500	S	100					
Solids, Total Suspended	-		9.5	82.0	17.4	13.9	12.3	11.5
Sulfate,Total	250	P	15.4	55	20.6	18.3	17.2	16.7
Sulfide,Total	-		0.020	0.001	0.020	0.020	0.020	0.020
Thallium,Total	0.002	P	**0.093**	0.00180	**0.094**	**0.093**	**0.093**	**0.093**
Thiocynate	-							
Thiosulfate	-							

Table 4.4.2-7b Surface Water Quality, PC

	Finished Drinking Water Standards (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
Thorium	-							
Tin,Total	-		0.1750					
Titanium,Total	-		0.024					
Vanadium,Total	-		0.010	0.01667	0.012	0.011	0.011	0.010
Zinc,Total	5.000	S	0.11	0.00133	0.11	0.11	0.11	0.11

- no data

The predicted effluent concentration are lower than all MCL's except for beryllium. At 330 feet downstream of the diffuser, beryllium concentrations are predicted to fall below its MCL, based on the numerical modeling results.

Option 2: NGCC

No changes in the diffuser would be needed. The comingled effluent is estimated to be 4,800 gpm. The discharge water quality is predicted to be below primary and secondary MCL's. The measured upstream concentrations, estimated discharge concentrations and predicted downstream concentrations are shown in Table 4.4.2-8.

Table 4.4.2-8 Surface Water Quality, NGCC								
	Finished Drinking Water Standards (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
5-pentanone, Total	-			0.105	0.010	0.006	0.003	0.002
Aluminum,Total	0.2	S	0.430					
Antimony,Total	0.006	P	0.0024					
Arsenic,Total	0.050	P	0.001					
Barium,Total	2.000	P	0.022					
Benzotriazole	-			0.119	0.011	0.006	0.004	0.003
Beryllium,Total	0.004	P	0.001					
Boron,Total	-		0.15					
Cadmium, Total	0.001	P	0.0002					
Calcium,Total	-		20.8					
Carbon, Total Organic	-		1.4					
Chloride, Total	250	S	7.6					
Chromium,Total	0.100	P	0.002					
Docosane	-			0.039	0.004	0.002	0.001	0.001
Ethyl Alcohol	-			0.0830	0.0079	0.0044	0.0028	0.0019
Isopropanol	-			0.010	0.001	0.001	0.000	0.000
Phosphorus,Total	-		0.06	0.033	0.06	0.06	0.06	0.06
Sodium,Total	-		6.83	0.0440	6.831	6.830	6.829	6.828
Toluene, Total	-		0.010	0.115	0.021	0.016	0.014	0.013
Triazole	-			0.201	0.019	0.011	0.007	0.005
Zinc,Total	5.000	S	0.11	0.023	0.11	0.11	0.11	0.11

The dilution for NGCC shown in Figure 4.4.2-2 is not as great as for some of the other options, but the impact on the river is smaller, due to the low concentrations of constituents in the effluent.

Option 3: IGCC

The comingled water effluent is predicted to be 15,300 gpm. To accommodate barge traffic, the diffuser would be lowered by five feet. The measured upstream concentrations, estimated discharge concentrations and predicted downstream concentrations are shown in Table 4.4.2-9.

Table 4.4.2-9a Surface Water Quality, IGCC

	Finished Drinking Water Standards (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
5-pentanone,Total	-		-	0.105	0.010	0.006	0.003	0.002
Aluminum,Total	**0.2**	S	**0.430**	0.260	**0.454**	**0.443**	**0.438**	**0.436**
Antimony,Total	0.006	P	0.0024	0.0059	0.0030	0.0027	0.0026	0.0026
Arsenic,Total	0.050	P	0.001	0.042	0.005	0.003	0.002	0.002
Barium,Total	1.000	P	0.022	0.140	0.035	0.029	0.027	0.025
Benzotriazole	-		-	0.119	0.011	0.006	0.004	0.003
Beryllium,Total	0.004	P	0.001	0.004	0.001	0.001	0.001	0.001
BOD 5 Day	-		1.2	1.2	-	-	-	-
Boron,Total	-		0.1	126.0	12.1	6.8	4.3	3.1
Bromide, Total	-		0.1	0.647	0.2	0.1	0.1	0.1
Cadmium, Total	0.001	P	0.0002	0.0006	0.0002	0.0002	0.0002	0.0002
Calcium,Total	-		20.8	45.5	25.1	23.2	22.3	21.8
Carbon, Total Organic	-		1.4	3.0	1.7	1.5	1.5	1.4
Chloride, Total	250	S	7.6	55.6	12.9	10.5	9.4	8.9
Chromium,Total	0.100	P	0.0015	0.0030	0.0018	0.0017	0.0016	0.0016
Cobalt,Total	-		0.0012	0.018	0.0029	0.0021	0.0018	0.0016
Copper,Total	1.3	P	0.01	0.012	0.01	0.01	0.01	0.01
Cyanide,Total	**0.200**	P	0.02	**3.0**	**0.30**	0.18	0.12	0.09
Docosane	-		-	0.039	0.004	0.002	0.001	0.001
Ethyl Alcohol	-		-	0.0083	0.0008	0.0004	0.0003	0.0002
Fluoride,Total	**4.0**	P	0.2	**13.6**	1.4	0.9	0.6	0.5
Formate	-		-	0.060	0.01	0.00	0.00	0.00
Iron,Total	**0.300**	S	**0.53**	0.089	**0.54**	**0.53**	**0.53**	**0.53**
Isopropanol	-		-	0.010	0.001	0.001	0.000	0.000
Lead,Total	0.015	P	0.0021	0.0006	0.0022	0.0022	0.0021	0.0021
Magnesium, Total	-		5.5	4.5	5.9	5.7	5.6	5.6
Manganese,Total	**0.050**	S	**0.062**	0.0006	**0.062**	**0.062**	**0.062**	**0.062**
Mercury,Total	**0.002**	P	**0.2**	0.0012	**0.2**	**0.2**	**0.2**	**0.2**
Molybdenum,Total	-		0.020	0.0071	0.021	0.020	0.020	0.020
NH_3+NH_4-N, Total	-		0.044	0.12	0.056	0.051	0.048	0.047
Nickel,Total	0.100	P	0.0017	0.0030	0.0019	0.0018	0.0018	0.0017
Nitrogen, Total Organic	-		0.1	0.1	0.2	0.2	0.1	0.1
NO_2&NO_3-N, Total	**10**	P	0.33	**76.8800**	7.66	4.40	2.89	2.13
Oil-Grease Freon-Gr	-		13.0	0.0059	13.0	13.0	13.0	13.0
Phenols,Total	-		0.001	0.0001	0.001	0.001	0.001	0.001
Phosphorus,Total	-		0.06	0.883	0.14	0.11	0.09	0.08
Potassium,Total	-		1.46	5.91	2.03	1.78	1.66	1.60
Selenium,Total	**0.050**	P	0.001	**1.000**	0.10	0.05	0.03	0.02
Silicon,Total	-		2.645	14.1900	3.997	3.396	3.118	2.977
Silver,Total	0.100	S	0.010	0.0006	0.010	0.010	0.010	0.010
Sodium,Total	-		6.83	88.1540	15.23	11.49	9.76	8.89
Solids, Total Dissolved	**500**	S	100	**1108**	206	159	137	126
Solids, Total Suspended	-		9.5	0.0	9.5	9.5	9.5	9.5
Sulfate,Total	250	P	15.4	87.0	23.7	20.0	18.3	17.4
Sulfide,Total	-		0.02	0.6	0.08	0.05	0.04	0.03
Sulfite	-		-	1.2	0.1	0.1	0.0	0.0

Table 4.4.2-9b Surface Water Quality, IGCC

	Finished Drinking Water Standards (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
Surfactants	-		-	0.1	0.0	0.0	0.0	0.0
Thallium,Total	**0.002**	P	**0.0933**	0.0006	**0.0934**	**0.0934**	**0.0934**	**0.0933**
Thiocyanate	-		-	0.1	0.0	0.0	0.0	0.0
Thiosulfate	-		-	0.6	0.1	0.0	0.0	0.0
Thorium	-		-	0.0006	0.00006	0.00003	0.00002	0.00001
Tin,Total	-		0.1750	0.0006	0.1751	0.1750	0.1750	0.1750
Titanium,Total	-		0.024	0.083	0.032	0.029	0.027	0.026
Toluene, Total	-		0.010	0.115	0.021	0.016	0.014	0.013
Triazole	-		-	0.201	0.019	0.011	0.007	0.005
Uranium	-		-	0.0006	0.0001	0.0000	0.0000	0.0000
Vanadium,Total	-		0.01	0.076	0.02	0.01	0.01	0.01
Zinc,Total	5.000	S	0.11	0.039	0.11	0.11	0.11	0.11

- no data

In most cases, the effluent concentrations are better than the drinking water standards, with the exception of cyanide, fluoride, NO_2+NO_3, potassium, and selenium. Modeling results indicate that 10 feet downstream of the diffuser, beryllium and TDS would return to ambient levels and NO_2+NO_3 would be below the MCL. By 33 feet cyanide and fluoride would be below the MCL's. By 330 feet downstream of the diffuser, selenium concentration is predicted to be below the MCL.

Option 4: IGCC/C

The combined water effluent is estimated as 7,300 gpm. To accommodate barge traffic, the diffuser would be lowered by five feet. The measured upstream concentrations, estimated discharge concentrations and predicted downstream concentrations are shown in Table 4.4.2-10.

Table 4.4.2-10a Surface Water Quality, IGCC/C

	Finished Drinking Water Standards (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
5-pentanone, Total	-		-	0.105	0.010	0.006	0.003	0.002
Aluminum,Total	**0.2**	S	**0.430**	**0.272**	**0.455**	**0.444**	**0.439**	**0.436**
Antimony,Total	0.006	P	0.0024	0.0062	0.0030	0.0028	0.0026	0.0026
Arsenic,Total	0.050	P	0.001	0.044	0.005	0.003	0.002	0.002
Barium,Total	1.000	P	0.022	0.174	0.039	0.031	0.028	0.026
Benzotriazole	-		-	0.119	0.011	0.006	0.004	0.003
Beryllium,Total	0.004	P	0.001	0.043	0.005	0.003	0.002	0.002
Boron,Total	-		0.15	131.7	12.7	7.1	4.5	3.2
Bromide, Total	-		0.1	0.662	0.2	0.1	0.1	0.1
Cadmium, Total	0.001	P	0.0002	0.0006	0.0002	0.0002	0.0002	0.0002
Calcium,Total	-		20.8	47.6	25.3	23.3	22.4	21.9
Carbon, Total Organic	-		1.38	3.1	1.7	1.5	1.5	1.4
Chemical Oxygen Demand	-		5.5	3.1				
Chloride, Total	250	S	7.6	58.1	13.1	10.7	9.5	9.0
Chromium,Total	0.100	P	0.002	0.0031	0.0018	0.0017	0.0016	0.0016
Cobalt,Total	-		0.0012	0.019	0.0030	0.0022	0.0018	0.0016
Copper,Total	1.3	P	0.01	0.012	0.01	0.01	0.01	0.01
Cyanide,Total	**0.200**	P	0.02	**3.1**	0.32	0.18	0.12	0.09
Docosane	-		-	0.039	0.004	0.002	0.001	0.001
Ethyl Alcohol	-		-	0.0083	0.0008	0.0004	0.0003	0.0002
Fluoride,Total	**4.0**	P	0.2	**14.2**	1.5	0.9	0.6	0.5
Formate	-		-	-	-	-	-	-
Iron,Total	**0.300**	S	**0.53**	0.093	**0.54**	**0.53**	**0.53**	**0.53**
Isopropanol	-		-	0.010	0.001	0.001	0.000	0.000
Lead,Total	0.015	P	0.0021	0.0006	0.0022	0.0022	0.0021	0.0021
Magnesium, Total	-		5.5	6.8	6.1	5.8	5.7	5.6
Manganese,Total	**0.050**	S	**0.062**	0.0006	**0.062**	**0.062**	**0.062**	**0.062**
Mercury,Total	0.002	P	0.002	0.0012	0.002	0.002	0.002	0.002
Molybdenum,Total	-		0.020	0.0074	0.021	0.020	0.020	0.020
NH_3+NH_4-N, Total	-		0.041	0.01	0.045	0.045	0.045	0.044
Nickel,Total	0.100	P	0.0017	0.0031	0.0020	0.0018	0.0018	0.0017
Nitrogen, Total Organic	-		0.145	0.1	0.2	0.2	0.1	0.1
NO_2&NO_3-N, Total	10	P	0.33	0.0804	0.34	0.33	0.33	0.33
Oil-Grease Freon-Gr	-		13.0	0.0062	13.0	13.0	13.0	13.0
Phenols,Total	-		0.001	0.001	0.001	0.001	0.001	0.001
Phosphorus,Total	-		0.06	0.923	0.15	0.11	0.09	0.08
Potassium,Total	-		1.46	0.0062	1.46	1.46	1.46	1.46
Selenium,Total	**0.050**	P	0.001	**1.050**	**0.10**	**0.06**	0.04	0.03
Silicon,Total	-		2.645	0.0148	2.646	2.646	2.645	2.645
Silver,Total	0.100	S	0.010	0.0006	0.010	0.010	0.010	0.010
Sodium,Total	-		6.83	0.1362	6.84	6.83	6.83	6.83

Table 4.4.2-10b Surface Water Quality, IGCC/C								
	Finished Drinking Water Standards (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
Thallium,Total	**0.002**	P	**0.0933**	0.0004	**0.0934**	**0.0934**	**0.0933**	**0.0933**
Thiocynate	-		-	0.04	0.00	0.00	0.00	0.00
Thiosulfate	-		-	0.4	0.0	0.0	0.0	0.0
Thorium	-		-	0.0004	0.0000	0.0000	0.0000	0.0000
Tin,Total	-		0.1750	0.0004	0.1750	0.1750	0.1750	0.1750
Titanium,Total	-		0.024	0.060	0.029	0.027	0.026	0.025
Toluene, Total	1		0.010	0.115	0.019	0.015	0.013	0.012
Triazole	-		-	0.201	0.015	0.008	0.005	0.004
Uranium	-		-	0.0004	0.0000	0.0000	0.0000	0.0000
Vanadium,Total	-		0.01	0.055	0.01	0.01	0.01	0.01
Zinc,Total	5.000	S	0.11	0.0346	0.11	0.11	0.11	0.11

- no data

The estimated effluent concentrations generally are lower than MCL's, except for beryllium, cyanide, and selenium. Numerical modeling results indicate beryllium and cyanide will be below drinking water standards within 33 feet. By 330 feet downstream of the diffuser, selenium concentrations are predicted to return to ambient.

Option 5: Combination

The comingled water effluent is estimated to be 10,500 gpm. To accommodate barge traffic, the diffuser would be lowered by five feet. The measured upstream concentrations, estimated discharge concentrations and predicted downstream concentrations are shown in Table 4.4.2-11.

Table 4.4.2-11a Surface Water Quality, Combination								
	Maximum Levels of Drinking Water (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
					10	33	330	2600
5-pentanone,Total	-		-	0.105	0.008	0.004	0.003	0.002
Aluminum,Total	**0.2**	S	**0.430**	0.190	**0.444**	**0.437**	**0.435**	**0.433**
Antimony,Total	0.006	P	0.0024	0.0043	0.0028	0.0026	0.0025	0.0025
Arsenic,Total	0.050	P	0.001	0.031	0.003	0.002	0.002	0.002
Barium,Total	2.0	P	0.022	0.102	0.030	0.026	0.025	0.024
Benzotriazole	-		-	0.119	0.009	0.005	0.003	0.002
Beryllium,Total	0.004	P	0.001	0.003	0.001	0.001	0.001	0.001
Boron,Total	-		0.15	91.9	7.1	4.0	2.6	1.8
Bromide, Total	-		0.1	0.556	0.1	0.1	0.1	0.1

Table 4.4.2-11b Surface Water Quality, Combination

	Maximum Levels of Drinking Water (mg/L)	Primary or Secondary Standard	Background Water Quality (mg/L)	Estimated Discharge Conc. (mg/L)	Predicted Concentration (mg/L) Distance Downstream (ft)			
Cadmium, Total	0.001	P	0.0002	0.0004	0.0002	0.0002	0.0002	0.0002
Calcium,Total	-		20.8	33.2	23.3	22.2	21.7	21.4
Carbon, Total Organic	-		1.38	2.2	1.5	1.5	1.4	1.4
Chloride, Total	250	S	7.6	40.6	10.7	9.3	8.7	8.3
Chromium,Total	0.1	P	0.0012	0.0022	0.0017	0.0016	0.0016	0.0015
Cobalt,Total	-		0.0012	0.013	0.0022	0.0017	0.0015	0.0014
Copper,Total	1.3	P	0.011	0.008	0.01	0.01	0.01	0.01
Cyanide,Total	0.2	P	0.02	2.2	0.18	0.11	0.08	0.06
Docosane	-		-	0.039	0.003	0.002	0.001	0.001
Ethyl Alcohol	-		-	0.0083	0.0006	0.0003	0.0002	0.0001
Fluoride,Total	**4.0**	P	0.2	**9.9**	0.9	0.6	0.4	0.3
Iron,Total	**0.300**	S	**0.53**	0.065	**0.53**	**0.53**	**0.53**	**0.53**
Lead,Total	0.015	P	0.0021	0.0004	0.0022	0.0021	0.0021	0.0021
Magnesium, Total	-		5.5	4.8	5.8	5.7	5.6	5.6
Manganese,Total	**0.050**	S	**0.062**	0.0004	**0.062**	**0.062**	**0.062**	**0.062**
Mercury,Total	0.002	P	0.002	0.0009	0.002	0.002	0.002	0.002
Molybdenum,Total	-		0.020	0.0052	0.020	0.020	0.020	0.020
NH_3+NH_4-N, Total	-		0.044	0.1	0.051	0.048	0.047	0.046
Nickel,Total	0.1	P	0.0017	0.0022	0.0018	0.0018	0.0017	0.0017
Nitrogen, Total Organic	-		0.145	0.1	0.2	0.1	0.1	0.1
NO_2&NO_3-N, Total	10	P	0.33	56.1	4.58	2.66	1.83	1.33
Oil-Grease Freon-Gr	-		13.0	0.0043	13.0	13.0	13.0	13.0
Phenols,Total	-		0.001	0.00004	0.164	0.091	0.059	0.040
Phosphorus,Total	-		0.06	0.65	0.11	0.09	0.08	0.07
Potassium,Total	-		1.46	4.3	1.8	1.6	1.6	1.5
Selenium,Total	0.05	P	0.001	0.735	0.057	0.032	0.021	0.014
Silicon,Total	-		2.45	10.4	3.4	3.1	2.9	2.8
Silver,Total	0.100	S	0.0100	0.0004	0.0100	0.0100	0.0100	0.0100
Sodium,Total	-		6.83	64.3	11.70	9.50	8.55	7.98
Solids, Total Suspended	-		9.5	4.3	9.9	9.7	9.7	9.6
Sulfate,Total	500	P	15.4	63.5	20.2	18.0	17.1	16.5
Sulfide,Total	-		0.02	0.4	0.05	0.04	0.03	0.03
Sulfite	-		-	0.9	0.1	0.0	0.0	0.0
Surfactants	-		-	0.04	0.00	0.00	0.00	0.00
Thallium,Total	**0.002**	P	**0.0933**	0.0004	**0.0934**	**0.0934**	**0.0933**	**0.0933**
Thiocynate	-		-	0.04	0.00	0.00	0.00	0.00
Thiosulfate	-		-	0.4	0.0	0.0	0.0	0.0
Thorium	-		-	0.0004	0.0000	0.0000	0.0000	0.0000
Tin,Total	-		0.1750	0.0004	0.1750	0.1750	0.1750	0.1750
Titanium,Total	-		0.024	0.060	0.029	0.027	0.026	0.025
Toluene, Total	1		0.010	0.115	0.019	0.015	0.013	0.012
Triazole	-		-	0.201	0.015	0.008	0.005	0.004
Uranium	-		-	0.0004	0.0000	0.0000	0.0000	0.0000
Vanadium,Total	-		0.01	0.055	0.01	0.01	0.01	0.01
Zinc,Total	5.000	S	0.11	0.0346	0.11	0.11	0.11	0.11

- no data

In most cases, the effluent concentrations are lower than MCLs for drinking water, with the exception of selenium. Results indicate that at 33 feet downstream of the diffuser, instream concentrations of selenium will fall below MCL's.

In summary, surface water cumulative impacts were assessed by considering background water quality near the plant, which reflects contributions of all discharges upstream, and adding the predicted impact of the Bellefonte conversion options. The additional impacts of Bellefonte conversion options are generally small, due to the low volume of the effluent compared with river flow, even under historically low river flow conditions, which have been assumed for this analysis. Selenium concentrations are higher than selenium MCLs for finished drinking water in the IGCC, IGCC/C, and Combination discharges; however, instream concentrations are predicted drop below this level within 33 feet downstream of the diffuser for the IGCC, and Combination Options, and within 330 feet for the IGCC/C Option. The NGCC Option would have the smallest impact, because the effluent water quality is higher than for other options. IGCC/C would have the greatest impact, because of its lowest effluent water quality and greatest volume discharge.

4.4.2.3 Cumulative Impacts on Global Warming

Manmade emissions of greenhouse gases, principally CO_2, N_2O, and methane (CH_4), tend to increase global temperatures by absorbing long-wave radiation. This impact has been offset, in part, by the production of secondary fine particulate aerosols (from SO_2 and NO_x) which have tended to decrease global temperatures by increasing the albedo (reflectivity) of the earth's atmosphere. The limited understanding of global climate change suggests that, in order to protect human health and welfare and the environment, the emission of greenhouse gases should be stabilized "...at a level that would prevent dangerous anthropogenic interference with the climate system." [97]

Although the estimated N_2O and CH_4 emissions for any Bellefonte conversion option are minimal, CO_2 emissions are significant for all conversion options and variants. Table 4.4.2-12 displays estimated CO_2 emissions for each and compares those emissions to estimated U. S. and global fossil fuel combustion CO_2 emissions. Although the CO_2 emissions estimates of these options and variants are relatively small in comparison to either U.S. or global estimates, they are significant in comparison to current total TVA

CO_2 emissions of about 110 million tons per year. In terms of total emissions, the small IGCC/C Option is the most desirable option and PFBC variant is the least desirable. In terms of CO_2 emissions per megawatt of production, the most desirable options are the Combination and NGCC and the least desirable is the PFBC variant.

Table 4.4.2-12 Estimated Annual CO_2 Emissions

Conversion Option or Variant	Estimated CO_2 Emissions (Million Tons per Year)	Emission per MW Capacity (Tons per MW)	% of US Fossil Combustion CO_2 Emissions [a]	% of Global Fossil Combustion CO_2 Emissions [b]
PC	25.97	11,920	0.53	0.11
PFBC	34.01	15,630	0.69	0.15
NGCC	9.68	3,905	0.18	0.04
NGCC Bypass	9.68	5,905	0.18	0.04
NGCC Oil	10.68	4,308	0.20	0.04
NGCC Oil Bypass	10.68	6,515	0.20	0.04
IGCC	21.98	8,081	0.40	0.09
IGCC Bypass	21.98	12,245	0.40	0.09
IGCC/C	2.81	6,244	0.05	0.01
Combination	9.27	3,614	0.17	0.04
Combination Oil	10.27	4,002	0.19	0.04

[a] - U.S. estimate of fossil fuel CO_2 emissions is 5,446 million tons per year
[b] - Global estimate of fossil fuel CO_2 emissions is 25,038 million tons per year

4.5 Identification of Mitigation Measures

In accordance with NEPA regulations measures that could minimize or mitigate expected environmental impacts should be discussed in the EIS. Mitigation includes avoiding, minimizing, rectifying, reducing, or compensating for the impacts. Numerous potential mitigation measures were identified in the discussions of environmental impacts in Section 4.2 and in the description of project operations in Sections 2.2 and 2.3. These measures are generally of two types:

- Components incorporated during project design and construction that would be part of operational activities of the plant and
- Programs and environmental controls initiated to meet regulatory standards.

Actions that could taken during construction and operation of Bellefonte to mitigate environmental impacts are presented in Table 4.5-1 for each conversion option.

Table 4.5-1a Potential Mitigation Measures

	PC	NGCC	IGCC	IGCC/C	Combination
AIR					
Install Low NO_x Burners	X				
Install High Efficiency Particulate Removal from Flue Gas	X				
Install Sulfur Dioxide Removal for Flue Gas	X				
Use Of Dust Suppression For Coal Conveyor System	X		X	X	X
WATER					
Use Of Cooling Towers To Reduce Temperature Of Blowdown	X	X	X	X	X
Use Of Lined Recycle Basin To Prevent Surface Water Runoff Pollution	X		X	X	X
Use Of Impermeable Or Synthetic Liners For:					
Coal Storage Area	X		X	X	X
Gypsum Storage Area	X				
Sodding of Completed Waste Disposal Areas at Closure	X		X	X	X
GEOLOGIC					
Use of Bedrock Treatment of Subsidence Incidents During Construction(if needed)	X	X	X	X	X
Design Facilities for Seismic and Liquefaction Protection	X	X	X	X	X
SOLID WASTE					
Construct Disposal/Storage Areas with Low Permeability Liners	X		X	X	X
Groundwater Monitoring (if required by ADEM)	X		X	X	X

Table 4.5-1b Potential Mitigation Measures

	PC	NGCC	IGCC	IGCC/C	Combination
HAZARDOUS WASTE					
Adopt Waste Minimization Program	X	X	X	X	X
AQUATIC ECOLOGY					
Dredging During Off Season	X		X	X	X
Employ BATs and BMPs During Dredging	X	X	X	X	X
WETLANDS					
Offset Wetlands	X		X	X	X
TRANSPORTATION					
Upgrade Railroad Crossings	X		X	X	X
NOISE					
Schedule Flexible Activities During Daytime Where Possible	X		X	X	X
Advance Public Notice of Steam Cleaning	X	X	X	X	X
SAFETY AND HEALTH					
Adhere to 49 CFR 192 - Safety Standards	X	X	X	X	X
Implement Safety Program	X	X	X	X	X
Design Chemical Containment and Transport to Limit Impacts to Plant Site and Off site Areas				X	X
Design Redundant Systems to Shorten Exposure When Off site Impacts Occur				X	X
NATURAL GAS PIPELINE					
Directional Drilling or Other Appropriate Measures to Allow Passage Below Streambeds, Wetlands, Railroads, and Roads		X			X
Restore Disturbed Areas To Original Contour And Revegetate With Grasses For Rapid Stabilization And Use Erosion Control Measures Until Revegetated		X			X
Segregate and Replace Top Soils to Restore Dry Wetlands and Farmland.		X			X
Use Good Alignment Planning to Reduce Impacts on Structures, Croplands, Cemeteries, and Sensitive Scenic Routes		X			X

4.5.1 Air Quality

Fugitive emissions can be minimized during construction and operation for all options. A dust suppressant is typically used for construction traffic where necessary.

Typical mitigation measures that could apply during operation include:

- Design conveyor systems with appropriate dust controls for changes in elevation of the conveyor belt (PC, IGCC, IGCC/C, and Combination).
- Reduce sulfur in the gas during startup to prevent significant air impact (IGCC, IGCC/C, and Combination). Additional equipment and/or modified startup procedures should allow some modern gasification technologies to achieve acceptable sulfur emissions during startup.
    - ⇒ Lower sulfur startup feedstock.
    - ⇒ Startup at higher rates and pressures to reduce the time to ramp up to design feed rate and pressure.
    - ⇒ Employ faster pressure ramp-up techniques to allow the acid gas removal absorber to come on line more quickly.
    - ⇒ Design and employ sulfur absorbers specifically for startup.
    - ⇒ Additional pumps, piping, and instrumentation to allow the acid gas removal absorber to operate at lower-than-normal design pressures.

Specific measures for mitigation of environmental impacts from flaring would be selected during the detailed design of the implemented option, if flaring applies. Some modern gasification technologies currently avoid the impacts caused by flaring during startup by routing the synthesis gas through the acid gas removal unit. Flares are excluded from the definition of stack and therefore exempt from the GEP requirements.

4.5.2 Geologic Stability

Subsidence incidents in the Chickamauga Formation are rare and can be mitigated by appropriate planning and design based upon a sound geotechnical investigation and proper construction practices. During construction of Bellefonte Nuclear Plant, bedrock foundation treatment consisted of: over-excavation of weathered joints/seams and filling with concrete/grout mixtures; and coring accompanied by pressure grouting to fill deeper fractures, joints, and cavities (Section 4.2.2). Construction of the proposed facility may require similar foundation treatment in weathered bedrock. Final design for all components would include the appropriate seismic design. Where the potential for liquefaction exists, design methods are normally included to minimize the risks of impacts.

4.5.3 Solid Nonhazardous Waste

The use of low permeability materials below waste disposal areas, adequate separation from the groundwater table below, and adherence to design requirements specified by the state serve to minimize further possible adverse impacts from the inert wastes in construction/demolition landfills. Groundwater monitoring further ensures the containment of landfill materials. In addition, surface water runoff from the fly ash and ash storage areas could be collected in a lined recycle basin to reduce potential water pollutants. Lining the gypsum storage area for the PC option with a two ft clay liner (reaching a permeability of 10^{-7} cm/sec) or a synthetic liner underlain with a clay layer of about one ft can help minimize impacts from the storage of gypsum.

4.5.4 Hazardous Wastes

TVA would adopt a hazardous waste minimization policy for the proposed facility, among other things, substituting nonhazardous for hazardous materials wherever feasible. All hazardous wastes would be disposed at landfills specifically permitted to accept such materials.

4.5.5 Surface Water

Mitigation measures would likely be imposed in permits obtained for all options. New construction activities that disturb five acres or more would require an NPDES permit for storm water discharges from the site to ensure the implementation of BMPs (Appendix L) and to minimize impacts to surface waters during construction. TVA would submit a revised Pollution Prevention Plan to the state outlining measures to control the water quality effects from storm water discharges during construction. Both structural and nonstructural (vegetative) measures would be designed, implemented, and properly maintained in accordance with the BMPs. The use of additional vegetative controls including seeding of berms and swales could further reduce erosion and sedimentation. Other erosion control practices could include, as necessary, the construction of temporary perimeter berms, rip-rap in potentially high-velocity areas, straw bales or other barriers, silt fences, diversionary berms or swales, and graveled road and railroad beds.

Operation of the facility would require revised SPCC, Facility Response, BMP, and SWPP plans for all options. Current plans exist and would be revised to reflect changes resulting from the option chosen. The purpose of these plans is to define a program, which when implemented, would prevent or minimize the potential for the release of pollutants to the waters of the U.S. through runoff from ancillary activities. These activities include material storage areas, site runoff, transfer processes and material handling areas, loading and unloading operations, and sludge waste disposal areas, spillage or leaks, or drainage from raw materials storage areas. These plans would be prepared in accordance with the regulations of the EPA and ADEM, which were developed as part of the NPDES.

The design of the coal storage and gypsum storage areas with liners help prevent leachate and runoff from entering the surficial aquifer. Properly designed leachate and storm water collection system would route collected water to the lined recycle basin, which would be capable of containing coal pile runoff in excess of the 25-year, 24-hour design storm event. The storage area for limestone, fly ash, and bottom ash would not be lined, but the runoff from these areas could be collected and piped to a recycle basin. The recycle basin, located in an area west of the existing intake pumping station, could accept storm water runoff flow from the ash, gypsum, coal, and limestone storage areas, in addition to cooling tower blowdown and miscellaneous other drains. Generally, a recycle basin of this type would be lined and the water reused.

4.5.6 Aquatic Ecology

Diffuser relocation and the barge terminal construction would require instream dredging and construction and is expected to result in near field impacts on the resident aquatic communities. PC, IGCC, IGCC/C, and Combination would require diffuser relocation and barge terminal construction. The impact of this relocation could be minimized by scheduling dredging and instream construction from late summer through winter to avoid the primary spawning season for fish. Futher, use of BMPs during the removal of sediment and BAT in design and operation of barge facilities can also help minimize impacts to aquatic communities.

4.5.7 Wetlands

Construction of barge handling facilities would be required for all options except NGCC. If it is shown that there is no practicable alternative for locating the barge handling facilities along the river bank and removal of the barrier islands is necessary, then the USACE would require the development of a mitigation plan to accommodate the removal of those wetlands. The loss of wetland areas are required to be offset. [47-50] The determination of CWA jurisdiction is made by the USACE under the auspices of the EPA. This recommendation is usually made by the U.S. Fish and Wildlife Service in response to the public notice of the proposed action as part of the Section 404 permitting process. Other public agencies such as State Environmental Agency, the State Historical Preservation Officer, as well various associations and the general public frequently make recommendations to the 404 permit.

Mitigation plans generally include restoration of prior converted croplands to functional wetlands, or less preferably the enhancement of existing wetlands. Prior converted croplands is defined in Section 512.15 of the National Food Security Act Manual, August 1988, as wetlands which are both manipulated (drained or otherwise physically altered to remove excess water from the land) and cropped before December 23, 1985, to the extent that they no longer exhibit wetland values. The mitigation site should be located as close to the lost wetlands as possible. Plans could be developed in conjunction with the Alabama Department of Conservation and Natural Resources, the agency that operates five wildlife management areas and refuges in Jackson County. Potential projects include restoration of bottomland hardwoods and the development of waterfowl-wetlands wildlife impoundments.

4.5.8 Transportation

For all options except NGCC, the traffic impacts on the local road networks may require specific site mitigation measures to improve future service levels on Bellefonte Road and Jackson 33. More detailed studies of average daily traffic, service volumes, intersection or other potential bottleneck areas, and traffic patterns may need to be conducted to determine if certain mitigation measures should be adopted. Such measures include physical improvements to the local road or road network to increase capacity. Potential capacity improvements could include construction of additional vehicle lanes throughout road segments, construction of passing lanes in certain locations, or realignment to eliminate some of the no-passing zones. It should also be recognized that a large amount of truck traffic, such as required for by-product delivery, also contributes to an increase in the pavement maintenance required. Employee programs that provide flexible hours could reduce road travel during peak hour and restriction for trucks traveling during the peak hour could be made. Also, establishing employee programs and incentives for ride sharing could be encouraged and bus and/or vanpool programs could be initiated.

With an increase in train traffic, potential for accidents at any intersection also increases. The Bellefonte Spur Track crosses two county roads at-grade before entering the plant site. The existing crossings presently have only crossbuck warning signs. If train traffic were to occur on this track, signals would be needed. The county roads being crossed do not have much daily traffic, therefore significant congestion problems on these roads should not occur.

4.5.9 Noise Impacts

To limit noise during construction for all options, typical mitigation measures include:

- Efforts to minimize the extent of construction,
- Scheduling activities during daylight hours,
- Use of noise abatement and muffling devices designed for construction equipment, and
- Providing advance notice to the potentially affected public.

Noise impacts to sensitive areas from heavy duty truck traffic are typically minimized by avoiding the use of the local street system where possible. However, truck traffic entering or leaving the site would impact the homes along the access roads. These impacts could be minimized by scheduling truck traffic when possible to daylight hours on week days.

For options that utilize flares, IGCC, IGCC/C, and Combination, well designed silencers could be incorporated to help abate the noise level during flaring activities. In addition, a possible mitigation measure might be to schedule gasification startup and shutdown during the daylight hours, which would minimize the total number of events to nighttime hours as emergency events.

To the maximum extent feasible, the facility would be designed to incorporate engineering controls for all noise sources and equipment purchase specifications that require minimum noise levels. For those cases where low levels cannot be met, the following mitigative actions would be considered, as needed:

- Source reduction,
- Noise source or receptor insulation,
- Public announcement prior to known significant noise events,

- Dense evergreen vegetation,
- Barrier construction, and
- Realignments.

To meet the need to both maintain flexibility for the plant design and operation and to provide sufficient latitude for the construction contractor, and to make a commitment to avoid (or reduce to the extent practicable) adverse noise impacts, TVA will commit the following:

(1) Once plans for construction have been developed, TVA will conduct a noise assessment to determine mitigation measures for offsite noise impacts that exceed the 65 Ldn level. The 65 Ldn value was used in this EIS as the threshold of significance for impact evaluation. Operational measures which could be included are the restriction of certain construction activities to daytime hours, enclosure of one or more pieces of equipment, and installation of sound abating walls.

(2) The EIS determined that there will be significant short-term noise impacts associated with the clean out of steam lines just prior to operation of a particular steam unit. To reduce the startle effect and short-term impacts of these events, TVA will ensure that all residents located near the plant will be notified by mail and by telephone of the approximate time that the steam blasts will be made.

(3) To ensure that the commitments described above occur, TVA further commits to noise monitoring and TVA will conduct at least three separate ambient noise monitoring studies during construction and three separate studies during the first three years of plant operation. Each study will consist of at least three measurements of ambient noise at each of the four sites used for noise modeling in the EIS.

4.5.10 Safety and Health

If a natural gas pipeline is used there would be an increased risk to the public during operation of the facility both on and off TVA property. Any pipeline that would be constructed to provide natural gas to Bellefonte would be designed, constructed, operated, and maintained in accordance with DOT Minimum Federal Safety Standards at 49 CFR Part 192. These regulations are intended to ensure adequate protection for the public from natural gas pipeline failures.

Additional mitigation measures that could be applied to reduce risks to the public include the following:

- 100% radiography to check rather than 10% required under 49 CFR 192,

- Pressure test pipe segments at the mill and again prior to placing the line in service,
- Perform enhanced aerial surveillance and leak surveys,
- Meet with local emergency personnel (e.g., fire departments) to develop plans and procedures for emergencies, and
- Conduct information outreach programs for property owners and others along the pipeline to inform them of the location of the line and risk associated with construction in the ROWs.

Workers would be exposed to health and safety hazards while constructing and operating the facilities. During construction, OSHA Construction Industry standards would be used. [63] The operating facilities would be subject to OSHA General Industry standards. [64] These standards establish practices, chemical and physical exposure limits, and equipment specifications to preserve employees' health and safety. Standards and requirements also apply to TVA contractors and vendors. Contractor operations would be monitored to ensure operations are conducted in a safe and healthful manner and that they meet contract requirements.

For options including chemical coproduction (IGCC/C and Combination), the chemical storage would be designed to reduce the storage volumes of any one tank. Air dispersion modeling showed that the use of four tanks for ammonia storage would significantly minimize the area of impact in the case of an accidental release resulting from a complete loss of containment of a tank. Also, when ammonia is stored refrigerated at atmospheric pressure, the toxic endpoint distances are minimized. Secondary containment would be constructed for chemical storage tanks and would be adequately protected to minimize accidents from vehicles and/or equipment. Check valves on chemical piping help minimize the release of vapor due to pipe rupture. BMPs would be developed to minimize the risk of spills during transfers and handling and storage of all chemicals and minimize accidents to tanks from overhead equipment. TVA emergency response teams would be trained for emergencies at Bellefonte. A risk management plan would be required for all facilities with reportable quantities of hazardous substances onsite.

4.5.11 Natural Gas Pipeline

Potential mitigation measures for the three natural gas pipeline corridors evaluated in the DEIS include such measures as directional drilling to allow passage below streambeds, wetlands, railroads, and roads, restore disturbed area to original contour and revegetate with grasses for rapid stabilization and use erosion control measures until revegetated, segregating and replacing tops oils to restore seasonally dry wetlands and farmland and good alignment planning to reduce impacts on structures, croplands, cemeteries, and sensitive scenic routes.

4.6 Irreversible Adverse Impacts

Discharge of industrial waste water streams would occur, however these discharges would be permitted under NPDES.

Loss of individual mussel specimens directly in the path of active dredging for diffuser relocation and barge terminal construction would be unavoidable. However, a survey of the area to be impacted was conducted in August 1995 and findings indicated that this area does not support a valuable commercial mussel resource. The NGCC Option does not require dredging operations. Entrainment and impingement of aquatic organisms from the intake would occur and is therefore proportional to the amount of water needed for each option. These impacts would be minimal due to the abundance of similar habitat near the plant.

Approximately 20 acres of wetlands would be removed for each option for barge terminal facilities. NGCC does not have barge terminal facilities, but the gas pipeline would impact some acreage and is dependent on the final alignment. Wetlands would be mitigated as described in Section 4.5.

Loss/replacement of most vegetative communities would occur in the site area. These impacts would not be significant because of abundance of these communities in the geographic area. Construction and operation of the NGCC facilities would not impact any additional acreage, but the gas pipeline would impact some acreage and is dependent on the final alignment.

4.7 Relationship of Short-term Uses and Long-term Productivity

The construction of the facilities required to convert Bellefonte to a fossil fuel power plant will result in relatively small short term impacts to the environment relative to the long-term maintenance and enhancement of productivity. The short-term impacts are primarily those that occur during the period of construction as a result of construction activities.

Many of the short-term impacts related to construction such as those associated with land clearing, earth moving, building erection, road and rail construction, dredging and filling of wetlands, and construction of connecting high voltage transmission lines have already occurred when the Bellefonte Nuclear Plant was constructed in the 1970s and 1980s. The extent of future modifications to the landscape, vegetation and terrestrial habitat destruction, and related infrastructure requirements is a small fraction of what has already occurred. These incremental impacts of construction are also small relative to what would occur if a new “grass roots” or greenfield” fossil fuel power plant were to be constructed elsewhere in the Tennessee Valley Region.

Short-term uses of materials include steel girders, piping and shielding devices and materials that provide for the functioning of processes that comprise the operational plants involved with the five conversion options. Insulation would be used in buildings to protect against extreme heat and cold.

Concrete, wooden beams, sheet metal, and steel reinforcement bars would be consumed in countless areas of construction, including foundations, buildings, walkways, impermeable pads to contain runoff from storage piles, culverts to divert liquid flow, etc. Steel would also be used to construct storage tanks for liquid products and raw materials. Asphalt and/or concrete would be used to prepare various roadways, additional parking areas and support structures for materials unloading, transfer, and conveying systems.

However, the economic and societal returns to the people living in this region would be considerable, including stable and dependable electricity and a considerable number of jobs covering a wide spectrum of pay ranges and types. Future demands for energy are projected to increase and new power production facilities must eventually be built to meet this increase in demand. In additional to the generation of electricity, the proposed conversion would result in the utilization of a TVA asset of considerable value, which is currently providing no benefit to TVA or the public at large.

For these reasons, the short-term use of resources associated with the proposed action are considered to be insignificant when compared to the beneficial long-term productivity associated with the production of electric power at Bellefonte.

4.8 Irreversible and Irretrievable Commitment of Resources

The proposed action would result in irreversible and irretrievable commitments of resources including land, water, energy, and other mineral resources over an assumed 30-year lifetime of the proposed facilities. Capital resources (money) and human resources (measured in man-years) are also included as a part of the comparison of the resource commitment by options. This comparison is presented in Table 4.8-1. The resource commitments associated with the natural gas pipeline and the land disposal of solids from the PC Option are included as separate subtotals for their respective conversion options in Table 4.8-1.

Depending on the conversion option selected, construction would remove up to 225 acres of land from future agricultural uses and disposal sites could consume another 200 plus acres throughout the life of the plant. Operation of the plant would result in consumption of fossil fuels, limestone (for some options), water, metals, and a number of other materials, some of which cannot be replaced.

The land resource commitment, while irretrievable, is not considered in short supply given the large amount of undeveloped land in the region. The water consumption is considered an irreversible and irretrievable loss only in the regional water shed. Water, of course, is only changed in form (water to vapor in the cooling process) and therefore returns to earth elsewhere as water as a part of the hydrologic cycle. In any event, water is not in short supply in this region.

Of the fuels, natural gas and oil are considered to be relatively less abundant, both globally and in the U.S., than coal. No severe shortages of these two fossil fuels are anticipated for the lifetime of the proposed action although supply and demand could drive up the cost of natural gas (or oil) relative to coal.

Limestone is not considered to be a scarce resource and would not be over the lifetime of the proposed action.

The availability of TVA capital resources is considered to be relatively more constrained currently than in the past. The proposed action would partially retrieve some of the several billion dollars of capital already expended to construct Bellefonte as a nuclear plant. However, as shown in Table 4.8-3, capital expenditures ranging from 1.3 billion to 4.1 billion are needed to produce power and returns on capital depending upon the conversion option.

The human resource commitments also vary by conversion option. The cost in dollars of this commitment is accounted for in the estimate of capital expenditures. Labor is considered to be in extremely short supply in the region.

Table 4.8-1 Irreversible and Irretrievable Commitments of Resources by Conversion Option

	CONVERSION OPTION					
Resource	**PC**	**Solids Disposal**	**NGCC Gas Pipeline**	**IGCC**	**IGCC/C**	**Combination**
Land (acres)	190	300[a]	46 [b]	190	225	225
Water[c] (Billions of Gallons)	206	N/A	230	285	90	237
Coal[d] (Millions of Tons)	198	N/A	0	224	111	111
Natural gas [e] (Billion Cubic Feet)	0	N/A	5076	0	0	0
Oil (Millions of Gallons)	183	N/A	0	312	39	39
Limestone (Millions of Tons)	38	N/A	0	2	1	1
Capital costs (Billions of $)	3.1		1.3	4.1	1.9	2.9
Man-years	6,100		7,700	12,500	21,600	29,300

[a] - Assumes PC solids stacked 100 feet high.
[b] - Assumes 35 mile pipeline with 50 feet ROW and 8 acres compressor station. Most of this ROW allows for some above ground uses.
[c] - Cooling tower evaporation losses only, excludes other consumptive uses.
[d] - Assumes 30 years at 85% capacity factor rounded to nearest 1 million.
[e] - Assumes 30 years at 85% capacity factor rounded to nearest 1bcf.

4.9 Environmental Justice

EO 12898 directs certain federal agencies to consider environmental justice in the environmental reviews of their programs and activities. Although TVA is not one of the agencies identified in the executive order, the agency has considered the issue of environmental justice as a part of this environmental impact statement.

Environmental justice refers primarily to ensuring that no segment of the population bears a disproportionate burden of health and environmental impacts of society's activities. Some studies suggest that poor, predominately minority populations are exposed disproportionately to adverse health and environmental impacts because of siting decisions for facilities with potential environmental impacts. Other studies dispute these findings.

Over 39% of the minority population of Jackson County is located in the Scottsboro census division, which includes the city of Scottsboro and the town of Hollywood and the areas surrounding them. Most of the population of this division is located west and southwest of Bellefonte. The next two largest concentrations are located in Stevenson and Bridgeport divisions, which are north and northeast of the site.

Nearby cities and towns with minority populations constituting a larger share than the county average include Hollywood, Scottsboro, and Pisgah. The city of Scottsboro, which is located about six miles southwest of the site, has a minority population of 1,060, about 31% of the county total. Hollywood, about 2.5 miles west of the site, has a minority population of 185, about 20.9% of its total population and 5% of the county total. Pisgah, located about five miles almost due east of the site, has a minority population share greater than the county average. Two other cities in the county, Stevenson, about 12 miles from the site, and Bridgeport, about 20 miles from the site, also have a larger share of nonwhite population than the county as a whole.

The plant site is located near the middle of Census Bureau Block Group (BG) 1, Block Numbering Area (BNA) 9509. This Block Group has a very small minority population of four persons, or 1.5% of its total population. While the median household income is somewhat below the county and state averages, the poverty rate is lower than in either the state or the county. The next closest is BG 2, in BNA 9510, less than one mile across the river to the east of the plant site. This BG has an even smaller minority population, two persons or 0.2 percent of total population. Median household income is above both the state and the county averages, while the poverty rate is much lower. Slightly farther away is BNA 9506, BG 1, about one mile to the northwest of the site. This BG has a larger minority population, above the county average but well below the state. Median household income is below the state average and slightly below the county average. The poverty rate is somewhat higher than the state and county levels. Two other Block Groups are within about two miles of the site. One is BNA 9509, BG 2, located to the southwest. It has no minority population, relatively high median household income, and a low poverty rate. The other is BNA 9506, BG 5, located to the west and southwest. It has a minority population share similar to that of the county, lower median household income, and a higher poverty rate.

Table 4.9-1 Income and Minority Population Data by Census Division, Jackson County

	Total Population, 1990	Nonwhite Population, 1990	Nonwhite as Percent of Total, 1990	Median Household Income, 1989	Percent of Persons Below Poverty Level, 1989
Division					
Bridgeport	4 ,090	474	11.6	21,394	17.0
Long Island	4,972	177	3.6	21,508	12.8
Paint Rock	2,869	160	5.6	24,184	16.1
Pisgah	3,910	235	6.0	22,041	15.3
Princeton	2,236	38	1.7	19,364	25.1
Scottsboro	18,069	1,337	7.4	23,970	14.8
Section	5,941	237	4.0	18,350	20.8
Stevenson	5,709	735	12.9	22,134	19.0
Jackson Co.	47,796	3,393	7.1	21,910	16.6
Alabama	4,040,587	1,064,790	26.4	23,597	18.3

Source: U. S. Department of Commerce, Bureau of the Census, 1990 Census of Population.

Table 4.9-2 Income and Minority Population Data for Places in Jackson County

	Total Population, 1990	Nonwhite Population, 1990	Nonwhite as Percent of Total, 1990	Median Household Income, 1989	Percent of Persons Below Poverty Level, 1989
City/Town					
Bridgeport	2,936	386	13.1	21,542	17.8
Dutton	204	9	4.4	20,391	25.5
Hollywood	884	185	20.9	18,125	25.9
Langston	203	8	3.9	15,500	18.2
Paint Rock	176	6	3.4	19,583	22.7
Pisgah	675	63	9.3	20,313	19.1
Scottsboro	13,786	1,060	7.7	24,676	14.5
Section	820	38	4.6	18,348	20.3
Skyline	772	25	3.2	18,672	16.5
Stevenson	2,008	459	22.9	20,083	15.8
Woodville	725	20	2.8	24,722	13.8

Source: U. S. Department of Commerce, Bureau of the Census, 1990 Census of Population.

Table 4.9-3 Income and Minority Population for Block Groups Near the Plant Site

		Total Population, 1990	Nonwhite Population, 1990	Nonwhite as Percent of Total, 1990	Median Household Income, 1989	Percent of Persons Below Poverty Level, 1989
BNA	BG					
9,509	1	264	4	1.5	20,446	14.8
9,509	2	142	0	--	30,441	5.6
9,510	2	1,037	2	0.2	24,167	10.0
9,506	1	1,600	163	10.2	21,071	19.6
9,506	5	2,369	160	6.8	20,600	22.4

Various aspects of the project alternatives could have differential impacts on minority or low-income persons. Such aspects include impacts from flaring, smoke plumes, increased traffic loads on the roads and the river, the economic impacts, noise, and risks of catastrophic accidents.

Flaring would occur with all the options except NGCC. However, the size of the flare is expected to be great enough that it would be visible to the mountains on both sides and for some distance along the valley. Under the IGCC/C Option, the flaring frequency would be less than under the other options. In all cases, however, it now appears that the area covered is large enough that there would not be special impacts to low income or minority populations.

Plumes from the stacks are expected to diffuse over a wide area, although they may be predominantly to the southeast. The area affected would be large enough that there would be no special impacts to low income or minority populations.

Road traffic impacts would be primarily to U.S. Highway 72 and the roads leading off U.S. Highway 72 to the plant site. Waterway traffic impacts would be to the Tennessee River and to the docking area at the site. No special impacts to minority or low-income populations are expected to result.

All hiring related to either construction or operation and maintenance of the site would be conducted in a nondiscriminatory fashion, in accordance with the law. Minorities would have equal access to all jobs. Secondary impacts would result in employment increases in the area for various types of jobs, at all skill levels.

Noise and catastrophic accidents should not have disproportionate impacts on minority or low-income populations. The closest county divisions are Scottsboro, Pisgah, and Section. The latter two divisions have a smaller percentage of minority population than in the county as a whole (see above). The percentage in the Scottsboro division is slightly higher; however, virtually all live in the city of Scottsboro, about six miles southwest of the site. Also, both Scottsboro and Pisgah divisions have higher income levels and lower poverty rates than the county as a whole.

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5.0 Permits and Approvals

5.1 Introduction

TVA has not begun efforts to acquire permits for the conversion of Bellefonte to fossil fuel. The time frame for converting Bellefonte allows permitting activities to be initiated at some future time. However, TVA has studied the time needed to prepare typical permit applications and for normal regulatory agency review and approval. TVA has also reviewed federal and state, and, as applicable, local laws and regulations, for their application to the conversion of Bellefonte to fossil fuel. The information contained in this chapter is intended to provide a generic look at applicable regulations and give the reader a “broad brush” understanding of what would be necessary for permitting a converted fossil facility. More detailed permitting information is presented in Appendix K. TVA currently holds air (minor source) and water discharge (NPDES) permits from the Alabama Department of Environmental Management (ADEM) for the maintenance of Bellefonte Nuclear Plant in inactive status.

Several permitting agencies would be involved in processing and approving various actions, phases, and components associated with the construction and operation of the converted Bellefonte plant. Some requirements discussed below may not apply to all conversion options. For example, no solid wastes would be generated by the operation of an NGCC plant (the preferred option); therefore no solid waste disposal permits would be required. The discussion in this chapter should be viewed as a description of permits and requirements for what would appear to be the most complicated option for permitting, the combination option. Other conversion options would involve a commensurately less intense level of activity and the acquisition of fewer permits and approvals.

The agencies and organizations expected to participate in the permitting processes at Bellefonte (should TVA elect to proceed with one of the conversion pathways described in this draft EIS) and the affected environmental resource area are listed in Table 5.1.1-1, along with brief notes pertaining to information requirements and scheduling.

Table 5.1.1-1 Permitting Requirements

Resource Area	Type of permit	Approving Agency	Reviewing Agencies	Major Elements
Air	PSD Construction	ADEM Air Div.	EPA Region IV	PSD ambient air quality analysis, PSD Visibility and Air Quality Related Values PSD BACT analysis, PSD additional impacts analysis, State air toxics analysis
	Operation	ADEM Air Div.	EPA Region IV	Title V permit, Emissions and air quality monitoring
Wastewater	Construction	ADEM Water Div.	EPA Region IV	Grubbing permit, NPDES permit, Best management practices plan, SPCC Plan, Facility response plan, engineering. report for new ponds, etc.
	Operation	ADEM Water Div.	EPA Region IV	NPDES permit, effluent and instream monitoring
Solids Disposal	Construction	ADEM Land Div.	EPA Region IV	Disposal facility construction permit,
	Operation	ADEM Land Div.	EPA Region IV	Nonhazardous wastes disposal permit, Obtain hazardous waste generator number, TCLP characteristics tests for some wastes, Hydrogeological testing for onsite landfills, Possible groundwater monitoring
Water Rights	Operation	none	US Army COE	Possible reporting to ADEM of withdrawals
Land Use	Construction	none	TVA	Land use review under Farmlands Protection Policy Act
Wetlands	Construction/ Operation	US Army COE	ADEM Water Div.	CWA 404 - dredge and fill permit, CWA 401 - certify meeting standards, Review under E.O. 11990, Mitigation if required, Submission of ENG 4345
Floodplains	Construction	none	TVA	Review of project under E.O. 11988, Review of FEMA information
Biological	Construction	none	Alabama Game and Fish Commission, US Fish and Wildlife Service	Reviews required prior to construction, Review of state Heritage information for T&E species, Possible section 7 ESA consultation
Cultural	Construction	Alabama Historical Commission, State Historic Preservation Officer	Advisory Council on Historic Preservation	Review and analysis of cultural and historic properties, Completion of NHPA section 106 process, Possible MOA with ACHP for affected sites
Air Navigation	Construction and Operation	Federal Aviation Administration	none	Notify FAA of structures >200 ‘, No-hazards determination, Lighting requirements
Noise	Construction and Operation	None	TVA	Review of standards, Noise monitoring

5.2 Overview

This section provides a brief synopsis of permit considerations for each resource area.

5.2.1 Air Quality

ADEM requires a preconstruction permit that includes the federal Prevention of Significant Deterioration (PSD) program elements, such as best available control technology (BACT) and pollutant specific ambient air quality analyses. The PSD pollutants for this project are likely to include SO_2, NO_x, CO, and PM and PM_{10}. The construction permit application review would address Alabama's air toxics program. ADEM has operating permit provisions that are being incorporated into the 1990 Clean Air Act Amendments (CAAA) Title V federal operating permit program. The Environmental Protection Agency (EPA) and ADEM developed and implemented a Title V operating permit program in December 1995.

The chemical plant, for the coproducts under consideration, would be subject to recently published rules for hazardous organic pollutants under Title III of the CAAA. These rules require maximum achievable control technology (MACT) for named sources and operations.

The federal operating permits, which must be applied for within 12 months after startup, would also likely address the CAAA Title III program and the Title IV (acid rain provisions) program.

5.2.2 Wastewater Discharges

ADEM requires a state-administered National Pollutant Discharge Elimination System (NPDES) storm water permit before site preparation and construction activities can commence and an NPDES permit for direct discharge of pollutants (process and storm water) during plant operations before operation can begin. National technology-based effluent limitations have not been developed for gasification plants, but the national categorical effluent limitation and guidelines for new source chemical plants and steam electric generating plants would be used where applicable.

Water quality-based limitations on effluent discharge quality are likely to be more constraining than technology-based limits. ADEM has specific design standards and subsurface investigation requirements for process wastewater or storm water ponds, particularly in the northern part of the state. ADEM issued an NPDES permit, which is still in effect, for the operation of existing facilities at Bellefonte for the discharge points, and the limits and conditions of operations for those points, and those associated with the operation of a nuclear plant. The NPDES would need to be supplemented and/amended to cover the additional discharge points and pollutants resulting from the construction and operation of the converted fossil plant.

5.2.3 Solid (and Hazardous) Waste Disposal

This program area is currently the most uncertain in terms of which permits would be required. Part of this uncertainty is based upon questions regarding the characteristics of solids generated from the processes and activities associated with the five conversion options. If any waste stream is hazardous, the waste would be disposed of off site, but TVA would be subject to certain storage and handling provisions of the Resource Conservation and Recovery Act (RCRA) while the material is managed on site. As long as onsite storage does not exceed 90 days, a RCRA permit would not be required for the plant. Under Alabama law, slag and fly ash are exempt from regulation as a waste. However, a solid waste permit is anticipated for water and wastewater treatment sludges, spent sorbents, and “off spec” fly ash and slag that may not be marketable. Based on discussions with ADEM, fly ash, slag, and FGD wastes are not defined as solid wastes as long as the waste is a result of burning fossil fuels for electric power generation.

5.2.4 Surface Water

Although ADEM does not require water rights permitting for surface water or groundwater diversion or extraction, the state has passed legislation requiring users to report water usage. However, TVA is not subject to the law. For the Tennessee River, TVA has its own Section 26a review requirements which are generally combined with the U.S. Army Corps of Engineers (USACE) Section 10 and Section 404 permit process to consider construction (in, across, and along the Tennessee River and its tributaries) that can potentially affect navigation, flood control, or public lands.

Nationwide permits (NWPs) are general permits issued by the USACE and are designed to regulate certain activities having minimal impacts. The NWPs are proposed, issued, modified, reissued (extended), and revoked from time to time after an opportunity for public notice and comment. Proposed NWPs or modifications to or reissuance of existing NWPs will be adopted only after USACE gives notice and allows the public an opportunity to comment on and request a public hearing regarding the proposals. USACE will give full consideration to all comments received prior to reaching a final decision.

5.2.5 Land Use

As a federal agency, TVA is not subject to state or local zoning requirements.

5.2.6 Wetlands

If wetland determinations indicate that "jurisdictional" wetlands would be modified or significantly altered to accommodate development of the proposed project, a Clean Water Act (CWA) 404 permit must be obtained from the USACE. It is possible that either the footprint of the project facilities or, more likely, the construction of pipelines, roads, rail spurs, or other project related linear facilities would affect jurisdictional wetlands. Depending upon the degree of impact, either a general or an individual permit would be required. The latter involves an application process that brings in state (Section 401) certification that the action would not violate state water quality standards as well as review and comment from other agencies. The application and review of the 404 permit is frequently tied to consideration of the Federal Rivers and Harbor Act of 1899, Section 10, permits for obstructions to navigation (such as construction of the intake structure or diffuser). Wetlands are also reviewed under E.O. 11990 (Protection of Wetlands).

5.2.7 Floodplains

Floodplain impacts are reviewed under E.O. 11988.

5.2.8 Biological

Alabama has a list of protected species that overlaps and extends beyond those protected by the Federal Endangered Species Act (ESA). Potential impacts on Alabama listed species are considered in the EIS. In addition, a more structured Section 7 ESA consultation process with the U. S. Fish and Wildlife Service (FWS) may be required if a "may affect" situation exists. The Fish and Wildlife Coordination Act also requires that aquatic species be considered in project planning and would be a requirement USACE must meet. The FWS usually handles both consultative processes together.

5.2.9 Cultural Resources

As with the protection of biological resources discussed above, a consultative process (this one mandated by Section 106 of the National Historic Preservation Act) can require determinations that properties of historic significance would not be adversely affected by the project. The NHPA Section 106 consultative process has been delegated to the State Historic Preservation Officer (SHPO) in Alabama. The review process, which would include document searches and field assessments, addresses both above ground buildings and buried archaeological resources.

5.2.10 Air Navigation

To ensure that the highest structures associated with the project do not impair the safety of aviation, coordination with Federal Aviation Administration (FAA) may be necessary. Submission of a letter of notification (with accompanying maps and project description) to the FAA would result in a written response from the FAA certifying either that no hazard exists or recommending project changes and/or warning devices, such as lighting.

5.2.11 Noise

Noise impacts and mitigation plans are addressed in the EIS. Although federal regulations apply to only certain pieces of construction equipment, any local noise requirement would have to be considered and met. However, no applicable local noise ordinances were identified for Jackson County.

5.2.12 Emergency Planning and Community Right-to-Know

Although aspects of emergency planning and discussions of hazards from chemicals produced, stored, and used at Bellefonte are discussed in the EIS, notification and reporting under the Emergency Planning and Community Right to Know Act (EPCRA) occurs when the plant becomes operational rather than as a preconstruction permit. Provisions of EPCRA flow down to designated Alabama and local officials and to the managers of the plant itself. Being a federal agency, TVA is not subject to EPCRA. However, as a matter of policy and consistent with E. O. 12856, TVA complies with EPCRA to the same extent as other utilities.

5.2.13 Health and Safety

The federal Occupational Safety and Health Administration (OSHA) governs the occupational safety and health of the construction workers and the operational staff of the Bellefonte Nuclear Plant. As a federal agency, TVA is not directly subject to regulation from OSHA; however, it must comply with OSHA's substantive requirements as these are incorporated in its occupational health and safety manual. Contractors would continue to be subject to these substantive requirements.

6.0 PUBLIC PARTICIPATION AND COORDINATION EFFORTS

Public participation and inter-agency coordination/review are part of the NEPA process during the preparation of an EIS. The public and appropriate federal, state, and local agencies were invited to provide input during the scoping process and to review and comment on the DEIS. Section 6.1 describes the scoping process to determine the content of the EIS and section 6.2 describes the public participation and agency review of the DEIS. Section 6.3 defines the role of lead and cooperating agencies of this EIS.

6.1 TVA Scoping and Public Participation Process

One activity in EIS preparation is the description of what the evaluation and document will cover--the scope of the EIS. An important part of this "scoping" process is soliciting public participation in determining the issues to be evaluated and including that information in the process. This section summarizes the public comments that helped to determine the content of the EIS.

6.1.1 Public Involvement

Formal public participation in determining the scope of the Bellefonte EIS began on April 29, 1996, when TVA published a Notice of Intent (NOI) in the *Federal Register* (61 FR 18767). In the notice, TVA announced its intention to prepare this EIS and invited comments on the scope. The NOI stated that a public meeting would be held to solicit comments from the public regarding environmental resources and issues to be addressed in the EIS. It further stated that comments on the scope of the EIS would be received through May 29, 1996. TVA issued an announcement on May 5, 1996, to local, regional, and national news media that the NOI had been published and invited members of the public to provide input on the proposed conversion of Bellefonte facilities. On May 13, 1996, paid advertisements with essentially the same information were placed in the major daily newspapers in Chattanooga, Tennessee; Huntsville, Alabama; and Scottsboro, Alabama. The same advertisement was placed in the North Jackson Progress, a bi-weekly newspaper that is distributed in Jackson County, Alabama. A copy of the paid advertisement is in the Public Scoping Document issued in July 1996. Listed below are the publications where related articles appeared:

- Knoxville News-Sentinel, Knoxville, Tennessee, May 3, 1996
  "Comment Sought On Bellefonte Conversion", Page B1
- Huntsville Times, Huntsville, Alabama, May 3, 1996
  "TVA Plans Hearing On New Bellefonte Plan", Page B8
- Chattanooga Times, Chattanooga, Tennessee, May 6, 1996
  "TVA May Convert Bellefonte", Page A1
  "No Hollywood Excitement For Bellefonte", Page A6
- Florence Times Daily, Florence, Alabama, May 7, 1996
  "TVA Eyes Bellefonte Conversion Options", Page B1

The Bellefonte EIS public scoping meeting was held on Thursday, May 16, 1996, at the Scottsboro High School Main Auditorium at 6:30 p.m. During the meeting, 31 people filled out registration cards. Participants at the meeting had the opportunity to look at a variety of exhibits and pick up several handouts. Among the handouts provided was an agenda that described TVA's proposal, how comments could be received, and some of the issues being covered in the environmental review. Also, a fact sheet was available that summarized the background of Bellefonte along with TVA's decisions regarding Bellefonte to date and a description of each fossil fuel and nuclear power alternative.

Following presentations by TVA staff about the EIS issue scoping process and a description of studies and activities underway to determine the best course of action for Bellefonte facilities, members of the public were invited to participate in small group discussions aimed at soliciting their ideas and concerns about the proposed course of action.

The public comments were reviewed to help identify key themes and environmental issues, that should be addressed in the EIS, and issues which need not be addressed at length.

In addition to the public comments at the public scoping meeting, three letters were received. Issues raised during the scoping process were summarized in the Public Scoping Document issued July 1996.

6.1.2 Major Issues of Public Concern

The public identified several environmental issues pertinent to the proposed actions and the comparison of alternatives. There are five major areas of public concern: *Socioeconomics, Public Risk, Water Quality, Air Quality,* and the *Use of Natural Gas as a Fuel Source*.

Socioeconomics: The issue raised most often in the three group sessions at the public meeting concerned effects on unemployment in the community. Jackson County currently has a 9% unemployment rate. It was requested that TVA consider the option that created the most jobs and the highest salaries and to consider the work force during downsizing so that employees from TVA fossil plants might be used at Bellefonte.

Public Risk: The issues concerning public risk were about fire protection and safe shipment of by-products and hazardous waste, safety precautions relative to natural gas distribution lines, coal pile fire impacts, and the potential of fatalities and/or injuries at the fuel source (mining, etc.). What happens if a line ruptures?

Water Quality: Concerns about water quality focused on the outfall impacts streams and rivers. What will be introduced into the water? Will temperature of effluents be detrimental to water quality? What is the impact of fuel storage on water quality, and storm water runoffs?

Air Quality: Several questions were raised about air quality. Will there be scrubbers to keep the air clean? Will local limestone be used in the scrubber process? Will the conversion of Bellefonte reduce air emissions currently coming from units 1-6 at Widows Creek? What are the impacts of the options (fugitive dust, etc.)?

The Use of Natural Gas as a Fuel Source: Several questions were raised about the impacts involving the use of natural gas as a fuel source. Concerns were about gas pipeline construction, safety precautions relative to distribution lines, land acquisition for pipeline construction, availability of natural gas, and reliability of the source.

6.2 Public and Agency Review of the DEIS

A courtesy briefing describing the impending release of the DEIS, the review and comment period, and public meeting plans to obtain public inputs was provided by TVA staff on March 6, 1997 to local elected officials, congressional staff, members of the print media, and community leaders from Jackson County. Attendees were invited to review and comment on the DEIS soon to be released and to attend the public hearing.

On March 6, 1997, the DEIS was sent to federal, state, and local government agencies and to members of the media, public interest groups, citizens groups, and private citizens. Copies were provided to each person who indicated a desire to receive the document, or that attended the public scoping meeting held May 16, 1996, at Scottsboro, Alabama. TVA issued an announcement March 7, 1997, to local, regional, and national news media that a DEIS had been completed and was available for review and comment. The announcement provided information about contents of the DEIS, the public hearing place, time, and date, and listed a point of contact with phone number for requesting copies of the document.

On March 14, 1997, EPA published a Notice of Availability (NOA) of the DEIS in the *Federal Register* (62 FR 12181). The NOA listed the name of the DEIS, and a point of contact with phone number for requesting copies of the document.

In the days following the DEIS's release, news articles were published in several local and regional newspapers and trade journals. Presented below is a partial list of the articles, the respective journals and dates, if available.

- The Daily Sentinel, Scottsboro, Alabama, March 6, 1997
  "Bellefonte's Future on Today's Agenda", Page 1
- The Daily Sentinel, Scottsboro, Alabama, March 7, 1997
  "Bellefonte's Future Discussed", Page 1
- Times Daily, Florence, Alabama, March 8, 1997
  "Study Supports Plant Conversion", Page B1.
- Chattanooga Free Press, March 9, 1997
  "No Threatened Species Found Near TVA's Bellefonte Nuclear Plant", Page B7
- The Energy Daily, March 11, 1997

“TVA Studies Environmental Impact of Bellefonte Conversion Plans”, Page 4

- The Daily Sentinel, Scottsboro, Alabama, March 13, 1997
  “Answer Due by Fall on Choice of Bellefonte Fuel”, Page C1, C4
- The Huntsville Times, Huntsville, Alabama, April 8, 1997
  “Proposed Use for Bellefonte Plant Will Be Discussed at Hearing Tonight”, Page B3
- The Daily Sentinel, Scottsboro, Alabama, April 8, 1997
  “TVA Hearing Set for Today”, Page 1
- Birmingham News, Birmingham, Alabama, April 9, 1997
  “Concerns Voiced over Bellefonte Plant”
- Decatur Daily, Decatur, Alabama, April 9, 1997
  “TVA Hears Concerns on Conversion Plan for Bellefonte Plant”, Page A9
- Huntsville Times, Huntsville, Alabama, April 9, 1997
  “Plan for Bellefonte to Burn Coal Gets Chilly Reception”, Page B1
- Chattanooga Times, Chattanooga, Tennessee, April 10, 1997
  “What to do With Plant?”, Page B1
- Birmingham News, Birmingham, Alabama, April 10, 1997
- “Group Fears Bellefonte to Use Plutonium From Bombs”, Page C2
- Times Daily, Florence, Alabama, April 10, 1997
  “Environmentalists Attack Plan to Convert Bellefonte”, Page 4B

On the last publication date before April 8, 1997, paid advertisements were printed in four local newspapers with information about the public hearing to be held on April 8, 1997.

- Chattanooga Times, Chattanooga, Tennessee
- Huntsville Times, Huntsville, Alabama
- The Daily Sentinel, Scottsboro, Alabama
- The North Jackson Progress, Stevenson, Alabama

The advertisement provided a synopsis of the project addressed in the DEIS and detailed information about the meeting place and time. Also included was the name, address, phone number, and e-mail address of a person from whom additional information about the project could be obtained.

The Bellefonte DEIS public meeting was held on Tuesday, April 8, 1997, at the Scottsboro High School Main Auditorium at 6:30 p.m. During the meeting, 31 people filled out registration cards. Participants at the meeting had the opportunity to look at a variety of exhibits and pick up several handouts. A transcript of meeting proceedings was prepared.

All comments from the meeting were reviewed. In addition to the public comments made at the public meeting, several letters were received, including letters from several State and Federal Agencies. Individuals and/or agencies providing comments to TVA are listed in Appendix P, Volume II.

Availability of EPA Comments for the Bellefonte DEIS appeared in the *Federal Register* (62 FR 28490) on May 23, 1997. EPA expressed environmental concerns regarding predicted impacts of conversion options to coal, a need for global climate change information, commitments to mitigation, wetland losses, off-site hazardous waste transport, a need for additional demographic comparisons (environmental justice) and summer thermal discharges. EPA requested additional information be provided in the final document.

These comments and all other comments received are summarized along with TVA's responses in Volume II, Appendix Q of the FEIS. Changes made in the DEIS as a result of reviewer comments are noted in the responses.

6.3 Lead and Cooperating Agencies

TVA is the lead agency in preparing this EIS. No cooperating agencies were identified. However, other Federal, State, and Local agencies were coordinated with, as appropriate, including the following:

- United States Army Corps of Engineers, Nashville District,
- Alabama Department of Environmental Management, Water Division and Air Division,
- The Alabama State Historic Preservation Office,
- United States Department of Interior,
- United States Environmental Protection Agency, Region IV, and
- United States Department of Agriculture, Forest Service.

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Appendix A ¾ Construction Aspects for Conversion Options

1.0 Pulverized Coal (PC)

1.1 Conversion Plan Description

This option considers the conversion of Bellefonte Units 1 and 2 in four phases of 600 MW blocks of power each:

Phase	Completion Date From the Start of Engineering (October 1, 1997)
1 - 1st 600 MW	2nd Quarter 2002
2 - 2nd 600 MW (Completion of "Unit 1")	2nd Quarter 2003
3 - 3rd 600 MW	2nd Quarter 2004
4 - 4th 600 MW (Completion of "Unit 2")	2nd Quarter 2005

Each phase of the project would convert one half of an existing unit at the Bellefonte Plant. Thus, it would require the completion of two phases of the project to fully convert one "Unit" at Bellefonte. One fully converted unit consists of two new pulverized coal fired steam generators which would provide main steam to two new 3,600 rpm topping turbine-generators, each of which would generate electric power. The expanded steam is reheated and admitted to a new intermediate-pressure turbine which replaces the existing 1,800 rpm high-pressure steam turbine which was part of the nuclear plant steam cycle. The new 1,800 rpm intermediate-pressure turbine would exhaust to the existing low-pressure turbines. The low-pressure turbines and condenser would be re-used, as well as most of the existing condensate system.

New air quality control equipment consists of low NO_x burners (and possibly Selective Catalytic Reduction for NO_x removal if required by a BACT analysis), an electrostatic precipitator system for flue gas particulate removal, and a scrubber system, without flue gas reheat, for SO_2 removal. The exhaust flue gas is released through a single chimney with two flues for each pair of 600 MW boilers.

New coal handling facilities are constructed for barge unloading of coal. The existing cooling towers and circulating water system are utilized for cycle heat rejection. The existing substation is augmented and a new auxiliary power system is constructed. A new distributed control and information system is constructed. NEW waste storage areas for ash and flue gas desulfurization waste solids are constructed.

1.2 Design Criteria

1.2.1 Design Basis

The following design criteria are the basis for the pulverized coal alternative:

- The total conversion of the Bellefonte Plant Units 1 and 2, would be 2,400 MW net power production. However, the project would be built out at 600 MW increments while accommodating provisions for expanding the conversion to include the completion of Unit 1 and then Unit 2 in a similar manner.
- The design would utilize as much of Bellefonte Unit 1 & 2 equipment and facilities as is cost effective.
- Unit would be base loaded with an 85% capacity factor.
- FGD system would be positive pressure without bypass and without reheat. The scrubber solids slurry is forced oxidized to produce a gypsum which can be processed into wallboard or other similar material.
- FGD waste solids would be wet stacked in accordance with TVA design guidelines. This results in a 1:3 slope at the outside of the stack with 15-feet wide benches, 25-feet high. Ash wastes would be stacked in a similar manner.
- The coal specified for the study is Modified Illinois No. 6, with ultimate analysis shown in Table 1.2.1-1.
- The analysis of the design basis limestone is shown in Table 1.2.1-2.

Table 1.2.1-1 Modified Illinois No. 6 Ultimate Analysis

Constituent	As Received	Dry
Carbon	58.70%	68.29%
Hydrogen	4.00%	4.65%
Oxygen	7.90%	9.19%
Nitrogen	1.11%	1.29%
Sulfur	3.05%	3.55%
Ash	11.00%	12.80%
Moisture	14.04%	0.00%
Chlorine	0.20%	0.23%
Total	100.00%	100.00%
HHV Heating Value	10,229 Btu/lb	11,900 Btu/lb

Table 1.2.1-2 Design Basis Limestone Analysis			
	Typical	**Minimum**	**Maximum**
Calcium Carbonate (Dry Basis)	90.1%	90%	
Magnesium Carbonate (Dry Basis)	4.6%		5%
Silica (Dry Basis)	5.4%		5.4%
Moisture			5%
Hardness as kvs Work Index			13
Grindability		2.99	
Particle Size Distribution	3/4 x 0 inch	50% retained on a ¼” screen	

1.2.2 Coal and Sorbent Handling

Coal receiving would be by barge only and limestone receiving would be initially by truck (during the first 1,200 MW of operation) and subsequently by barge with re-use of the initial low capacity coal unloading equipment. This plan for receiving of coal and limestone is the result of an economic analysis which compared initial truck unloading of limestone but switching to barge unloading at that point in time when truck traffic is deemed excessive (greater than six trucks per hour over a 12 hour receiving period) against only barge unloading of limestone. This results in limestone truck delivery requirements of approximately 4 ½ trucks/hour at 40 hours per week during the 1st 600 MW operation and an increase to six trucks per hour at 60 hours per week during 1,200 MW operation (to limit limestone unloading truck traffic to approximately six trucks per hour).

The coal unloading equipment and facilities for the first 600 MW would be designed such that with minor modifications, the unloading equipment can be converted to allow limestone unloading for the third construction phase of 600 MW (1,800 MW total buildout). At that stage, limestone unloading would be shifted to the barge unloading area where the clamshell unloader initially used for coal unloading during the first 600 MW phase of operation, would be used for unloading limestone barges.

At the second 600 MW phase of construction, new continuous bucket wheel coal unloading equipment would be installed in order to meet the higher coal unloading requirements for 1,200 MW operation. The construction sequence is shown in Table 1.2.1-3.

Table 1.2.1-3 Construction Sequence for Unloading Equipment

	LIMESTONE UNLOADING	COAL UNLOADING
600 MW	Truck Unloading Station 4 ½ Trucks Per Hour, 108 tph	Barge Unloading Area #1 1,800 tph
1,200 MW	Truck Unloading Station 6 Trucks Per Hour, 144 tph	Barge Unloading Area #1 Upgrade to 3,500tph
1,800 MW	Barge Unloading Area #1 Modify the coal unloading equipment for Limestone unloading, 360 tph	Barge Unloading Area #2 Upgrade to 5,300 tph
2,400 MW	Barge Unloading Area #1 No changes required except for daily throughput, 500 tph	Barge Unloading Area #2 Upgrade to 7,000 tph

1.2.2.1 Limestone System

The required limestone feed rate at 100% rated plant capacity for 2,400 MW is 120 tons per hour (tph). The limestone handling system has the following design criteria:

- Limestone receiving and stockout operation at up to 12 hours per day, five days per week.
- Limestone reclaim operation at eight hours per day, seven days per week (56 hours per week)
- 30 days of total limestone storage (excluding the silos)
- Three days of live limestone storage (excluding the silos)
- 16 hours limestone storage in the silos
- 12 hours of limestone slurry storage

Limestone stockout is via a conveyor discharging into a concrete stacking tube. Reclaim is through reclaim hoppers located under the stacking tube and conveyor into the Additive Preparation Silos.

<u>Limestone Receiving</u>

Trucks discharge the limestone into one of two limestone receiving hoppers with isolation gates and variable rate feeders. The feeders discharge onto collecting conveyor C-1 for transfer to stockout conveyor C-2. Conveyor C-1 has a capacity of 500 tph and includes all the necessary chute work to transfer the limestone between the conveyors.

<u>Limestone Storage and Reclaim</u>

Conveyor 2 transfers limestone from the collecting conveyor (Conveyor 1) to a concrete stacking tube at the limestone stockout pile. Conveyor 2 is furnished with an electronic belt scale and a two-stage sampling system complete with stainless steel chute work and sample collector. Conveyor 2 is rated at 500 tph.

Conveyor 2 builds the active storage pile directly over the dual reclaim hoppers. The pile capacity is equivalent to 30 days of limestone consumption at the 2,400 MW requirement, 84,000 tons. The pile is 270 ft in diameter by 95 ft high with a 35° angle of repose. The reclaim hoppers are 16 ft x 20 ft with a minimum valley angle of 65°. The hoppers include dewatering slide gates and two variable rate belt feeders discharging to Conveyor 3 which conveys limestone to the Additive Preparation Building. Conveyor 3 is a 36 in belt conveyor rated at 600 tph. Conveyor 3 is furnished with an electronic belt scale.

The head end of Conveyor 3 is complete with reducer, coupling, and motor and a magnetic separator with tramp iron chute and container.

Conveyor 3 transfers limestone from the reclaim hopper to a series of conveyors and flop gates into the limestone day bins. There are a total of five day bins for the 2,400 MW plant, one of which is for spare capacity. Each bin has a capacity of 600 tons. The bins are 24 ft diameter. x 35 ft tall (straight side length) with vibrating bin bottom, slide gate and pulse jet type bin vent filter. Four of the bins feed active limestone ball mills. One feeds a standby ball mill. The conveying system is sized to fill all of the active bins in 16 hours. The active bins provide a limestone surge capacity of 16 hours. Two of the five bins and associated downstream preparation equipment are constructed during the first 600 MW phase of construction. Thereafter, one bin and preparation train are provided for each 600 MW phase of construction.

The limestone conveyors are open type trusses with corrugated covers over the belts. One 3-feet walkway of galvanized expanded metal is provided with each gallery. Protective cover plates are provided in areas above roadways, waterways, and building roofs. Exits are provided at 300 ft minimum spacing. The conveyor gallery support bents consist of exposed, braced, simply supported space frames with foundations on spread footings and piers. The foundations, piers, excavation, handrail, structural steel, and ladders are included. The conveyor belting, stringer supports, conveyor drive systems, spray dust suppression, and fire protection are included. The conveyors have 35° troughing idlers. Maximum allowable conveyor slope is 15°.

<u>Dust Control</u>

Dust control for the limestone handling system would consist of a freeze protected spray foam system.

1.2.2.2 Coal System

The required coal burn rate at 100% rate plant capacity for 2,400 MW is approximately 1,100 tph burning Illinois No. 6 coal. The Coal Handling System has the following design criteria:

- Barge unloading and stockout operation at 12 hours per day, five days per week during 1st 600 MW (clamshell coal unloading) and 10 hours per day, five days per week after completion of the 2,400 MW buildout.
- Coal reclaim operation at eight hours per day, seven days per week (56 hours per week)
- 30 days of total coal storage (excluding the silos)
- Three days of live coal storage (excluding the silos)
- 16 hours of storage in the silos

The coal handling system includes the equipment required for unloading, conveying, preparing, and storing the coal delivered to the plant. The scope is from the barge unloader and barge breasting equipment to the tripper conveyors feeding the coal silos at the boiler front. The system is designed to provide short term coal storage in the coal silos for 16 hours of operation using the lowest specification heat content of the coal while operating the boiler at the rated 100% load. The reclaim rate is capable of providing the necessary coal to allow filling the 16-hour coal silos in eight hours.

The phased construction of the coal handling facilities would be as follows.

- <u>Coal Unloading and Stockout</u>: For the initial construction phase, the barge unloading equipment is sized for unloading coal barges at the required rate for a 600 MW power block, however, the collecting belt and stockout belts are sized to handle the required rate for 1,200 MW. For the 2nd 600 MW construction phase, the unloading equipment would be upgraded for the 1,200 MW unloading requirement and the barge unloader used for the first 600 MW operating phase would be placed in a standby mode. For the 3rd 600 MW construction phase, a new high capacity barge unloading system would be constructed downstream from the operating unloader along with a new transfer conveyor and stockout conveyor. The new unloader and conveyors would be designed with conveying capacity sufficient for the 2,400 MW unloading requirements. The barge unloader used during the first phase of construction would be modified for barge unloading of limestone.
- <u>Coal Reclaiming</u>: For the initial construction phase, the coal reclaiming equipment, from the coal pile to the plant transfer building, would have the required conveying and crushing capacity for 1,200 MW. At the 1,800 MW construction phase, the reclaiming system would be duplicated, providing the capacity for the f,ull 24,00 MW.

The system includes the following for the initial 600 MW plant:

- <u>Barge Unloading</u>: Coal is delivered by barge. Assuming 1,600 ton capacity barges (195 ft x 35 ft x 9 ft draft), approximately 6 barges must be unloaded per day. An 1,800 tph clamshell type unloader with self-contained breasting system, barge unloading collecting conveyor, electrical room, control cab, and jib crane is provided. The chute work and collecting conveyor has a capacity of

3,500 tph. The barge unloader collecting conveyor feeds the coal onto Conveyor C-4 which has a conveying capacity of 3,500 tph. Conveyor C-4 conveys the coal to the Coal Transfer Building.

- Transfer Building: Conveyor C-4 transfers coal through a flop gate to the active storage pile stacker reclaimer conveyor C-3. Conveyor C-4 is equipped with an electronic belt scale, a magnetic separator with tramp iron chute and container, and an electronic metal detector, paint marking system, and electronic belt scale. Conveyor C-4 also has a 2-stage "as-received" sampling system complete with stainless steel chute work, sample crusher, and automated final sample collectors. The stacker reclaimer conveyor C-3 is a reversing conveyor feeding a trencher type stacker/reclaimer which can stack at a rate of ,3500 tph or reclaim at rates up to 2,000 tph. When reclaiming, conveyor C-3 discharges into the crusher surge bin. The reclaim head of conveyor C-3 also has a magnetic separator with tramp iron chute and container and an electronic metal detector, paint marking system, and electronic belt scale.
- Coal Crushing: The crusher surge bin in the transfer building includes level controls, a load cell system, two discharge hoppers, isolation gates, and variable rate feeders. The belt feeders feed two crushers which can feed transfer conveyors C-6A and C-6B. Conveyors C-6A and C-6B transfer the coal to the Plant Transfer Building, each at a rate of 800 tph. Conveyors C-6A and C-6B are each equipped with electronic metal detector, paint marking system, electronic belt scale and 2-stage "as-fired" sampling systems (similar to the "as-received" sampling system).
- Plant Transfer Building: Conveyors C-6A and C-6B transfer coal to a surge hopper in the Plant Transfer Building. The surge hopper has four variable rate feeders which feed the tail end of transfer conveyors C-101A and C-103A and tripper conveyors C-101B and C-102B. Each conveyor is rated at 800 tph. Transfer conveyors C-101A and C-103A feed the Boiler 1A tripper conveyors C-102A and C-104A, respectively. There are two traveling tripper conveyors over each row of coal silos (two for boiler 1A and two for Boiler 1B). Each tripper is self-propelled with single leg discharge and a flat belt seal system over the silo top opening.
- Dust Control: Dust control for the coal handling system would consist of a spray foam system which would spray at various points in the conveying system to prevent dusting.

1.2.3 Coal and Sorbent Preparation and Feed

The coal preparation and feed system includes the coal silos, feeders, pulverizers, and piping to the coal burners. This equipment is provided by the turnkey boiler vendor.

The sorbent preparation and feed system includes the Scrubber Additive Preparation System which prepares, stores and supplies limestone slurry for the scrubber modules. The Scrubber Additive Preparation System for the first 600 MW power block (Boiler 1A) consists of two horizontal closed circuit ball mill systems, one operating and one standby, which produce a 30% solids limestone slurry with product size of 90% passing 325 mesh. The mill systems are each rated at 33 tph and operate continuously. The product slurry is stored in a 430,000 gallon storage tank for use by the Scrubbers. The tank is constructed of rubber lined carbon steel, 50-feet diamater. x 32-feet tall. An additional system of 1 mill and one storage silo is required for each subsequent 600 MW power block with an additional 430,000 gallon slurry tank to be added at phase 3 such that at 2,400 MW, the slurry tanks would have a capacity for 12 hours. At the full 2,400 MW buildout, there would be five storage silos and five mill systems with one spare for the entire 2,400 MW.

Each mill system includes a limestone feeder with weigh scale, a horizontal, closed circuit, trunnion type ball mill (with gear reducer, clutch, lubrication system and drive motor), a mill slurry sump tank, two mill classifier feed pumps, a mill classifier with hydrocyclone modules, ball charging hopper, and hoist.

The mill classifier assemblies produce limestone slurry by gravity through a distribution box to the limestone slurry storage tank.

1.2.4 PC Boiler and Accessories

The Steam Generator and Auxiliary Equipment (the Boiler Island) which would be provided by a turnkey vendor includes the following for the first phase of construction (600 MW). The requirements for each successive 600 MW phase of construction are similar.

Steam Generator (Boiler) for producing 600 MW power which would include:

- Furnace,
- Superheater,
- Superheater Desuperheaters,
- Reheater,
- Economizer,
- Boiler Structural Steel and platforms,
- Foundations,
- Insulation and lagging,
- Soot Blowing Steam System,
- Two FD Fans and electric motor drivers and isolation and control dampers,
- Two PA Fans and electric motor drivers and isolation and control dampers,
- Two Secondary Air regenerative air heaters,
- One Primary Air regenerative air heater,
- ID Fans and electric motor drivers and isolation and control dampers,
- Interconnecting ductwork and dampers,
- Two Stages of air preheating coils (at FD Fan inlet and at FD Fan outlet),
- Ignitor Fuel Oil System,
- Particulate Removal System,
- Flue Gas Desulfurization System,
- Limestone Handling and Preparation System,
- Coal Handling and Feed System,
- Instrumentation and Controls for all equipment in scope,
- Bottom Ash, Fly Ash, and Gypsum conveying systems, and
- Continuous Emissions Monitoring Equipment.

The Boiler Island interfaces include:

- Feedwater Inlet,
- Main Steam Outlet,
- Cold Reheat Inlet,
- Hot Reheat Outlet,
- Boiler Blowdown and Blowoff Tank drains,
- Boiler Drains,
- FGD Waste (slurry pump discharge),
- Bottom Ash conveyor discharge,
- Fly Ash Holding Silo Unloading discharge points
- Cooling Water Supply,
- Cooling Water Return,
- Control Air, and
- Fire Protection Water Supply.

1.2.5 Hot Gas Cleanup

The flue gas cleanup systems are provided by the turnkey boiler vendor and include particulate collection and flue gas desulfurization. Selective Catalytic Reduction is not included but may be required if a BACT analysis so indicates. The NO_x emissions are to be limited to 0.15 Lb/MMBtu. Low NO_x burners are provided to achieve this.

Particulates (fly ash) are collected in an electrostatic precipitator system which is located in the flue gas path at the outlet of the air heaters and just upstream of the induced draft fans. The system is designed to meet an emissions limit of 0.03 lb/MMBtu heat input. The fly ash collected by the precipitator elements collects in the hoppers at the bottom of the casing and is pneumatically conveyed to the fly ash collection silos which are located near the waste ash disposal area.

Flue Gas Desulfurization is accomplished by a wet flue gas scrubber which utilizes a limestone slurry which reacts with the SO_2 in the flue gas to form salable gypsum product. The scrubber is designed for 95% SO_2 removal. The scrubber is located downstream from the induced draft fans and includes one absorber module per 600 MW power block. There is no reheat and there is no spare capacity. The scrubbed flue gas is directed to one of the flues in the chimney (which serves two boilers). The gypsum is pumped as a slurry to the on site gypsum wet stacking areas where the dewatering occurs. The runoff from the wet stacking area is collected and routed to the recycle basin which is the collection point for all the waste storage areas as well as coal pile runoff. The recycle basin has a pumping station which pumps the collected liquid back to the scrubber system for re-use.

1.2.6 Ducting and Stack

The ducting includes the primary air and secondary air ducts supplying the new boiler and the ducts carrying flue gas exiting the boiler and through to the stack.

The primary air ductwork is from the primary air fans to the air heater to the pulverizers where pulverized coal is added to the air stream which enters the coal piping going to the coal burners on the boiler.

The secondary air ductwork is from the outlet of the forced draft fans to the air heater and on to the windbox of the new boiler.

The flue gas, after exiting the economizer section of the new boiler, enters ductwork carrying it to the air heaters and then to the electrostatic precipitators. From the precipitators, the ductwork carries the flue gas to the inlet of the induced draft fans. From the outlet of the induced draft fans, the ductwork carries the flue gas to the scrubber and then to the stack.

A single stack is provided for each 1,200 MW power block (serving two boilers). The stack contains a single independent flue for each 600 MW boiler. Stack height is based on the GEP (Good Engineering Practice) stack height calculation which results in a stack height of 503 ft.

1.2.7 Steam Turbine-Generator

Each 1,200 MW phase of operation includes two new HP Turbine-Generators (one associated with each new boiler), one new IP Turbine (to replace the existing nuclear plant HP Turbine), and one existing LP Turbine which along with the IP Turbine is coupled to one existing generator. The new HP Turbines would each be located in a new turbine island building adjacent to and south of the new boiler island. The new turbine building would house all the associated HP Turbine-Generator equipment as well as the two new HP feedwater heaters (0A and 1A).

The IP and LP Turbine-Generators are located in the existing turbine building along with the condensate system equipment, boiler feed pumps and deaerator.

1.2.8 Cooling Water System

1.2.8.1 New Power Block Cooling Water System

The new Power Block area, which includes the boiler, flue gas treatment, high-pressure topping turbine, and high-pressure feedwater heaters has the following cooling loads:

- Generator Hydrogen Cooling,
- Alternator Cooling,
- Stator Winding Cooling,
- Bus Duct Cooling,
- Turbine Lube Oil Cooling,
- Electro-Hydraulic Control Oil Cooling,
- Primary Air Fan Bearing Cooling,
- Forced Draft Fan Bearing Cooling,
- Pulverizer Bearing Cooling,
- Boiler Access Door Cooling, and
- Sample Cooling.

These loads are cooled by a new once-through open cycle cooling water system. A new 12 in supply header is provided to each 600 MW power block. The 12 in header for each power block branches off each of the four existing 36 in essential raw cooling Water headers which are located underground in the vicinity of the new power block. During the initial 600 MW phase of construction, stub-ups would be provided for the entire 2,400 MW buildout. As each phase of construction commences, the stub-up for that phase would be uncapped and the header would be extended through the plant to the associated equipment for that phase. The return header is an 18-in header which is common to two 600 MW power blocks and is routed to the existing control building where it ties into the 42-in headers which return the water to the cooling tower basins as makeup. The full 2,400 MW buildout has two 18-in cooling water return headers routed from the new power block area to the control building which house the existing two 42-in cooling tower basin return lines (which serve as cooling tower makeup lines).

1.2.8.2 Existing Turbine Building Cooling Water System

The existing raw cooling water pumps (4 for each 1,200 MW power block) provide the cooling water requirements for the existing Secondary System (non-nuclear power generation equipment). This system would be re-used. The four pumps take suction from the condenser circulating water supply duct, just upstream from the inlet to the main condenser. The heated water is returned to the condenser circulating water return duct, downstream from the main condenser outlet. Raw water recirculating pumps are included in this system to recirculate heated water to the generator coolers to maintain a minimum cooling water temperature.

1.2.9 Ash Handling System

Bottom ash and fly ash from the boiler gas passage hoppers is collected from the boiler area by a submerged scraper conveyor. The system cools the ash as it drops through the water filled trough of the conveyor and dewaters it as it is conveyed and lifted out of the trough. The ash is conveyed to a discharge point where a flop gate directs the ash into a truck for transport to the disposal area or onto a belt conveyor for conveying to a temporary storage area.

Fly ash from the electrostatic precipitators is collected in hoppers below the casing of each precipitator. A dense phase pneumatic conveying system is provided which conveys the fly ash to either of the two fly ash storage silos which each have a three day storage capacity. The silos are equipped with a fluidizing air system, dustless unloader, and pug mill ash conditioner so that the ash may be unloaded dry into an enclosed transport vehicle, or wet into the bed of an open haul truck for disposal at the on site ash disposal area. The silos are also equipped with vent filters and level instrumentation. Two silos are provided for each 600 MW power block. The silos would require truck unloading at the rate of four 24-ton trucks per hour on a 40-hour per week basis for each 600 MW power block.

1.2.10 Improvements to Site

1.2.10.1 Site Arrangement

The suggested site arrangement for the Pulverized Coal Plant is in Appendix B. The Civil/Structural features and work necessary to implement this arrangement are described in the sections that follow. The location of the new power generation blocks was determined from an economic analysis of three possible locations: east of the existing service & office building (the location decided upon), the area directly east of the auxiliary building, and the area south of the cooling towers. The main factors in the resulting location were the longer distances required to run high energy piping for the location south of the cooling towers and the greater excavation required for the area east of the Reactor Building.

1.2.10.2 Demolition

To accommodate the new power plant, existing buildings and utilities would require demolition or relocation. The buildings and utilities requiring demolition or relocation are generally located south and east of the existing plant site. The following would require demolition:

- Power Stores Warehouse,
- Construction warehouses and storage buildings, including concrete slabs and underground utilities. Approximately 50 buildings are included, and
- Fencing.

The following would be relocated:

- Construction office located east of the hot machine shop,
- Mechanical fabrication, electrical fabrication, and paint/solvent shops, and
- Miscellaneous underground and overhead utilities.

Cooling tower blowdown lines would be lowered to prevent interference with barge traffic in the barge unloading area.

The barge unloading area would consist of a loaded barge storage dock, unloading dock, and empty barge storage dock. The docks would be constructed of cells interconnected with walkways. The cells would be constructed of sheet pile walls with a granular fill material. Cells which support the barge unloader equipment and barge pulling equipment would be topped with 2-feet thick reinforced concrete slabs. Fifty 20-feet diameter cells have been included in the estimate plus a double cell at the barge unloading structure.

To accommodate the draft of the barges, the two existing cooling tower blowdown diffuser pipes would need to be lowered. The pipes are 54-inch diameter approach pipes with 42 and 36 in diffuser pipes at each end. Approximately 425 ft of one pipe and 475 ft of the other blowdown diffuser pipe would be lowered from the barge unloading dock to the end of the pipes. The pipes would be lowered approximately five ft and be bedded similar to their current construction. Lowering of the pipes would require approximately 1,000 cubic yards of soils and 1,000 cubic yards of rock excavation in the river bed.

In addition to lowering the diffuser pipes, the river in the area of the barge storage and loading areas would require dredging.

1.2.10.3 Site Preparation

The boiler island and the high pressure turbine-generator island would be constructed in an area to the east of the existing plant site. After completion of demolition described above, this area would be cleared and grubbed to remove existing vegetation. The area would be leveled to elevation 640 for construction of the plant. This elevation was selected to provide the best balance between cuts and fill with consideration of the underlying rock elevation.

The existing ERCW pipes and conduit banks which are located underground in this area would not be relocated. Foundations which are above these pipes and conduit banks would be designed to span over them without placing excessive forces on the pipes or conduit banks.

1.2.10.4 Fly Ash And Bottom Ash Disposal

The fly ash and bottom ash disposal areas are shown (along with the gypsum disposal storage areas) in Appendix B. Phase I disposal for fly ash and bottom ash would be provided by a common pile located northwest of the existing plant. An existing water tank and pumphouse would require demolition to make way for the disposal area. The existing road which loops past the training facility and back to the main road would be abandoned.

The disposal area would be surrounded by a dike to elevation 605 to protect the pile from a 500 year flood. The area would not be lined. Runoff from the area would be collected and piped to the recycle basin.

Fly ash and bottom ash would be placed in separate piles within the disposal area and the piles would be allowed to run together. The disposal area occupies an area of approximately 110 acres and would be piled to a maximum height of 200 ft. The sides of the pile would have slopes of 3:1 with 15-feet wide benches at 25 feet intervals. A haul road would be provided for access to the pile. The pile would be covered with earth taken from borrow areas on site.

The Phase I disposal area would provide approximately 14 years of disposal at 2,400 MW. After the Phase I area is filled, a new disposal area would be created on the hillside between the river and the plant. This area of the site has the potential to hold an additional 27 years of ash disposal.

As an option, a disposal area could be provided in the area to the south and west of the cooling towers. Full utilization of this area would require that the existing 500 kV transmission line be relocated. This area has the potential for 18 years of ash disposal.

1.2.10.5 Gypsum Disposal

Disposal for gypsum would be provided by a pile located north of the existing plant. The existing north access road would be closed to provide the maximum possible volume in this area. A road at the base of the pile between the pile and town creek would provide a means of egress in that direction from the plant site.

The disposal area would be surrounded by a dike to elevation 605 to protect the pile from a 500 year flood. The area would be lined. Runoff from the area would be collected and piped to the recycle basin.

The disposal area occupies an area of approximately 196 acres and would be piled to a maximum height of 200 ft. The sides of the pile would have slopes of 3:1 with 15-feet wide benches at 25 feet intervals. A haul road would be provided for access to the pile. The pile would be covered with earth taken from borrow areas on site.

The eastern edge of this disposal area was stopped at the edge of the potential SWMU's (Solid Waste Management Units). Stopping the pile at this location would provide approximately 20 years of disposal at 2,400 MW. If the pile is allowed to extend to the river, the disposal area has the potential to add 20 additional years of capacity.

1.2.10.6 Coal Storage

The coal pile would be located on a predominately level area south of the cooling towers. This area was chosen over the area to the east of the cooling towers to reduce earthwork costs for preparation of the coal pile area. The area to the east of the cooling towers would have required considerable excavation into the existing hillside to create a level area for the coal pile.

The coal pile would be sized for a 30 day supply of coal based on the requirements for 2,400 MW. The area under the coal pile would be lined to prevent runoff from infiltrating the ground water. Prior to placing the lining, the area would be probed and voids in the rock would be grouted. A geotextile would be provided under the liner to provide protection to the liner. The liner would be covered with four feet of graded fill material equipped with an underdrain system to collect leachate. Runoff from the coal pile would be collected and pumped to the recycle basin.

1.2.10.7 Limestone Storage

Limestone storage would be provided in an area east of the existing plant. The limestone storage area would not be lined. Run off from this storage area would be collected and pumped to the recycle basin.

1.2.10.8 Bottom Ash Day Storage

After the bottom ash is conveyed out of the collection trough, it is discharged either into the bed of a haul truck for transport to the on site disposal area or it is discharged onto a nearby storage pile until such time as it can be loaded onto a haul truck for on site disposal.

1.2.10.9 Recycle Basin

A recycle basin would be provided in an area west of the existing intake pumping station. This recycle basin would accept flow from the ash storage area run off, gypsum storage area run off, coal pile run off, limestone storage run off, cooling tower blowdown, and miscellaneous other drains. Water from the recycle basin would be re-used. This basin would be lined.

1.2.10.10 Foundation Design

Foundation systems final design is dependent upon the depth of soil over rock and the extent of sinkholes and subsurface voids at the location of each structure.

Heavily loaded and settlement-sensitive structures are founded on rock. Where rock is determined to be near the ground surface, a reinforced concrete mat is placed on rock after excavating any voided rock zone. If the rock is too deep to allow the use of a mat, drilled piers or piles would be used. For purposes of the estimate we have assumed mat foundations founded on rock.

Lightly loaded structures or structures which allow some settlement, such as tanks, are supported by spread footings or mat foundations. If significant subsurface voids are detected, ground improvement using probe and grout may be used to limit the potential for the collapse of voids or subsidence of soil into voids.

2.0 Natural Gas Combined Cycle (NGCC)

2.1 Conversion Plan Description

The Bellefonte conversion using NGCC would convert only one Bellefonte steam turbine. To leave Unit 1 available for potential nuclear service, only Unit 2 is converted. Convertion consists of nine new natural gas fired combustion turbine-heat recovery steam generator (HRSG) blocks that send steam to a new Unit 2 1,800 rpm replacement HP turbine section and the existing Unit 2 LP steam turbine-generator. Superheated steam is generated in dedicated heat recovery steam generators and expanded through the steam turbine.

Full buildout of the facility is planned by developing three phases of three CTs-HRSGs. The NGCC power plant consists of nine Westinghouse 501F combustion turbines with dedicated HRSGs located in a power block located to the south of the existing Bellefonte cooling towers. The HRSGs are of a three pressure design with the high pressure section superheater feeding the new HP turbine section. The HRSG intermediate pressure section superheater supplies steam to mix with the HP turbine section outlet steam, providing steam to the LP turbine section. The HRSG low pressure section supplies an integral deaerator.

2.2 Design Criteria

2.2.1 Design Basis

The design basis, related to this conceptual study, is as follows.

- Convert Bellefonte Unit 2 only, and preserve as much of Unit 1 as possible. The Unit 2 design should accommodate provisions for converting of Unit 1.
- Utilize as much of Bellefonte Unit 2 equipment and facilities as is cost effective.
- Transmission system limitation is 2,400 MW at 40°C (104°F) and 115% of 2,400 MW (2,760 MW) at 0°C (32°F). The replacement of two power circuit breakers at the Madison Substation is required to exceed the 2,400 MW limitation. To meet the 2,400 MW limitation under all temperature conditions, the combustion turbine combined cycle plant would be limited to a nominal net capacity of 2,400 MW at performance rating conditions of 15°C (59°F).
- The existing Bellefonte LP Steam Turbine is converted by implementing only one of the two double flow sections to allow for reasonable low load turndown. This limits the LP Turbine inlet steam flow to a maximum of 5,400,000 lb/hr. The minimum allowable steam flow is 1,200,000 lb/hr.
- Advanced (“G”) technology combustion turbines, with 2350+°F firing temperature are used as the basis for conceptual design and cost estimate. Advanced (“F”), GT 24 and ATS machines were modeled. Conceptual design and layout differences are noted for these options in the report.

- The existing steam turbine bypass system passes approximately 7.3 million lb/hr of steam at 1049.7 psia and 630°F. Therefore, upon loss of the high-pressure or low-pressure steam turbine, steam from the HRSGs may be attemperated to the equivalent enthalpy and injected up to this maximum rate. This arrangement permits all combustion turbine capacity to be maintained and operated (using the steam bypass system) upon a trip of the high-pressure or low-pressure turbine.
- Combustion turbine supplemental backup fuel is not included.
- HRSG duct supplemental firing is included for operational considerations and power augmentation for operation with less than nine CTs in operation.
- Hot gas bypass is included to allow continued operation in simple cycle mode should the steam turbine-generator or condenser become unavailable. Switching to total simple cycle operation would impact approximately 730 MW, and 1,570 MW would remain available from combustion turbine simple cycle operation.
- Design capacity factor is 85% for NGCC.
- The natural gas combined cycle is installed in phases, with approximately 1 year between phases. All construction would be in phases of two or three combustion turbine-heat recovery steam generators (CT-HRSG) per phase.

Phase	Approximate Plant Capacity upon Completion (for F machines)
1	731 MW
2	1,466 MW
3	2,206 MW

Phase	Approximate Plant Capacity upon Completion (for G machines)
1	628 MW
2	1,256 MW
3	2,248 MW

- Ambient dry-bulb temperature range is -29 to 43°C (20 to 110°F). One percent design wet-bulb temperature is 26°C (78°F). One percent design dry-bulb temperature is 35°C (95°F). Average annual relative humidity is 70%. Average annual precipitation is 1.4 m (55 in). Existing plant site elevation is 192 m (630 ft) above sea level. New combustion turbine-HRSG plant site elevations would be stepped to conform to existing grade and underlying rock elevations. With full buildout there would be three different plant site elevations.
- Minimal discharge to Town Creek is allowed for non-contaminated surface water runoff. All sumps have controlled discharge via CCW diffuser. Design for minimum wastewater discharge from the plant site.
- During construction, surface water runoff is collected in a settling pond to allow settling of solids and monitoring the water quality discharged to Town Creek. This pond is left in place for operation to be utilized as a containment for any spill and for future regulation requirements.

2.2.2 Natural Gas Feed

Natural gas would be supplied to the Bellefonte Plant site by means of a buried gas line. Onsite, the gas line branches into supply lines to each block of two combustion turbines.

Pipeline	Natural Gas per Combustion Turbine
Flow, lb/hr	73,870
Parallel Lines	1
Press, psig	400
Temp, ^{o}F	60
Main Line Size, in.	24

Fuel gas delivery to the site is anticipated to be 400 psig. For the F machines, this is adequate pressure so that gas compressors are not required. For the ATS, G and GT 24, gas compression may be required, however, costs for gas compression were not included in the scope of this supply. A pressure regulating station is provided for each block of two combustion turbines. The fuel gas supply to each combustion turbine includes a gas scrubber, dual gas filters, and flow metering equipment. A drain tank is provided for each block of two combustion turbines to collect wastewater discharged from the fuel gas scrubbers and filters.

The Fuel Gas System delivers cleaned fuel gas to the combustion turbine fuel flow control equipment at the pressure range required by the combustion turbine manufacturer through carbon steel piping. The main fuel gas header is 24-inches diameter.

2.2.3 Combustion Turbine and Accessories

The combustion turbines would be provided by the turnkey vendor. Three types of Advanced “F” Technology combustion turbines are available in this size range: The ABB GT 24; the General Electric MS7231FA; and the Westinghouse W501F. All three vendors are involved in the U.S. DOE Advanced Turbine Systems (ATS) program. Vendor estimates of capital costs of the General Electric and Westinghouse turbines in this class are roughly equivalent, with the cost of the ABB machine being slightly higher. Results with the GE would be very close, with the ABB machine generating higher electrical output due to recent performance improvements.

The Advanced “G” Technology and ATS combustion turbines were also modeled. The combustion turbine-generator selected for this application is based on the Westinghouse 501G. This machine is an axial flow, single spool, constant speed unit, with variable inlet guide vanes. The combustion turbine is provided with dry low NO_x burners for natural gas firing. Although the 501F is used here, the other combustion turbines would be compared to the 501F.

The ATS technology was investigated. There are concerns for the use of the ATS machine due to lack of maturity. To date, no ATS technology units have been built. This alone would rule out the ATS machines as a viable option. However, due to the performance potential of the ATS technology, the ATS was modeled. Modeling results indicate that the ATS technology is reasonable for greenfield or brownfield configuration but is not recommended for Bellefonte conversion.

2.2.4 HRSG, Ducting and Stack

2.2.4.1 HRSG

The HRSG, ducting, bypass stack and stack would be provided by the turnkey vendor. Each of the heat recovery steam generators is a drum type, triple pressure design that is matched to the characteristics of Westinghouse 501F exhaust gas when firing natural gas. The HRSGs are flat bottom, natural circulation, bottom supported units equipped with inlet and outlet ductwork, insulation and architectural lagging, bypass stack, diverting damper and exhaust stack. All heat transfer in the steam generator is accomplished by convection through banks of finned tubes.

Major equipment supplied with the HRSG include an integral deaerator and economizer, an IP economizer, a steam drum with IP evaporator, an IP superheater, an HP economizer, a steam drum with HP evaporator, and an HP superheater.

NO_x emissions are controlled in the combustion turbine by use of dry low NO_x combustors.

Insulation and architectural lagging of the HRSG exterior walls, ducts, and piping are provided to reduce heat loss from the unit and to provide safe maintenance areas around the steam generator.

Safety valves and vent piping are provided for overpressure protection. Blowdown tanks are provided to receive HRSG high energy drains.

Each HRSG is of the modular design, comprising approximately six modules, and is provided with easy access to valves and operators and other equipment requiring maintenance.

The Heat Recovery Steam Generator System is designed for the maximum possible combustion turbine exhaust gas flow.

The G machine HRSG nominal steam conditions are as follows:

High-Pressure Steam	602,400 lb/hr at 1,005 psig and 1,005°F
Intermediate-Pressure Steam	117,800 lb/hr at 91 psig and 404°F.
Low-Pressure Steam	Operates at 8 psig and saturation temperature (integral deaerator).

The F machine HRSG nominal steam conditions are as follows:

High-Pressure Steam	520,600 lb/hr at 1,006 psig and 1,005°F
Intermediate-Pressure Steam	71,153 lb/hr at 77 psig and 417°F.
Low-Pressure Steam	Operates at 8 psig and saturation temperature (integral deaerator).

2.2.4.5 Stack

There are nine steel shell combined cycle chimneys with an 18 ft inside diameter and 200-ft height. This study uses 200-ft height. A stack of the full 200-ft height is not necessary for meeting area concentrations, however Good Engineering Practice (GEP) is 200 ft. If the stack is less than GEP (200 ft), downwash modeling would have to be done before using the reduced height. One lined steel shell stack is used for each heat recovery steam generator unit. The system includes an access ladder, gas sampling platforms, and aviation warning lights.

2.2.4.7 Bypass Stack

The HRSG is provided with an inlet bypass stack and diverting damper at the inlet of the HRSG for start-up and emergency simple cycle operation. The bypass stack is approximately 85-100-feet tall due to the better dispersion at the elevated exhaust temperatures.

2.2.5 Steam Turbine-Generator

The Steam Turbine-Generator System consists of two turbines: high-pressure turbine and the low-pressure turbine-generator.

2.2.6 Cooling Water System

2.2.6.1 CT-HRSG Auxiliary Cooling Water System

The Auxiliary Cooling Water System provides cooling water to all the components in the new CT-HRSG power block which require water cooling. This includes for each CT-HRSG set:

- Combustion Turbine-Generator Hydrogen Cooler,
- Combustion Turbine Lube Oil Cooler,
- Combustion Turbine Electro-Hydraulic Control Oil Cooler,
- Boiler Feed Pump Lube Oil Cooler,
- Steam Cycle Sampling System Coolers, and
- CEMs Equipment Coolers.

A new 36 inch header would supply cooling water from the existing Essential Raw Cooling Water Headers located in the existing Auxiliary Building to the new CT-HRSG power block. The header would have two supply sources, the “A” ERCW header and the “B” header. Either of these sources can be open or isolated to the header which would provide redundancy to the cooling water system. At the power block, the single header would supply the individual cooling loads by a distribution piping system. The oil coolers and hydrogen coolers would have temperature control valve bypasses (provided by the equipment supplier) to maintain required setpoint temperatures. The heated water would be returned to the cooling tower basin by a new 36 inch header.

The full size supply and return headers would be installed with the initial power block construction phase. The following phases would only require extension of the header. Isolation valves would be provided at the end of the header during each phase of construction to allow the buildout without interruption of cooling water to equipment operating from the previous phases.

2.2.6.2 Turbine Building Auxiliary Cooling Water System

The auxiliary equipment requiring cooling in the existing Turbine Building would be cooled by the existing raw cooling water system. This system pumps condenser circulating water (CCW) from the CCW inlet duct just upstream of the main steam turbine condenser into the cooling water distribution piping system and returns the heated water to the CCW discharge duct, downstream from the main steam condenser outlet, for return to the cooling tower. No appreciable modification to this system would be required.

2.2.7 Improvements to Site

2.2.7.1 Site Arrangement

The suggested site arrangement for the Natural Gas Combined Cycle Plant is shown in Appendix B. The Civil-Structural features and work necessary to implement this arrangement are described in the sections that follow.

2.2.7.2 Site Preparation

The Combined Cycle Plant site is located in an area south of the existing cooling towers. The area slopes downward from east to west and was used as a construction laydown, storage, and parking area during construction of the nuclear plant. The site preparation work includes demolition and removal of the following:

Construction warehouses and storage buildings, including concrete slabs and underground utilities. Approximately 40 buildings are included.

- Desilting pond,
- Alum sludge ponds,
- Fencing,
- Clearing and grubbing of site areas, and
- Earthwork to provide a level stepped for the units.

Site Improvements

- The site improvements include the following new features,
- Asphalt roads and parking areas,
- Potable waterline,
- Natural gas pipeline,
- Soils exploration and underground voids detection,
- Grouting underground voids in rock,
- Sanitary sewer system connection to existing sewage treatment plant,
- Storm drainage system, including oil/water separators,
- Combustion turbine yard runoff pond/wastewater collection basin,
- Security fencing and gates,
- Crushed stone surfacing within the power block area, and
- Finish grading, seeding, mulching, and fertilizing.

3.0 Integrated Gasification Combined Cycle (IGCC)

3.1 Conversion Plan Description

Conversion consists of eight new integrated gasification combined cycle blocks that send steam to a new 1,800 rpm topping turbine and existing LP steam turbine generator. Coal is gasified in each of the gasification units. No. 2 fuel oil is the start-up fuel. The synthesis gas produced in each gasifier is cleaned of impurities and fired in advanced combustion turbine generators. Steam is generated and superheated in dedicated heat recovery steam generators, then expanded through the steam turbine.

An air separation plant is constructed for each gasifier to supply the pressurized 95% (by volume) oxygen required for the oxygen blown gasifiers. The air separation units receive part of their air from the combustion turbine compressors and return excess nitrogen to the combustion turbines for power augmentation and NO_x control.

New coal handling facilities for barge unloading of coal are constructed to deliver fuel to the gasification blocks. The existing Unit 2 cooling tower and circulating water systems are utilized for cycle heat rejection. The existing substations are augmented. A new auxiliary power system is constructed. A new Distributed Control System is constructed. A new slag storage area for gasifier solids is constructed.

3.1.1 Configuration

The IGCC power plant is composed of eight trains, each with an oxygen-blown Texaco entrained flow quench mode gasifier integrated with an “F” technology combustion turbine, followed by one heat recovery steam generator. Steam produced from the gasification train and HRSG is fed to the existing Bellefonte steam turbine to produce a net total of 1,951 MW. Raw gas exiting each gasifier is quenched in the bottom of the gasifier to an equilibrium temperature of 475°F, followed by convective coolers and knockout drums to reach a gas cleanup temperature of 105°F. Sulfur compounds are removed with a Dow Gas Spec selective amine process, then recovered as elemental sulfur from a Claus plant. The Claus plant is followed by a Beavon-Stretford tail gas treatment process.

3.1.1.1 Gasification

Each Texaco gasifier is a single stage, pressurized, down-flow entrained bed process featuring a water slurry feed, sized for a nominal throughput of 3,000 TPD as-received coal. Feed coal is finely ground (70% passing through 200 mesh), then slurried with enough water to make a 65% coal/35% water slurry (includes coal moisture). The coal/water slurry and 95% pure oxygen are then fed into a burner mounted at the top of the gasifier. The gasification reactions take place at approximately 2,700°F. No steam injection is required since the water in the slurry moderates the reaction. By maintaining the operating temperature above the ash fusion temperature of the coal, molten slag forms and coats the walls, then drains by gravity into a water-filled slag tank where it is quenched and shattered. Slag, suitable for landfill, is removed from the bottom of the gasifier through a water-sealed lock hopper. In the quench gasifer mode, hot raw gas leaving the gasifier is cooled and water quenched by passing downward through an annular water-flooded quench ring along with the slag where the equilibrium temperature of 450°F is reached. Following the quench, the gas temperature is cooled to 105°F in a convective cooler and condensed water is removed in knockout drums before entering the sulfur removal process.

3.1.1.2 Fuel Gas Cleaning and Sulfur Recovery

During this cooling, any NH_3 remaining in the fuel gas stream is condensed and sent to the waste water treatment section. No separate COS hydrolysis unit is needed since the Gas Spec solvent absorbs both COS and H_2S. The cool raw gas is routed to a counter-current absorber where it contacts the Gas Spec solvent. Approximately 99.4% of the H_2S is removed from the raw gas stream. Clean fuel gas then flows to the fuel gas preheater.

The Dow Gas Spec reduction process was selected because of its high selectivity towards H_2S over CO_2. This is needed for the desulfurization of fuel gases with the relatively high CO_2 concentrations produced by a Texaco gasifier. For the Gas Spec stripper, medium pressure steam (150 psia) is used to regenerate the Gas Spec solvent in a separate stripper column. The H_2S containing gas stream, or acid gas, is routed to the Claus Plant.

Elemental sulfur is produced from the separated H_2S in the sulfur recovery unit (Claus unit). The tail gas from the sulfur recovery unit, which contains three to five percent of the original sulfur removed by the Gas Spec solvent, is treated in a Beavon-Stretford tail gas treating unit. In the gas treating process, at least 90% of the remaining sulfur compounds are recovered, resulting in a total sulfur recovery of 99.5% based on the original sulfur removed in the acid gas removal unit. The only contaminants in the cleaned fuel gas leaving the acid gas removal unit are residual H_2S and HCN, both in very low concentrations.

3.1.1.3 Air Separation Unit

Each air separation plant is designed to produce a nominal output of 2,500 tons/day of 95% pure O_2. The high pressure plant is designed with liquefaction and liquid oxygen storage providing an eight hour backup supply of oxygen.

The oxygen stream is produced in the air separation unit (ASU) from the combustion turbine compressed air supply (216 psia). Separation occurs in a “cold box” by means of cryogenic distillation. Prior to the distillation, water and CO_2 are removed by molecular sieves. Medium pressure steam (350 psia) is used to regenerate the molecular sieves.

The efficiency of the cycle is improved by using the combustion turbine compressor to supply part of the air to the ASU. The oxygen stream (95% purity) is compressed to 500 psia for usage in the gasifier. The remaining nitrogen stream from the ASU is compressed (using intercooling) and fed to the combustion turbine burners to reduce NO_x emission, as well as providing additional gas flow.

3.1.1.4 Combustion Turbine

Three types of “F-Technology” combustion turbines are available in this size range: The ABB GT-24; the General Electric MS7231FA; and the Westinghouse W501-F. All three vendors are involved in the U.S. DOE Advanced Turbine Systems (ATS) program. Vendor estimates of capital costs of the General Electric and Westinghouse turbines in this class are equivalent to within 6 percent, with the cost of the ABB machine being slightly higher. Westinghouse is currently testing medium-Btu combustors for use with advanced pressurized fluidized bed combustion (PFBC) systems. However, General Electric Frame

MS7231FA combustion turbines have been used in the most IGCC applications, and have been selected for this application as well.

3.1.1.5 Steam Recovery and Generation

The only steam generated from the quenched gas path is low pressure steam which is integrated with feed to the existing Bellefonte steam turbine. High pressure steam is generated in a HRSG.

The Steam Turbine-Generator System consists of two turbines: high-pressure turbine and the low-pressure turbine-generator. The high-pressure (HP) turbine receives steam from the HRSG HP superheater outlets via the HP steam piping. The new HP turbine replaces the existing HP turbine to accommodate the following nominal steam conditions:

- Throttle Temperature--1,000°F.
- Throttle Pressure--1215 psia.
- Exhaust pressure--67 psia.

The low-pressure (LP) turbine generator consists of existing Unit 2, which is one of two existing ABB tandem compound 1,800 rpm double flow low-pressure (LP) turbines located in the existing Turbine Building. In addition, a 1,800 rpm hydrogen cooled generator, capable of an output of 1,314 MW, is existing and is reused. Both LP sections would be needed to handle the steam flow.

3.2 Design Criteria

The systems, components, and structures constituting the converted Bellefonte Unit 2 station are further described in this section. This section states the design criteria established by TVA to direct conceptual design for the IGCC Option. The resultant design is then described by functional areas within the power plant.

3.2.1 Design Basis

The Design Basis for this conceptual study is presented in three groups: plant design criteria, site characteristics, and emission limits. Site characteristics and emission limits are listed in Section 4. Plant design criteria for this conversion option are listed below.

- Convert Bellefonte Unit 2 only, and preserve as much of Unit 1 as possible. The Unit 2 design should accommodate provisions for converting of Unit 1.
- Utilize as much of Bellefonte Unit 2 equipment and facilities as is cost effective.
- Transmission system limitation is 2,400 MW at 104°F and 115% of 2,400 MW (2,760 MW) at 32°F with the replacement of two power circuit breakers at the Madison Substation. To meet the 2,400 MW limitation under all temperature conditions, the combustion turbine combined cycle plant would be limited to a nominal net capacity of 2,400 MW at performance rating conditions of 59°F.
- Advanced ("F") technology combustion turbines, with 2350+ °F firing temperature are used as the basis for conceptual design.
- The existing steam turbine bypass system passes approximately 7.3 million lb/hr of steam at 1029.7 psia or 1015 psig and 630°F. Therefore, upon loss of the high-pressure or low-pressure steam turbine, steam from the HRSGs may be attemperated and dumped to the main condenser up to this maximum flow rate. This arrangement permits all combustion turbine capacity to be maintained (using the steam bypass system) upon a trip of the high-pressure or low-pressure steam turbine.
- Oil storage capacity allows for simple cycle operation of the combustion turbine during startup, which is conservatively assumed to be 24 hours.
- Coal is delivered either by barge or, if necessary, by barge and rail. The unloading facility should accommodate 12 barges.
- Selective catalytic reduction (SCR) is not included. Space is provided for possible retrofit at a later date.
- Design capacity factor is 85% for IGCC and 90 percent for chemical coproduction.
- The IGCC is installed in four phases of approximately equal generating capacity, with approximately 9 months between phases.
- If the flows from all gasifiers or all combustion turbines need to be combined into a single header, the header is sized to accommodate the final flows for the complete 2,400-MW plant.
- Design complies with TVA <u>Occupational Health and Safety Design</u> <u>Requirements</u> released March 1994.
- Sound level does not exceed OSHA standards for unlimited exposure with attenuation.
- A Distributed Control System is used.
- No asbestos is utilized.
- The coal specified for the study is Modified Illinois No. 6, the ultimate analysis of which is shown in Table 3.1-1.

Table 3.1-1 Modified Illinois No. 6 Ultimate Analysis

Constituent	As Received	Dry
Carbon	58.70%	68.29%
Hydrogen	4.00%	4.65%
Oxygen	7.90%	9.19%
Nitrogen	1.11%	1.29%
Sulfur	3.05%	3.55%
Ash	11.00%	12.80%
Moisture	14.04%	0.00%
Chlorine	0.20%	0.23%
Total	100.00%	100.00%
HHV Heating Value	10,229 Btu/lb	11,900 Btu/lb

3.2.2 Coal Handling

The Modified Illinois No. 6 bituminous coal is delivered to the site by barges measuring 35 ft x 195 ft. The 2" x 0 coal is discharged from the barge unloader onto a belt conveyor to the reclaim area. The conveyor passes under a magnetic plate separator to remove tramp iron, and then on to the reclaim pile. Coal from the reclaim pile is fed by two vibratory feeders, located under the pile, onto a reclaim conveyor which conveys the reclaimed coal to the crusher surge bin. The crusher surge bin with two isolation gates and variable rate feeders, feed coal into either of two crushers. The coal is reduced in size to 1" x 0 in the crushers, and then passed through flop gates onto two belt conveyors which transport the coal to the transfer tower. Two additional conveyors continue the transport of the coal to the top of the coal silos.

The Coal Handling System has the following design criteria:

- Barge unloading and stockout operation at 8 hours per day, 5 days per week,
- Coal reclaim operation at 8 hours per day, 7 days per week (56 hours per week),
- 30 days of total coal storage (excluding the silos),
- 3 days of live coal storage (excluding the silos), and
- 16 hours of storage in the silos.

Coal Handling Requirements and Design Basis (8 gasifiers)

- Coal Burn Rate,
- Maximum Coal Burn Rate = 1,988,592 lb/hr = 994 tph plus 10% margin = 1,094 tph ,
- (based on the 100% MCR rating for the plant, plus 10% design margin),
- Average Coal Burn Rate = 1,859,334 lb/hr = 930 tph,
- (based on MCR Rate multiplied by an assumed capacity factor) ,
- Coal Delivered to the Plant by Barge,
- Conveying Rate to Storage Piles = 3,905 tph (maximum, both conveyors in operation) ,
- Reclaim Rate = 3,905 tph,
- Storage Piles with liners, Run-off Collection, and Treatment Systems,
- Live Storage = 78,748 tons (72 hours at maximum burn rate), and
- Dead Storage = 669,360 tons (30 days at average burn rate).

The conceptual design for this area includes the new equipment and systems listed below.

- New coal receive & unload,
- New coal stackout & reclaim,
- New coal conveyors & yard crush,
- New other coal handling, and
- New Coal Handling Foundations.

3.2.3 Coal Preparation and Feed

After crushing, a conveyor delivers the Modified Illinois No. 6 coal to the rod mill feed hopper which provides a surge capacity of about six hours of downstream throughput. A vibrating feeder supplies the weigh feeder which in turn feeds the rod mill.

The rod mill grinds the coal to 200 mesh and wets it with treated slurry water from a slurry water tank. The slurry is then pumped from the rod mill product tank to slurry storage and slurry blending tanks, then fed to the pressurized Texaco gasifier.

The coal grinding and conveying systems are equipped with a dust suppression system consisting of water sprays aided by a wetting agent. The degree of dust suppression required would depend on local environmental regulations.

The slurry feed pump takes suction from the slurry run tank in the coal slurry section. The slurry feed pump discharge is sent to the feed injector. During preparation for start-up, the coal feed is diverted back to the slurry run tank. Oxygen from the air separation unit is vented during preparation for start-up and is sent to the feed injector during normal operation.

The conceptual design for this area includes the new equipment and systems listed below.

- New Coal Crushing,
- New Coal Conveyor and Storage,
- New Coal Injection System
- New Misc. Coal Prep and Feed,
- New Booster Air Supply System, and
- New Coal Feed Foundation

3.2.4 Gasifier and Accessories

Modified Illinois No. 6 coal is ground to 200 mesh and mixed with water and fed as a slurry to eight new pressurized Texaco oxygen-blown gasifiers. The slurry is fired with oxygen to produce medium Btu gas consisting mainly of CO, H_2, and CO_2. The gas is quench cooled to 400°F.

The gasifiers have the following features:

- Operating pressure of 480 psig.

- Partial integration with air separation unit (ASU). Part of the air into the ASU is supplied by the combustion turbine compressor, oxygen from the ASU is fed to the gasifier, and nitrogen from the ASU is forwarded to the combustion turbine combustors.
- Hot gas quench to 400°F
- Water wash to remove NH_3 and HCN
- Hydrolysis to convert COS to H_2S
- Selective chemical amine acid gas removal to remove H_2S, which is then concentrated and converted to elemental sulfur in a Claus plant.

The eight new air separation plants are designed to produce a nominal output of 19,551 ton/day of 95% pure O_2. Each gasifier train is designed with one full-capacity production train, with liquefaction and liquid oxygen storage providing an eight hour backup supply of oxygen.

3.2.5 HRSG, Ducting and Stack

3.2.5.1 HRSG

Each of the heat recovery steam generators is a drum type, triple pressure design that is matched to the characteristics of GE MS7231FA exhaust gas when firing coal gas. The HRSGs are flat bottom, natural circulation, bottom supported units equipped with inlet and outlet ductwork, insulation and architectural lagging, bypass stack, diverting damper and exhaust stack. All heat transfer in the steam generator is accomplished by convection through banks of finned tubes.

Major equipment supplied with the HRSG include an integral deaerator (LP steam drum), preheater, and LP evaporator; an IP economizer, IP steam drum with IP evaporator, an IP superheater; an HP economizer, an HP steam drum with HP evaporator, and an HP superheater.

3.2.5.2 Stack

There are 4 lined steel shell chimneys, 22 ft inside diameter and 325-feet high. One lined steel shell chimney is used for each two heat recovery steam generator units.

3.2.5.3 Bypass Stack

The HRSG is provided with an inlet bypass stack and diverting damper at the inlet of the HRSG for start-up and emergency simple cycle operation. The bypass stack would be between 85 and 100-feet high.

3.2.6 Cooling Water System

3.2.6.1 CT-HRSG Auxiliary Cooling Water System

The auxiliary cooling water system provides cooling water to all the components in the new CT-HRSG power block which require water cooling. This includes for each CT-HRSG set:

- Combustion Turbine Generator Hydrogen Cooler
- Combustion Turbine Lube Oil Cooler
- Combustion Turbine Electro-Hydraulic Control Oil Cooler
- Boiler Feed Pump Lube Oil Cooler
- Steam Cycle and Feedwater Sampling System Coolers

A new 36" header would supply cooling water from the existing essential raw cooling water headers located in the existing auxiliary building to the new CT-HRSG power block. The header would have two supply sources, the "A" ERCW header and the "B" header. Either of these sources can be open or isolated to the header which would provide redundancy to the cooling water system. At the power block, the single header would supply the individual cooling loads by a distribution piping system. The oil coolers and hydrogen coolers would have temperature control valve bypasses (provided by the equipment supplier) to maintain required setpoint temperatures. The heated water would be returned to the cooling tower basin by a new 36 inch header.

The full size supply and return headers would be installed with the initial power block construction phase. The following phases would only require extension of the header. Isolation valves would be provided at the end of the header during each phase of construction to allow the buildout without interruption of cooling water to equipment operating from the previous phases.

3.2.6.2 Turbine Building Auxiliary Cooling Water System

The auxiliary equipment requiring cooling in the existing turbine building would be cooled by the existing raw cooling water system. This system pumps condenser circulating water (CCW) from the CCW inlet duct just upstream of the main steam turbine condenser into the cooling water distribution piping system and returns the heated water to the CCW discharge duct, downstream from the main steam condenser outlet, for return to the cooling tower. No appreciable modification to this system would be required.

3.2.7 Ash Handling System

The ash handling system conveys, stores and disposes of ash removed from the gasification process. The ash is removed from the process as slag.

Spent material drains from the gasifier bed into a slag quench vessel, and then through a lock hopper system to let down the pressure to atmospheric. The cooled, solidified slag is stored in a storage hopper. The hopper is sized for a nominal holdup capacity of 3,937 tons, which represents about 36 hours of full load operation.

Ash would be stored on site. The ash handling system removes ungasified solids from the gasification process equipment. These solids are made up from the ash and unconverted coal components, primarily carbon and glass encapsulated metals, that exit the gasifier in the solid phase.

4.0 IGCC with Chemical Coproduction (IGCC/C)

4.1 Candidate Chemicals and Markets

TVA and their consultants conducted a market assessment to compile a list of products and prices for coproduction. The analysis consists of two phases: an initial screening of the complete list of products, including year 2001 prices; and, upon selection of the final list, a full market analysis of the remaining products including price forecasts through 2020.

Price forecasts, screening criteria, and suggestions of chemicals to select or reject for further consideration were developed by consultants. TVA combined their analyses to arrive at Year 2001 price forecasts for all 24 chemicals and the selection of coproduct chemicals for more detailed analysis.

Selection criteria included:

- Growth rates greater than two percent.
- Potential market size great enough for world scale facility.
- Relatively low cost raw materials.

The selected chemicals and the rationale for their selection is presented in Table 4.1-1:

Table 4.1-1 Rationale for Selection of Chemicals

Acetic Acid	High growth rate, but a joint venture with a chemical company to use to avoid marketing risks would be necessary.
Ammonia	The Bellefonte location may be advantageous for supplying it as fertilizer for rice crops.
Carbon Dioxide	Production of this chemical would be dependent on economics of other coproducts.
Formaldehyde	High growth rate of two to three percent.
Methanol	High growth rate of 2.6 percent and the variable costs are very dependent on the input energy costs.
Urea	High growth rate of 2.5 percent.
Methyl Tertiary Butyl Ether (MTBE)	High growth rate depends on oxygenate fuel policy

The chemicals selected fall into two major classes, agricultural chemicals and the methanol based chemicals. The agricultural chemicals (ammonia and urea), are manufactured by first shifting the syngas to hydrogen. The methanol based chemicals, (methanol, formaldehyde, acetic acid, MTBE) require that methanol be made from the syngas. CO_2 can be recovered as a byproduct from both types of processes.

4.2 Definition of Cases

For the seven chemicals selected, nineteen different cases were analyzed and a profitability index calculated for each.

1a. Syngas to Ammonia with N_2 from the Air Separation Unit,
1b. Syngas to Ammonia with N_2 from the Air Separation Unit, CO_2 byproduct,
2a. Syngas to Ammonia to Urea with CO_2 recovery for Urea,
2b. Syngas to Ammonia to Urea with CO_2 recovery for Urea, CO_2 byproduct,
2c. Syngas to Ammonia and Urea with CO_2 recovery for Urea,
2d. Syngas to Ammonia and Urea with CO_2 recovery for Urea, CO_2 byproduct,
2e. Syngas to Ammonia and Urea with CO_2 for Urea and a CO_2 byproduct,one gasifier,
3a. Syngas to Methanol via vapor phase,
3b. Syngas to Methanol via vapor phase, CO_2 byproduct,
4a.. Syngas to Methanol via liquid phase, and
4b. Syngas to Methanol via liquid phase and $CO_{2.}$

Using the liquid phase methanol route abov:e
5. Syngas to Methanol to Formaldehyde,
6a. Syngas to Methanol and Formaldehyde,
6b. Syngas to Methanol and Formaldehyde and $CO_{2,}$
7. Syngas to Methanol to Acetic Acid,
8a. Syngas to Methanol and Acetic Acid,,
8b. Syngas to Methanol and Acetic Acid and CO_2
10a. Mixed Liquid Phase Alcohols to MTBE and Methanol, and
10b. Mixed Liquid Phase Alcohols to MTBE and Methanol and $CO_{2.}$

Cases 1a and 1b produce ammonia with and without CO_2 recovered as a byproduct utilizing nitrogen from the air separation unit. Cases 2a and 2b utilize ammonia as a feedstock to produce urea with and without CO_2 recovery. Cases 2c and 2d produce both ammonia and urea. Case 2e reduced the ammonia production to below TVA's projected market allowing the plant to operate with one coal gasification unit.

Cases 3a and 3b produce methanol by the conventional vapor phase reaction process again with and without CO_2 recovery. Cases 4a and 4b utilize the soon to be commercially demonstrated liquid phase methanol process. Because of the lower capital requirements and its potential to be integrated with an IGCC power plant, this process was selected for the methanol based chemical cases.

Case 5 utilizes methanol as a feedstock to produce formaldehyde. Cases 6a and 6b produce both methanol and formaldehyde with and without CO_2 recovery. Case 7 utilizes methanol as a feedstock to produce acetic acid. Cases 8a and 8b produce both methanol and acetic acid with and without CO_2 recovery. The CO utilized in the acetic acid synthesis is recovered from the syngas.

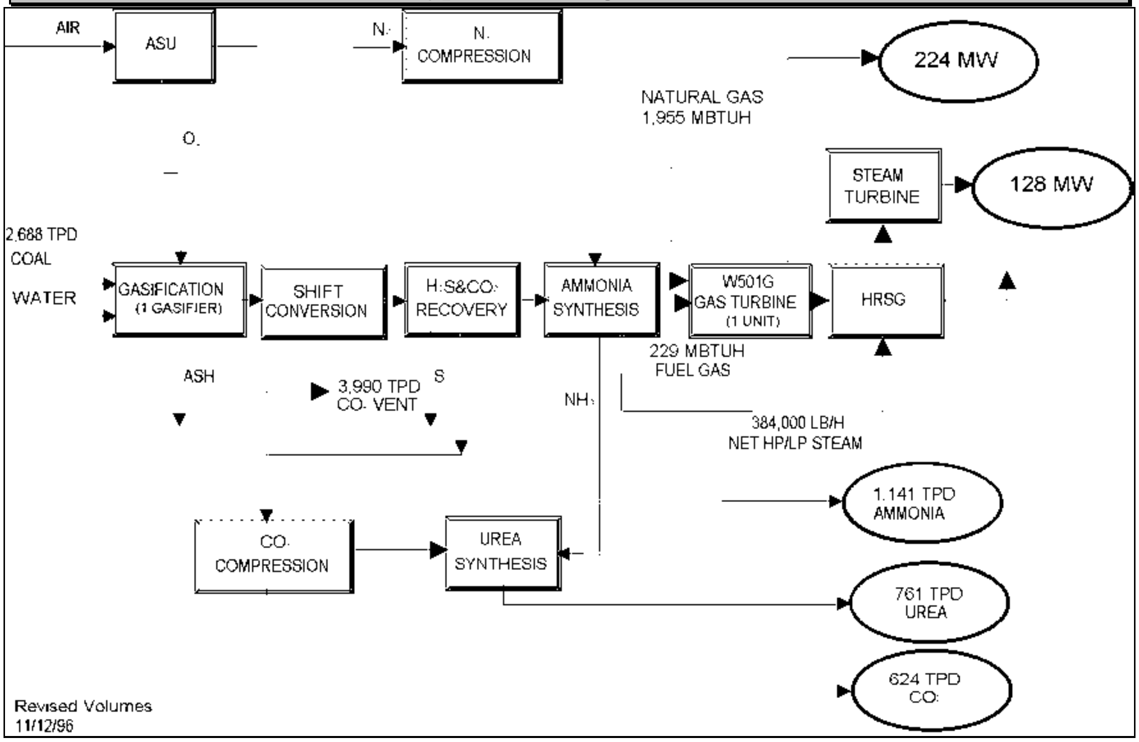
Cases 10a and 10b assume a variation of the liquid phase methanol process which is under development. This process produces mixed alcohols. Methanol and isobutanol are separated and utilized as a feedstock to produce MTBE.

4.3 Coproduction Design Basis

The design basis for the gasification and power generation systems involved in IGCC coproduction is similar to that for IGCC. Refer to the description presented earlier in this appendix (for IGCC) for more detailed information about those systems and design assumptions.

Converting the Bellefonte Nuclear Plant with IGCC and the coproduction of chemical products is a potential option. Case 2e was selected as the IGCC with chemical coproduction option. Under this scenario, the coproduct plant is assumed to consist of one gasifier providing syngas to fuel the coproduct facility and, with supplemental natural gas, a “G” technology combustion turbine. The facility would be able to generate approximately 287 net MW (352 gross MW) with the capability to produce ammonia, urea and CO_2. Figure 4-1 shows a block flow diagram of this option. The coproduct facility is assumed to be sited at Bellefonte and as such, existing facilities would be utilized.

Figure 4-1 Case 2e - Syngas to Maximun Urea, Ammonia to Match One Gasifier and CO_2 Byproduct Integrated for Power



4.4 Design Criteria

4.4.1 Design Basis

Converting the Bellefonte Nuclear Plant with IGCC and the coproduction of chemical products is a potential option. A screening study identified agricultural chemicals as the most promising coproducts.

Under this scenario, the coproduct plant is assumed to consist of one 2,688 TPD (as received) gasifier providing syngas to fuel the coproduct facility and, with supplemental natural gas, a Westinghouse “G” technology combustion turbine. The facility would be able to generate approximately 287 net MW with the capability to produce 1,141 TPD ammonia and 761 TPD of urea.

The coproduct facility was assumed to be a stand alone plant with its own steam turbine. It was assumed to be sited at Bellefonte and as such, existing facilities would be utilized. Therefore, the conceptual design generated for the coproduct plant reflected the use of existing Bellefonte facilities. Plant design criteria for this conversion option are listed below.

- Utilize as much of Bellefonte Unit 2 equipment and facilities as is cost effective.
- Advanced Westinghouse “G” technology combustion turbines are used as the basis for conceptual design and cost estimate.
- A new steam turbine would be used for this combined cycle facility.
- Natural gas allows for simple cycle operation of the gas turbine during startup, which is conservatively assumed to be 24 hours.
- Coal is delivered by barge. The unloading facility should accommodate several barges for the coproduction plant. Rail facilities would be provided for the sale of sulfur.
- Selective catalytic reduction (SCR) is not included. A best available control technology is required to determine whether SCR is ultimately required. Space is provided for possible retrofit at a later date.
- Design capacity factor is 90 percent for chemical coproduction.
- Design complies with TVA Occupational Health and Safety Design Requirements released March 1994.
- Sound level does not exceed OSHA standards for unlimited exposure with attenuation.
- A Distributed Control System is used.
- No asbestos is utilized.
- The coal specified for the study is Modified Illinois No. 6, the ultimate analysis of which is shown in Table 4.4-2.

Table 4.4-2 Modified Illinois No. 6 Ultimate Analysis

Constituent	As Received	Dry
Carbon	58.70%	68.29%
Hydrogen	4.00%	4.65%
Oxygen	7.90%	9.19%
Nitrogen	1.11%	1.29%
Sulfur	3.05%	3.55%
Ash	11.00%	12.80%
Moisture	14.04%	0.00%
Chlorine	0.20%	0.23%
Total	100.00%	100.00%
HHV Heating Value	10,229 Btu/lb	11,900 Btu/lb

4.4.2 Coal Handling

The Modified Illinois No. 6 bituminous coal is delivered to the site by barges as previously described.

The Coal Handling System has the following design criteria:

- Barge unloading and stockout operation at eight hours per day, five days per week
- Coal reclaim operation at eight hours per day, seven days per week (56 hours per week)
- 30 days of total coal storage (excluding the silos)
- Three days of live coal storage (excluding the silos)
- 16 hours of storage in the silos

Coal Handling Requirements and Design Basis (one gasifier)

- Coal Burn Rate
- Maximum Coal Burn Rate = 224,000 lb/h = 112 tph plus 10% margin = 123 tph
- (based on the 100% MCR rating for the plant, plus 10% design margin)
- Average Coal Burn Rate = 221,760 lb/h = 111 tph
- (based on MCR Rate multiplied by an assumed capacity factor)
- Coal Delivered to the Plant by Barge
- Conveying Rate to Storage Piles = 466 tph (maximum, one conveyor in operation)
- Reclaim Rate = 466 tph
- Storage Piles with liners, Run-off Collection, and Treatment Systems:
- Active Storage = 8,870 tons (72 hours at maximum burn rate)
- Dead Storage = 79,834 tons (30 days at average burn rate)

4.4.3 Coal Preparation and Feed

After crushing, a conveyor delivers the Modified Illinois No. 6 coal to the rod mill feedhopper which provides a surge capacity of about six hours of downstream throughput. A vibrating feeder supplies the weigh feeder which in turn feeds the rod mill. The rod mill grinds the coal and wets it with treated slurry water from a slurry water tank. The slurry is then pumped from the rod mill product tank to slurry storage and slurry blending tanks.

The coal grinding and conveying systems are equipped with a dust suppression system consisting of water sprays aided by a wetting agent. The degree of dust suppression required would depend on local environmental regulations.

4.4.4 Gasifier and Accessories

One Texaco quench gasifier is utilized for IGCC/Coproduction. The gasifier operating characteristics are identical to that described in Section 4.2.

The gasifier is one new Texaco oxygen-blown gasifier with hot gas quench and with the following features:

- Operating pressure of 970 psig.
- No operational integration with air separation unit (ASU). Air for the ASU is supplied by a dedicated compressor, oxygen (95%) from the ASU is fed to the gasifier, and nitrogen from the ASU is forwarded to the ammonia plant.
- Hot gas quench to 450°F
- Water wash to remove NH_3 and HCN

- Rectisol acid gas removal to remove H_2S and CO_2. H_2S is then concentrated and converted to elemental sulfur in a Claus plant. CO_2 is either compressed and stored as a liquid product or vrnted off site.

The new air separation plant is designed to produce a nominal output of 2,500 ton/day of 95% pure O_2 with liquefaction and liquid oxygen storage providing an eight hour backup supply of oxygen. For the purposes of this conceptual design, the air compressor in each train is powered by an electric motor.

4.4.5 Syngas Cleanup and Synthesis

4.4.5.1 Shift Reactors

Maximum conversion to CO_2 is achieved by utilizing a high, intermediate and low temperature shift reactor in series. For this application, a sulfided Cobalt/Molybderrum catalyst is utilized which is sulfur compatible and has a relatively high activity over the range of 390°F to 890°F. The presence of H_2S suppresses carbon formation, thereby reducing the steam requirement. The shift catalyst also promotes COS hydrolysis. Following the low temperature shift reactor, the fuel gas is cooled before being fed to the Rectisol unit. During this cooling, part of the water vapor condenses. This water is sent to the water treatment plant.

4.4.5.2 Acid Gas Removal

Rectisol was selected because of its high selectivity toward both H_2S and CO_2 when operated in a two-stage mode which is needed for the desulfurization of fuel gases with relative high CO_2 concentrations as produced during the shift reaction. For the Rectisol stripper, medium pressure-steam is used to liberate the acid gas from the Rectisol solvent.

The fuel gas is cleaned in a dual column Rectisol unit consisting of two packed bed absorbers. The first column removes most of the H_2S (99.4%) and a small fraction of the CO_2. The second column removes the greater portion of the CO_2. Because of the two column arrangement, H_2S and CO_2 leave the Rectisol unit in separate streams. In this unit the fuel gas is counter-currently contacted with Rectisol solvent in a packed bed absorber. Acid gas scrubbing is necessary in order to meet the required H_2S concentration in the cleaned coal gas and to recover CO_2. To ensure complete removal of CO_2 and H_2O from the syngas, a final wash with liquid N_2 is conducted.

From the separated H_2S, elemental sulfur is produced in the sulfur recovery unit (Claus unit). The tail gas from the sulfur recovery unit, which contains three to five percent of the original sulfur removed in the acid gas removal unit, is treated in a Beavon-Stretford tail gas treating unit. In the Beavon-Stretford tail gas treating process at least 90% of the remaining sulfur compounds are recovered, resulting in a total sulfur recovery of 99.5% based on the original sulfur removed in the acid gas removal unit.

Also needed are provisions for:

- Ammonia Transfer and Storage - Ammonia is stored as a pressurized refrigerated liquid in large spherical tanks (Horton spheres). When the ammonia market is favorable, these storage tanks would be used as a shipping buffer to hold several hours of production. When the ammonia market is unfavorable, the process is altered and ammonia is neither produced nor stored. The nominal ammonia production rate is about 1,200 tons (60,000 liquid cubic feet) per day.
- Urea Transfer and Storage - Urea is prilled and stored as a solid. When the urea market is favorable, the storage area would be used as a shipping buffer to hold several hours of production. When the urea market is unfavorable, the process is altered and urea is neither produced nor stored. The nominal urea production rate is about 750 tons (25,000 cubic feet) per day.
- CO_2 Transfer and Storage - CO_2 can be stored as a pressurized liquid in cylindrical pressurized storage tanks. In view of the continuous supply of CO_2 stream available from the syngas, CO_2 storage is not deemed necessary. When the CO_2 market is unfavorable, the CO_2 is vented to the atmosphere. The nominal CO_2 production rate is about 680 tons per day.
- Sulfur Transfer and Storage - Sulfur is a benign solid that can be stored on site. When the sulfur market is favorable, sulfur is stored as a liquid in heated storage tanks as a shipping buffer to hold several hours of production. When the sulfur market is unfavorable, the process is altered and sulfur is solidified and stored as a solid. The nominal sulfur production rate is about 82 tons per day, having a bulk volume of about 2,000 cubic feet.
- Ammonia Loading Facilities
- Urea Loading Facilities
- CO_2 Loading Facilities
- Sulfur Loading Facilities

4.5 Ash Handling System

The ash handling system conveys, stores and disposes of ash removed from the gasification process. The ash is removed from the process as slag.

Spent material drains from the gasifier bed into a slag quench vessel, and then through a lock hopper system to let down the pressure to atmospheric. The cooled, solidified slag is stored in a storage hopper. The hopper is sized for a nominal holdup capacity of 450 tons, which represents about 36 hours of full load operation.

Ash would be stored on site.

Appendix B ¾ SITE DRAWINGS

Pulverized Coal Combustion Units (PC)
Natural Gas Combined Cycle Units (NGCC)
Integrated Gasification Combined Cycle Units (IGCC)
Integrated Gasification Combined Cycle Units with Chemical Coproduction (IGCC/C)
Integrated Gasificatio Combined Cycle Unit, Natural Gas Combined Cycle Units with Chemical Coproduction (Combination)
Bellefonte SPCC Drawing
Bellefonte Environmental Features
Combustion Waste Disposal Sites for PC

Appendix C ¾ Employee Estimates for Each Conversion Option

Employment for Each Option								
Conversion Option	Option 1 Totals Pulverized Coal				Option 2 Totals Natural Gas Combined Cycle			
	Const.	EPC	Op & Maint.	Total Manpower	Const.	EPC	Op & Maint	Total Manpower
FY1998	-	-	-	-	-	-	-	-
2nd Quarter	16	-	10	26	30	-	10	40
3rd Quarter	16	-	10	26	30	-	10	40
4th Quarter	108	10	20	138	45	5	25	75
FY1999	159	25	20	204	90	10	25	125
2nd Quarter	331	25	40	396	205	10	25	240
3rd Quarter	679	25	50	754	255	15	25	295
4th Quarter	948	35	70	1,053	280	20	25	325
FY2000	918	50	80	1,048	305	20	35	360
2nd Quarter	998	50	103	1,151	330	25	55	410
3rd Quarter	1,006	50	123	1,179	330	30	65	425
4th Quarter	960	45	133	1,138	330	25	75	430
FY2001	917	45	153	1,115	345	30	75	450
2nd Quarter	826	50	165	1,041	330	30	75	435
3rd Quarter	658	50	185	893	330	25	85	440
4th Quarter	783	45	195	1,023	345	30	105	480
FY2002	998	45	215	1,258	330	30	115	475
2nd Quarter	918	50	225	1,193	330	25	125	480
3rd Quarter	1,014	50	258	1,322	345	30	125	500
4th Quarter	1,006	50	268	1,324	330	30	125	485
FY2003	1,052	55	288	1,395	330	25	135	490
2nd Quarter	968	60	298	1,326	345	30	155	530
3rd Quarter	998	50	330	1,378	330	30	165	525
4th Quarter	1,006	50	340	1,396	330	25	175	530
FY2004	1,052	55	360	1,467	345	30	175	550
2nd Quarter	968	60	370	1,398	330	30	175	535
3rd Quarter	1,014	50	403	1,467	300	25	175	500
4th Quarter	1,006	50	413	1,469	300	25	180	505
FY2005	1,052	55	433	1,540	240	20	190	450
2nd Quarter	968	60	443	1,471	125	15	200	340
3rd Quarter	998	50	475	1,523	90	15	200	305
4th Quarter	1,006	50	485	1,541	50	10	200	260
FY2006	1,052	55	505	1,612	25	5	200	230
2nd Quarter	968	60	515	1,543	15	5	200	220
3rd Quarter	998	50	538	1,586	-	-	200	200
4th Quarter	990	50	548	1,588	-	-	200	200
FY2007	944	45	558	1,547	-	-	200	200
2nd Quarter	809	35	568	1,412	-	-	200	200
3rd Quarter	666	25	580	1,271	-	-	200	200
4th Quarter	327	25	580	932	-	-	200	200
FY2008	104	20	580	704	-	-	200	200
2nd Quarter	50	10	580	640	-	-	200	200
3rd Quarter	-	-	580	580	-	-	200	200
4th Quarter	-	-	580	580	-	-	200	200

Employment for Each Option (Cont'd)

Conversion Option	Option 3 Totals Integrated Gasification Combined Cycle				Option 4 Totals IGCC/C			
	Const.	EPC	Op & Maint	Total Manpower	Const.	EPC	Op & Maint	Total Manpower
FY1998	-	-	-	-	-	-	-	-
2nd Quarter	50	-	10	60	50	-	10	60
3rd Quarter	50	-	10	60	50	-	10	60
4th Quarter	180	15	25	220	180	15	25	220
FY1999	289	35	35	359	289	35	35	359
2nd Quarter	589	35	35	659	589	35	35	659
3rd Quarter	1,089	35	35	1,159	1,059	35	35	1,129
4th Quarter	1,420	50	35	1,505	1,290	45	35	1,370
FY2000	1,338	70	45	1,453	1,244	60	45	1,349
2nd Quarter	1,497	70	140	1,707	1,498	90	140	1,728
3rd Quarter	1,548	70	150	1,768	1,589	90	145	1,824
4th Quarter	1,575	75	175	1,825	1,430	100	155	1,685
FY2001	1,353	75	195	1,623	1,749	110	180	2,039
2nd Quarter	1,497	70	285	1,852	2,089	135	340	2,564
3rd Quarter	1,548	70	195	1,813	2,419	130	250	2,799
4th Quarter	1,575	75	195	1,845	2,160	85	250	2,495
FY2002	1,353	75	205	1,633	2,439	100	260	2,799
2nd Quarter	1,497	70	300	1,867	2,418	130	350	2,898
3rd Quarter	1,548	70	310	1,928	1,909	125	355	2,389
4th Quarter	1,575	75	335	1,985	1,130	70	365	1,565
FY2003	1,353	75	355	1,783	1,250	50	380	1,680
2nd Quarter	1,497	70	445	2,012	1,000	50	520	1,570
3rd Quarter	1,548	70	355	1,973	500	50	430	980
4th Quarter	1,575	75	355	2,005	-	-	430	430
FY2004	1,353	75	365	1,793	-	-	430	430
2nd Quarter	1,497	70	460	2,027	-	-	430	430
3rd Quarter	1,548	70	470	2,088	-	-	430	430
4th Quarter	1,575	75	495	2,145	-	-	430	430
FY2005	1,353	75	505	1,933	-	-	430	430
2nd Quarter	1,497	70	595	2,162	-	-	430	430
3rd Quarter	1,548	70	505	2,123	-	-	430	430
4th Quarter	1,575	75	505	2,155	-	-	430	430
FY2006	1,353	75	505	1,933	-	-	430	430
2nd Quarter	1,497	70	510	2,077	-	-	430	430
3rd Quarter	1,498	70	510	2,078	-	-	430	430
4th Quarter	1,395	60	520	1,975	-	-	430	430
FY2007	1,064	40	520	1,624	-	-	430	430
2nd Quarter	908	35	530	1,473	-	-	430	430
3rd Quarter	459	35	530	1,024	-	-	430	430
4th Quarter	155	25	530	710	-	-	430	430
FY2008	15	5	530	550	-	-	430	430
2nd Quarter	-	-	530	530	-	-	430	430
3rd Quarter	-	-	530	530	-	-	430	430
4th Quarter	-	-	530	530	-	-	430	430

Employment Estimates for Each Option (Cont'd)

	Option 5 Totals Combination			
Conversion Option	**Const.**	**EPC**	**Op & Maint**	**Total Manpower**
FY1998	-	-	-	-
2nd Quarter	30	-	10	40
3rd Quarter	30	-	10	40
4th Quarter	45	5	25	75
FY1999	140	10	35	185
2nd Quarter	225	10	35	270
3rd Quarter	390	25	50	465
4th Quarter	479	45	60	584
FY2000	689	45	60	794
2nd Quarter	1,154	45	60	1,259
3rd Quarter	1,475	65	60	1,600
4th Quarter	1,468	90	70	1,628
FY2001	1,927	120	165	2,212
2nd Quarter	2,418	115	170	2,703
3rd Quarter	2,480	125	180	2,785
4th Quarter	2,698	135	205	3,038
FY2002	2,922	160	365	3,447
2nd Quarter	2,848	155	275	3,278
3rd Quarter	2,425	115	275	2,815
4th Quarter	2,638	125	285	3,048
FY2003	2,832	155	375	3,362
2nd Quarter	2,738	150	380	3,268
3rd Quarter	2,180	95	390	2,665
4th Quarter	2,229	75	405	2,709
FY2004	1,878	80	545	2,503
2nd Quarter	999	85	455	1,539
3rd Quarter	365	30	465	860
4th Quarter	300	20	485	805
FY2005	370	30	495	895
2nd Quarter	480	30	505	1,015
3rd Quarter	540	35	505	1,080
4th Quarter	520	40	545	1,105
FY2006	430	35	555	1,020
2nd Quarter	420	40	575	1,035
3rd Quarter	380	40	585	1,005
4th Quarter	355	30	595	980
FY2007	360	35	605	1,000
2nd Quarter	330	30	605	965
3rd Quarter	300	25	605	930
4th Quarter	300	25	610	935
FY2008	240	20	620	880
2nd Quarter	125	15	630	770
3rd Quarter	90	15	640	745
4th Quarter	50	10	640	700
FY2009	25	5	640	670
2nd Quarter	15	5	640	660
3rd Quarter	-	-	640	640
4th Quarter	-	-	640	640

Appendix D ¾ Properties of Coproduction Chemicals

Properties of Coproduction Chemicals							
Chemical and State	**Chemical Formula**	**Physical Description**	**Exposure Limits(REL)**	**Chemical and Physical Characteristics**	**Flammability**	**Target Organs**	**Uses and Descriptions**
Acetaldehyde	CH_3CHO	Color liquid or gas with a pungent fruity odor	Suspect Carcinogen OSHA (200)	MW: 44.1 BP: 69 F SOL: Miscible Fl.P. -36F IP: 10.22 eV Sp.Gr.: 0.79 VP: 740MM FRZ:-190F UEL: 60% LEL: 4.0%	Class IA Flammable Liquid	**eyes**, skin, resp sys, CNS, **repro sys**	manufacture of acetic acid and acetic anhydride, n-butanol, 2-ehtylhexanol, peracetic acid, aldol, pentaerythritol, pyridines, chloral, 1,3 bu-tylene glycol, and trimethylolpropane; synthetic flavors
Acetic Acid - Glacial - 99.8 %	CH_3COOH	Colorless liquid or crystals with sour, vinegar like odor	10 ppm STEL 15 ppm, OSHA 10 ppm	MW: 60.1 BP: 244 F SOL: Miscible Fl.P.: 103F IP: 10.66 eV Sp.Gr.: 1.05 VP: 11MM FRZ: 62F UEL: 19.9% (200F) LEL: 4.0%	Class II Combustible Liquid	eyes, skin, resp sys, teeth	Acetic anhydride, cellulose acetate, plastics, pharmaceuticals, dyes insecticides, photographic chemicals, latex coagulant, textile printing - Vinegar.
Acetic Anhydride	$(CH_3CO)_2O$	Colorless liquid with strong pungent, vinegar odor	NIOSH - C 5 ppm OSHA 5 ppm	MW: 102.1 BP: 282F SOL: 12% Fl.P. 120F IP: 10.00 eV Sp.Gr.: 1.08 VP: 4MM FRZ:-99F UEL: 10.3% LEL: 2.7%	Class II combustible liquid	eyes, skin, resp sys	cellulose acetate fibers and plastics, vinyl acetate; dehydrating and acetylatin agen in production of pharmaceuticals, dyes, perfumes, explosives; etc.; aspirin, Esterifying agen for food starch.
Ammonia, Liquid Anhydrous - refrigerated	NH_3	colorless gas with pungent, suffocating odor - easily liquified under pressure	25 - STEL 35 ppm OSHA STEL 50 ppm	MW: 17.0 BP: -28 F SOL: 34% Fl.P.: NA(Gas) IP: 10.18 eV RGasD: 0.60 VP: 8.5 atm FRZ: -108F UEL:28% LEL:15% - Ref Den - 5.04 lb/gal	Should be treated as a flammable gas	eyes, **skin**, resp sys	Fertilizer, Nitric acid, urethane acrylonitrile, refrigerant, synthetic fibers dyeing latex preservatives, explosives, fuel cells, rocked fur; yeast nutrient
Ammonium Nitrate	NH4NO3	Colorless crystal		MW: 80.0 BP: 210 C decomposes SOL: soluble M.P. 169.6C Sp.Gr.: 1.725	Oxidizer, explosion hazard	eyes, skin, resp sys	Fertilizers, explosives, Pyrotechnics, hervicides an insecticides, maufactur of nitrous oxide, absorbent for nitrogen oxides, nutrient for antibiotics and yeast, catalyst
Ammonium Phosphate	Dibasic - $(NH_4)_2 HPO_4$ Hemi - $NH_4H_2PO_4*H_3PO_4$ Mono -$NH_4H_2PO_4$	White crystals or powder, - Hemi - somewhat hygroscopic, Mono - Brilliant white		MW: Di - 132.1, Hemi - 213.1, Mono -115.04 SOL: soluble to moderately soluble Sp.Gr.: Di - 1.619,, Mono - 1.803	non flammable	No date available	fertilizers, flameproofing f wood, papter and textiles, coating vegetation to retard forext fires, manufacture of yeast, vinegar, and bread improvers, flux for soldering tin, copper, brass, zinc. purifying sugar, in annoniated dentrifices,food additive

Properties of Coproduction Chemicals

Chemical and State	Chemical Formula	Physical Description	Exposure Limits(REL)	Chemical and Physical Characteristics	Flammability	Target Organs	Uses and Descriptions
Ammonium Sulfate	$(NH_4)_2SO_4$	Brownish-gray to white crystals		MW: 132.1 MP: 513 C decomposes SOL: soluble Sp.Gr.: 1.77	non flammable		Fertilizers, water treatment, fermentation, fireproofing compositions, viscose rayon, tanning, food additive
Carbon Dioxide	CO_2	Colorless, odorless gas, shipped as a liquified compressed gas - solid form is dry ice	Niosh - 5000ppm st 30,000ppm OSHA 5000ppm	MW: 44.0 BP: sublimes SOL: 0.3% Fl.P. -22F IP: 10.08eV RGasD: 1.53 VP: 56.5 atm FRZ:-109F UEL:na LEL: na	nonflammable gas	**resp sys**, CVS	Refrigerant, carbonated beverages, aerosol propellant, chemical intermediated, low-temperature testing, fire extinguishing, inert atmospheres, municipal water treatment, medicine, mining, miscible pressure source, shielding gas for welding…
Chloromethanes - Methyl chloride	CH_2Cl	Colorless gas with a faint sweet odor whichis not noticable at dangerous concentrations	suspect carcinogen OSHA 100ppm 300 ppm (5 min Max peak in any 3 hrs.)	MW: 50.5 BP: -12 F SOL: 0.5% Fl.P. N/A IP: 11.00 eV RGasD: 1.78 VP: 5.0 atm FRZ: -144F UEL: 17.4% LEL: 8.1%	Flammable Gas	CNS, liver kidneys, **repro sys**	Catalyst carrier in low temperature polymerization, tetramethyl lead, silicones, refridgerant, methylating agent in organic synthesis, extractant and low temperature solvent, herbicide, topical anesthetic
Dimethyl terephthalate	$C_6H_4(COOCH_3)_2$	Colorless crystal		MW: 162.1 MP: 140 C Sublimes: 300C SOL: insoluble	nonflammable		Polyester resin for film and fiber production, especially polyethylene terephthalate, intermediate
Formaldehyde - 37% soln with Water Also known as - Formalin	HCHO	Soln: Colorless liquid with pungent odor, pure: Nearly colorless gas with pungent odor	0.016 ppm, 0.1 ppm (15min) OSHA 0.75 ppm STEL 2 ppm - Suspected Carcinogen	MW: 22.44 BP: 214F SOL: Miscible Fl.P. 185F IP: ? Sp.Gr.: 1.08 VP: 0.1 (86F) FRZ: ?F UEL: 73% LEL: 7%	Class IIIA Combustible Liquid	eye, resp sys, **[nasal cancer]**	resin, ethylene glycol, embalming fluids, preservative, durable press treatment of textile fabrics, foam insulation particle board, plywood.
Granular Urea, Solid	$NH_2C{=}O$ NH_2	Pure: White crystals or powder, almost odorless, with saline taste		MW: 60 MLT: 132.7C Sp.Gr.: 1.335 Bulk Density: 0.74g/cm3 Cp: 1.44 J/kgK	Non Compustible	skin, resp sys	Fertilizer, animal feed, plastics, chemical intermediate, stabilizer in explosives, medicine (diuretic), adhesives, pharmaceuticals, cosmetics, …
Isobutanol - Isobutyl Alcohol	$(CH_3)_2$ $CHCH_2OH$	Colorless, oily liquid with a sweet, musty odor	NIOSH 50 ppm OSHA 100ppm	MW: 74.1 BP: 227 F SOL: 10% Fl.P. 82F IP: 10.12 eV Sp.Gr.: 0.80 VP: 9MM FRZ: -162F UEL: (202F) 10.6% LEL:(123F) 1.7%	Class IC Flammable Liquid	Eyes, skin, resp sys, **CNS**	Organic synthesis, latent solvent in paints and laquers, intermediate for amino coating resins, substitute for n-butanol. pain removers, fruit flavor concentrates

Properties of Coproduction Chemicals

Chemical and State	Chemical Formula	Physical Description	Exposure Limits(REL)	Chemical and Physical Characteristics	Flammability	Target Organs	Uses and Descriptions
Isobutylene, isobutene	$(CH_2)_3C:CH_2$	Colorless, volatile liquid with a coal gas odor		MW: 74.1 BP: -6.9 C SOL: none Fl.P. -105F IP: 10.12 eV Sp.Gr.: 0.60 AI.P.: 869F UEL: 8.8% LEL: 1.8%	Class IA Flammable Liquid	resp sys	Production of isooctane, high octane aviation gasoline, butyl rubber, polyisobutene resins, tert-butyl chloride, co-polymer resins with butadiene, acrylonitrile…
Mehtyl Methacrylate	CH_2=C (CH_3) $COOCH_3$	Colorless liquid with an acrid, fruity odor	NIOSH/OSHA 100 ppm	MW: 1001 BP: 214 F SOL: 1.5% Fl.P. 50F IP: 9.70 eV Sp.Gr.: 0.94 VP: 29MM FRZ: -54F UEL: 8.2% LEL: 1.7%	Class IB Flammable liquid	Eyes, skin, resp sys	monomer for polymethacrylate resins, impregnation of concrete
Methanol, Liquid State	CH_3OH	colorless liquid with charactistic pungent odor	200 ppm - STEL 250 ppm (skin) OSHA - 200 ppm	MW: 32.1 BP: 147 F SOL: Miscible Fl.P. 52F IP: 10.84 eV Sp.Gr.: 0.79 VP: 96MM FRZ:-144F UEL: 36% LEL: 6.0%	Class IA Flammable Liquid	eyes, skin, **resp sys**, CNS, GI tract	chemical intermediate, antifreeze solvent , denaturant for ethanol, dehydrator for NG, fuel cell
Methylamine	CH_3NH_2	Colorless gas with a fish- or ammonia like odor	NIOSH/OSHA 10 ppm	MW: 31.1 BP: 21 F SOL: soluble Fl.P. 14F(liq) IP: 8.97 eV Sp.Gr.: 0.70 (13F) RGasD: 1.08 VP: 3MM FRZ: -32F UEL: (250F) 7.9% LEL:(151F) 1.1%	Class IA Flammable liquid	Eyes, skin, resp sys	Intermediate for accelerators, dyes , pharmaceuticals, insecticides, fungicides, surface active agents, tanning dyeing of acetate textiles, fuel additive, polymerization inhibitor, component of paint removers, solvent, photographic developer…
Methyl-*tert*-Butyl ether, Liquid State	CH_3OH	colorless liquid		MW: 88 BP: 55C SOL: 4% Fl.P.: 52F Sp.Gr.: 0.74 FRZ:-110C	Flammable - equivalent to a Class IA Flamable Liquid	eyes	Octane booster for Unleaded Gasoline (7% Vol)
Nitric Acid	HNO_3	Colorless, yellow or red, fuming liguid with an acrid, suffocating odor	NIOSH/OSHA 2ppm ST 4PPM	MW: 63.0 BP: 181 F SOL: miscible Fl.P. NA IP: 11.95 eV Sp.Gr.: (77F)1.50 (13F) VP: 48MM FRZ: -44F UEL: NA LEL: NA	Noncombustible gas but increases the flammablility of combustible materials	Eyes, skin, resp sys, teeth	Manufacture of ammonium nitrate, organic synthesis (dyes, drugs, explosives, cellulose nitrate, nitrate salts) metallurgy, photoengraving, etching steel, ore flotation, urethanes, rubber chemicals, reprocessing spent nuclear fuel
Nitrogen Solution - nitrogen gas	N_2	Colorless, odorless, tasteless gas - colorless liquid		MW: 28 BP: -195.5C SOL: slightly Fl.P. NA Sp.Gr.: 0.804(liq) RGasD: 0.96737 VP: 48MM FRZ: -210 C	Combustible	resp sys	Production of ammonia, acrylonitrine, nitrates, cyanamide,…, inert gas for purgin, blanketing, and exerting pressure, electric and electronic industries, in-transit food refrigeration and freeze drying, food antioxidant, source of pressure in oil wells…

Properties of Coproduction Chemicals

Chemical and State	Chemical Formula	Physical Description	Exposure Limits(REL)	Chemical and Physical Characteristics	Flammability	Target Organs	Uses and Descriptions
Oxo Alcohol - **N-Butanol**, 2-Ethyl Hexanol	$CH_3(CH_2)_2CH2OH$	colorless liquid, vinous odor		MW: 28 BP: 117.7C SOL: 7.7% Fl.P. 95F Sp.Gr.: 0.8109 FRZ: -89 C AI.P.: 689 F	Class IC Flammable Liquid		Preparatio of esters, expecially butyl acetate, solvent for resins and coatind, plasticizers, dyein assistant, hydraulic fluids, detergen formulations, dhydrating agent, intermediate, glycol ethers, bytul acrylate
Urea Ammonium Nitrate (UAN Solution) N=32: Urea 35.4%, Ammonium Nitrate 44.3%, Water 20.3% by weight				placeMW: 60.3 Sp.Gr.: 1.32 Dens: 11lb/gal Hsol: 65.1 Btu/lb Crys: 28F			Fertilizer, explosives, pyrotechnics, herbicides nitrous plastics, chemical intermediate, stabilizer in explosives, medicine (diuretic), adhesives, pharmaceuticals, cosmetics, …

Appendix E ¾ COAL REFINING CHAR

Coal refining (CR) is a process capable of producing end-use products and chemical feed stocks (coproducts) directly from coal. CR rearranges the hydrogen molecules (H_2) to produce coproducts in excess of the volatile content of the feed coal. The CR concept would integrate many technologies that are commercially available in the petroleum refining industry with a coal/hot gas reactor design for coal hydrocracking and char separation.

The CR process was initially proposed by Carbon Fuels Corporation (CFC) as a means of upgrading subbituminous Wyoming coal to a higher heating value low sulfur fluidic boiler fuel–thus the name, the Charfuel® coal refining process. As the process was first conceived, the char (which remains after the coal is reacted) and some of the hydrocarbon oils (which are formed during the reaction) would be combined into the "char-fuel" fluid. CFC envisioned transporting the charfuel fluid by rail or through existing oil pipelines to utilities throughout the country as a replacement boiler fuel to meet compliance regulations.

Process Description

The heart of the CR process is based on results of the Cities Services/Rockwell (CS/R) flash-hydropyrolysis tests in which coal is thermally devolatilized by heating in a H_2 atmosphere. The CS/R work was partially funded by the U.S Department of Energy (DOE) from 1975 until funding was terminated in 1986. CFC calls the process "coal hydrocracking" and has taken some of the public access information from earlier CS/R tests (tests in which coal liquefaction was the primary objective) and further elaborated on the downstream possibilities, specifically:

- Hydrotreating of the oils to produce refinery feedstocks
- Recycle of H_2 inherent in the coal–thereby eliminating expensive externally generated H_2.

CFC also claims to have developed a slot reactor design for the coal hydrocracker to accommodate higher coal feed rates necessary for commercial operation. The design was successful in cold flow tests.

Coal and air are the only feedstocks for the CR process. The process is not limited to a specific type or grade of coal. When a higher grade coal is used, coproduct yield/unit of feed coal increases. A more complex CR process can yield a varied slate of high value coproducts such as BTX, naphtha, fuel oil, methanol, as well as byproducts such as sulfur, ammonia, and industrial grade CO_2.

TVA has evaluated several coproduction options as a means of reducing the cost of electricity including an IGCC Coproduction Demonstration Project (CDP) for the Clean Coal Technology (CCT) program sponsored by DOE. Coproduction of chemicals provides:

- Enhanced economic performance through the synergistic use of process equipment and flow streams, lowering the cost of producing both the coproduct chemical and electricity and
- Revenues from the sale of a high value chemical product.

TVA has conducted preliminary evaluations of the direct coproduction CR process for use with IGCC. Using the CFC CR coproduct yields, capital cost numbers, and the TVA CDP IGCC costs, the combined CR/IGCC economics for a 300 MW demonstration unit appear very promising To achieve the maximum coproduct output to enhance the overall economics and to produce the same amount of power as a stand-alone IGCC, more than twice the amount of feed coal is required for a CR/IGCC. The coproduct revenue is substantial, though some of the economic advantage for CR/IGCC is clearly “cost of scale.”

Verification of CFC’s assumptions for the CR process requires additional pilot plant studies. However, TVA is proceeding–to the maximum extent possible without specific pilot plant data–with a computer simulation evaluation of the CR/IGCC process to verify:

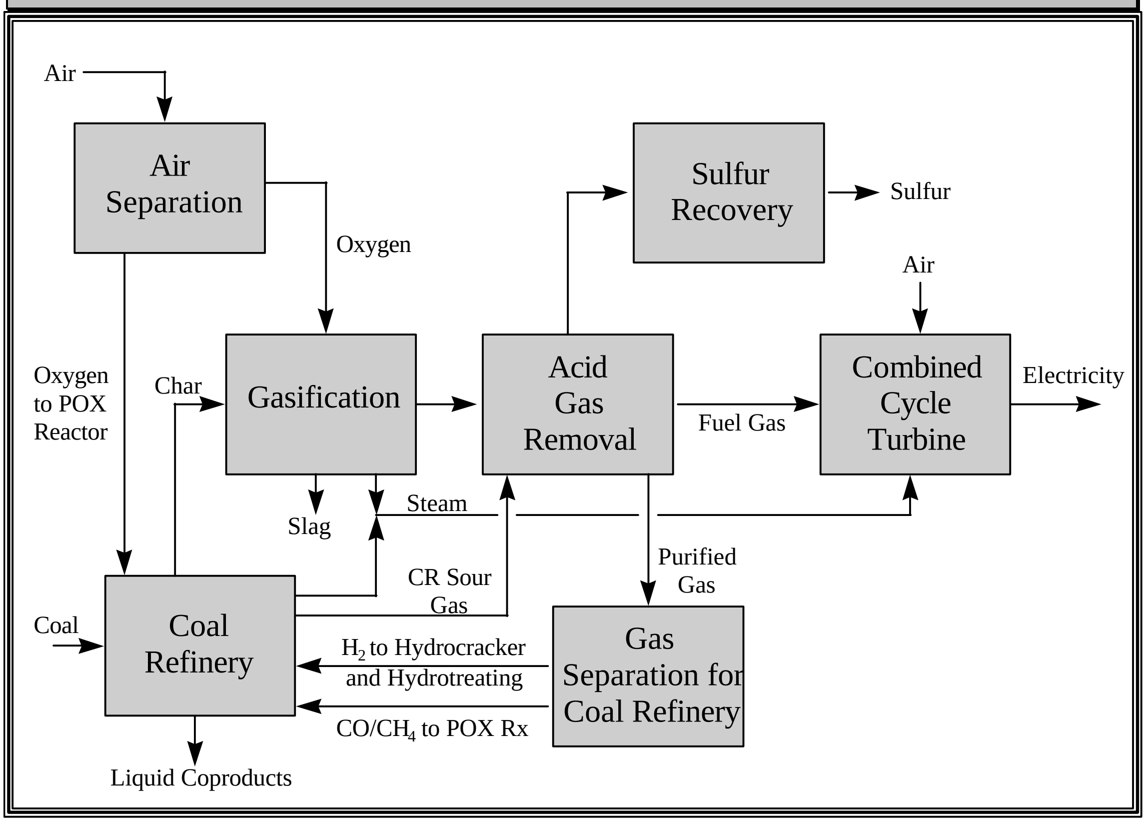
- Heat and material balances,
- H_2 requirements,
- Recycle requirements,
- Equilibrium relationships
- Separation feasibilities,
- Equipment requirements and sizes, and
- Equipment costs.

The essence of the CR process is rapidly heating demoisturized, pulverized coal in the presence of H_2 to effect a short residence time devolatilization and subsequent hydrogenation (fluidized hydrocracking) to produce char, H_2 rich gases, and hydrocarbon liquids. A generalized block flow diagram is shown in the figure below.

The processes involved are:

- Hot partial oxidation (POX) gas enters the down-flow entrained flow coal hydrocracker to provide the required energy and hydrogen-rich atmosphere for hydrocracking of the dried coal.
- Coal is rapidly heated by contact with the hot POX gas to volatilization temperatures of 1600 to 1800°F. The residence time of the coal in the first stage of the hydrocracker is less than 100 milliseconds and less than one second in the second stage. CS/R concluded that by controlling certain variables (such as reactor operating temperature, residence time, gas to coal feed ratio, and to a lesser extent pressure) production of liquids, the highest value material, is maximized while production of char and gas is minimized.

CR/ IGCC Coproduction



- Flash volatilization of the coal is followed by a partial quench to hydrogenation temperature of 1200-1400°F using recycled heavy oil and hydrogen to control cracking (conversion of large molecules to smaller molecules) of the heavy unsaturated hydrocarbons thereby maximizing formation of and partially hydrogenating the liquid hydrocarbons to enhance liquid quality. The products are further quenched to about 1000°F to essentially terminate the reaction.

- Char is separated from the hydrocarbon gas phase and sent by pressure differential to IGCC gasification. No additional grinding is required for the free-flowing char. Nearly all of the char carbon is partially gasified to CO in a commercial gasifier operating at 2600°F.
- The sour gas is cooled to generate steam and routed to acid gas removal with the cooled CR gas.
- After coal hydrocracking and separation from the char, the hot quenched hydrocarbon vapors are sent to the cooling separation section, where the vapor is cooled in consecutive stages to condense the water and hydrocarbon liquids.
- The water and hydrocarbon liquid are separated by an oil-water separator, with the heavier hydrocarbons recycled back to the coal hydrocracker as oil quench.
- The condensed light oil is sent to the hydrotreating & fractionation section, where the light oils are hydrotreated (elimination of sulfur and nitrogen by the action of hydrogen under pressure over a catalyst).
- The resulting liquid is fractionated to separate the benzene, toluene, and xylene (BTX) from the naphtha and middle oils (fuel oil).
- Water from the cooling separation section is stripped of ammonia in the ammonia recovery section by conventional means.
- The cooled sour gas is sent to acid gas removal where CO_2 is removed and the sulfur containing compounds (H_2S, COS, etc.) are removed and sent to sulfur recovery.
- The treated CR/IGCC gases are separated into a H_2 rich gas and a CO/CH_4 rich gas.
- The H_2 rich gas is recycled to oil hydrotreating and to the coal hydrocracker.
- Up to half of the CO/CH_4 rich stream is recycled to a high temperature POX reactor where the CH4 and CO are sub-stoichiometrically reacted with O_2 to produce H_2 and additionally CO.
- Steam is added to the POX reactor to shift water and part of the CO to H_2 which is sent to the coal hydrocracker. The amount of recycle gas to the POX reactor is dependent on the amount of CH_4 in the recycle gas (to produce the required H_2) and the quantity of heat necessary to raise the temperature and devolatilize the coal.
- The remaining CO/CH_4 rich gas is sent to the combined cycle as fuel gas or all or part of the remaining CO/CH_4 rich gas is fed to an indirect liquefaction process where part of the gas is reacted with part of the separated H_2 in a once through methanol synthesis reactor.
- Gas that does not react is separated from the methanol and routed to the combined cycle as fuel gas for the gas turbine.

The only references available for CR emissions are the CCT proposals submitted by CFC to U.S. Department of Energy (DOE). The estimates are based on the CS/R pilot plant data. A review of the CS/R data did not lend any information more than an ultimate analysis of the char and the amount of sulfur and nitrogen release from the selected feed coal that could be expected at specific operating conditions. From that information, CFC tried to estimate quantities for NOx, SOx, and PM for the Charfuel® compliance boiler fuel. The CO, PM10, and solid waste amounts followed the same guidelines as an equivalent pulverized coal power plant/MBtu. Air toxics were not quantified because of lack of data.

The CR liquid coproducts would be hydrotreated to remove sulfur and nitrogen. The design of the hydrotreater would be similar to petroleum refinery processes and should be a matter of following guidelines already established by the petroleum refining industry.

The CR and IGCC gases would be treated in a combined acid gas removal process. The expected release of controlled substances would be selected for the design specifications chosen based on computer simulation models and/or more extensive pilot plant data. The selected acid gas removal process would be an efficient licensed process well established in commercial applications for both coal gas liquefaction processes and coal gasification processes.

For a fully integrated CR/IGCC process, it is nominal if the sulfur, nitrogen, or particulate is removed in the CR section or the IGCC section. Emissions and efficiencies are expected to be equivalent to that of IGCC. However, as stated earlier, the quantity of coal necessary to produce the same amount of electrical power for full coproduct recovery of a combined CR/IGCC is more than double the amount of coal required for a stand-alone IGCC. Therefore, if the same removal efficiencies are assumed for the combined CR/IGCC process as for a stand-alone IGCC process, the total emissions would more than double based simply on the amount of feed coal.

Conclusions

It is concluded that not enough is known about coal refining to fully assess its availability as a proven technology for use at Bellefonte, its technical feasibility or economic viability. However, coal refining offers considerable promise as a future fuel for power and chemicals production.

Appendix F ¾ Geologic Setting

This information provides more technical detail in support of Section 3.2.1, Seismicity and Faulting.

1.1 Seismotectonic Setting

The Bellefonte site is located within the North American crustal plate. This intraplate tectonic setting is far removed from any of the tectonic activity that takes place at boundaries between the earth's crustal plates. The tectonic stress regime throughout the southern Appalachians and most of eastern North America is characterized by a maximum compressive stress that lies near horizontal and is oriented east-west to northeast-southwest (Zoback and Zoback, 1991).

The *New Madrid Seismic Zone* is located in the Central Mississippi Valley within the Reelfoot Rift. The New Madrid Seismic Zone has produced damaging earthquakes in historical time including at least three earthquakes estimated to have had moment magnitudes of 8.0 or greater in the 1811-12 sequence. Johnston and Nava (1985) have determined recurrence intervals for NMSZ earthquakes based on historical and instrumental data. Their study indicates that a moment magnitude earthquake 6.0 or greater can be expected to occur somewhere within the zone one or more times in 70 years.

A recent compilation of studies related to the New Madrid Seismic Zone was published in Seismological Research Letters (1992). The New Madrid Seismic Zone is approximately 400 kilometers (250 miles) west-northwest of the Bellefonte site.

The *Wabash Valley Seismic Zone* is an area of moderate seismicity located in southwestern Indiana and southeastern Illinois. This area has produced moderately strong earthquakes in historical times including a magnitude 5.4 event in 1968. Evidence of at least one major, prehistoric earthquake has been found in this region by Obermeir (1992). This earthquake occurred approximately 2,400 years ago and is estimated to have had a magnitude of at least 6.5. The Wabash Valley Seismic Zone is located approximately 530 kilometers (330 miles) northwest of the Bellefonte site.

During historical time, only the New Madrid Seismic Zone has produced stronger earthquakes than the *Charleston, South Carolina Seismic Zone*. In 1886, an earthquake with estimated moment magnitude of 7.6 occurred near Charleston, South Carolina (Algermissen and Bollinger, 1993). Other strong earthquakes are believed to have occurred in this area in prehistoric time based on paleoliquefaction evidence (Talwani and Cox, 1985). The Charleston Seismic Zone is located about 460 kilometers east-southeast (285 miles) of the Bellefonte site. Additional information on the Charleston Seismic Zone can be found in Nuttli, et al., (1986) and Gohn (1983).

The *Southern Appalachian Seismic Zone* stretches from southwestern Virginia to northeastern Alabama, and may extend farther to the southwest to the Alabama-Mississippi border region. The largest earthquake in this zone (estimated magnitude 5.8) occurred in southwestern Virginia in 1897. However, over the past twenty years and perhaps longer, seismic activity within this zone has been concentrated in a band from about 50 kilometers north of Knoxville, Tennessee southwestward to the Alabama - Georgia border about 60 kilometers south of Chattanooga. This portion of the Southern Appalachian Seismic Zone is called the Eastern Tennessee Seismic Zone. Recent investigations of the Eastern Tennessee Seismic Zone can be found in Powell, et al., (1994) and Chapman, et al., (1996).

Due to its rate of seismic activity and proximity to the Bellefonte site, the Southern Appalachian Seismic Zone is the most important contributor to Bellefonte's seismic hazard, particularly for structures that would respond strongly to high frequency ground motion.

No recent surface faulting is known near Bellefonte; however, small to occasionally moderate earthquakes continue to occur in the southern Appalachians. Essentially all of these recent earthquakes occur within the basement rocks of the southern Appalachians at depths from 5 to 26 kilometers. Reactivation of zones of existing weaknesses within the basement rocks are believed to be responsible for present day earthquake activity in the region (Algermissen and Bollinger, 1993).

1.2 Physiography

The present valley floor is in all respects like those of the folded Ridge and Valley province to the east. Due to the easier weathering of the weaker rocks below the sandstone cover, the valley walls, which are bounded by escarpments, remain steep. The straightness of the valley merely reflects the straightness of the structural contours. Base-leveling of the upturned hard rocks on the flanks was never completed and these remain as low monoclinal ridges that are interrupted at intervals by gaps cut down to general level. At the site, the valley is approximately 8 km wide, and the Tennessee River flows southwestward forming the upper reaches of the Guntersville Reservoir. The river entrenched its course to about 174 m-msl before impoundment of the reservoir. The plant site occupies the former floodplain and gently rolling terrain of the river valley (around 192 m-msl). The valley is regionally bounded on the southeast by the prominent flank of Sand Mountain, which rises to about 425 m-msl. The highly dissected and irregular edge of the Cumberland Plateau, rises to similar elevations and forms the northwestern flank of the valley.

Geologic formations within the region are primarily sedimentary rocks of Paleozoic age. The predominant strata are of Carboniferous age. In Alabama, the majority of the bedrock in the Appalachian Plateaus province are made of the:

- *Knox Group,*
- *Chickamauga Formation,*
- *Red Mountain Formation, the Bangor Limestone, and*
- *Pottsville Formation.*

The *Pottsville Formation* (~365-m thick) is a succession of shale and sandstone beds, and represents the youngest Paleozoic rocks in Alabama, as well as the coal bearing rocks. The *Knox Group* (~760 to 915 m thick) consists mostly of dolomite with some limestone. The *Chickamauga Formation* of Ordovician age underlies the Bellefonte site and is mainly alternating layers of limestone, siltstone, and shale approximately 425-m thick. The *Red Mountain Formation* (~7 to 215-m thick) is partly composed of sandstone (closely associated with the Fort Payne Chert) and is almost entirely clastic material such as sand, pebbles, and clay. The *Bangor Limestone* consists of thick-bedded, oolitic limestone over most of the region and ranges in thickness from ~30 to 215 m.

Most of the major faulting in the region lies within the Valley and Ridge province to the east, which is complexly folded and faulted. The Appalachian Plateaus province contains a few minor folds and thrust faults trending northeast-southwest, particularly adjacent to the Valley and Ridge province. The Appalachian Plateaus province is bounded on all sides by outfacing escarpments, which reflect the regional synclinal structure of the plateau. The Paleozoic sedimentary rocks of the region are basically flat-lying.

Directly southeast of the plant, a low ridge is developed in the more resistant beds of the southeastward-dipping Chickamauga Formation. The ridge separates the site from the Tennessee River by a distance of about 915 m and stands at an elevation of about 245 m-msl. Gaps in the ridge are due to erosional development along normal dip joint systems and no cross-faulting is evident.

Northwest of the plant, the land slopes gently downward to a linear depression known as Town Creek Embayment. Quite typical of the area, the Town Creek Embayment exhibits erosional development along the more soluble belts of the lower Chickamauga and Upper Knox Formations. The Knox Group underlies the Chickamauga and outcrops to the northwest near the reservation boundary.

Only the Chickamauga Formation of Middle Ordovician age is involved in the foundations for the major structures. At the site, the Chickamauga is primarily overlain by a relatively thin (0 to 11 m) regolith of residual silts and clays derived from in-place weathering of the underlying rock. As shown in Figure B.1-1 overburden has been disturbed by plant construction activities. In many undisturbed areas, there is no sharp interface between residuum and sound rock.

A mineralogical analysis was performed on selected soil samples from monitoring wells W14, W15, W17, and W18. In general, the samples (2.7 to 10.8-m deep) contained clays, quartz, calcite (except W14), and traces of iron oxide (Table B.1-1). The clay fractions of all the samples contained illite, kaolinite, and montmorillonite. Muscovite, which has an x-ray diffraction pattern similar to that of illite, was determined by polarized light microscopy to be present in all samples except W19. The estimated amounts of clay in the samples are the totals for all clay phases determined to be present in each sample. Iron oxide is present in all the samples at concentrations of less than 2%, mainly as amorphous Fe_2O_3 -nH_2O. A chemical characterization has also been performed for selected soil samples from wells W12, W14, W15, W16, W17, W18, and W19 to measure geochemical parameters required for attenuation analyses.

Figure 1 Landfills, Borrow Pits, & Spoil Areas

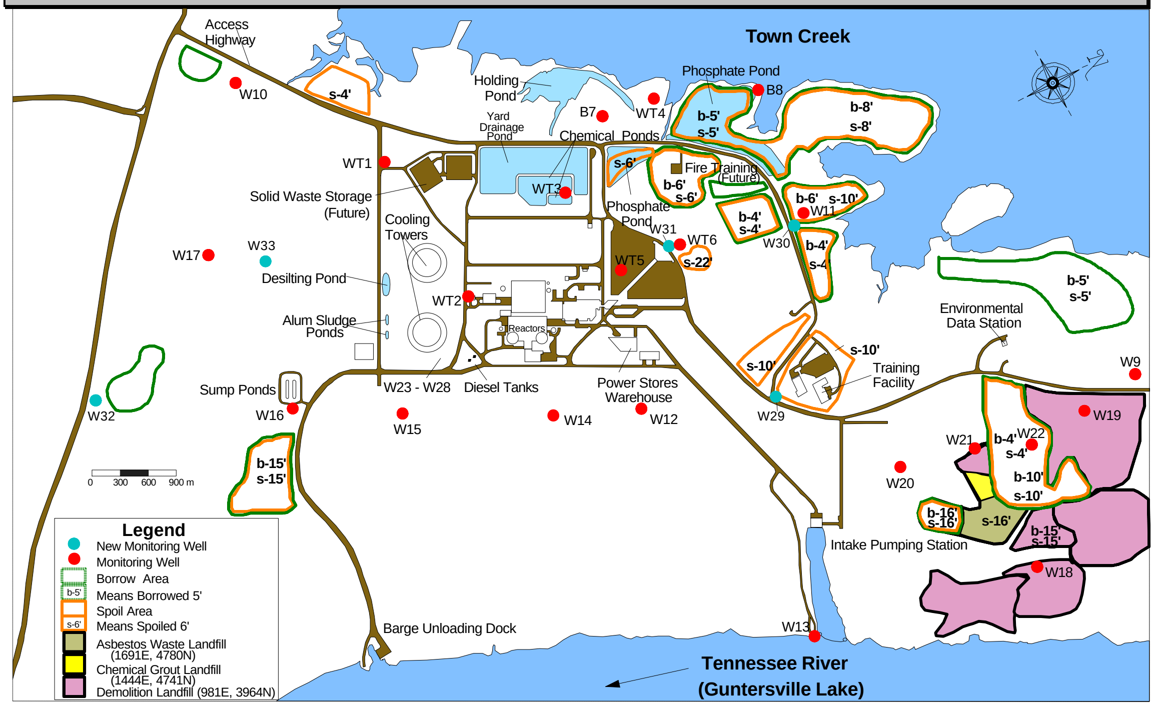


Table 1 Estimated Mineral Phases of Site Residual Soils

Well No.	Depth (m)	Total Clay[a] (%)	Quartz (%)	Calcite (%)	Iron Oxide
W-14	10.4-10.8	50 (I,K,M,C)	50	--	trace
W-15	2.7-3.2	30 (I,K,M,C)	40	30	trace
W-17	2.7-3.2	35 (I,K,M,C)	30	35	trace
W-18	4.3-4.7	15 (I,K,M)	80	5	trace

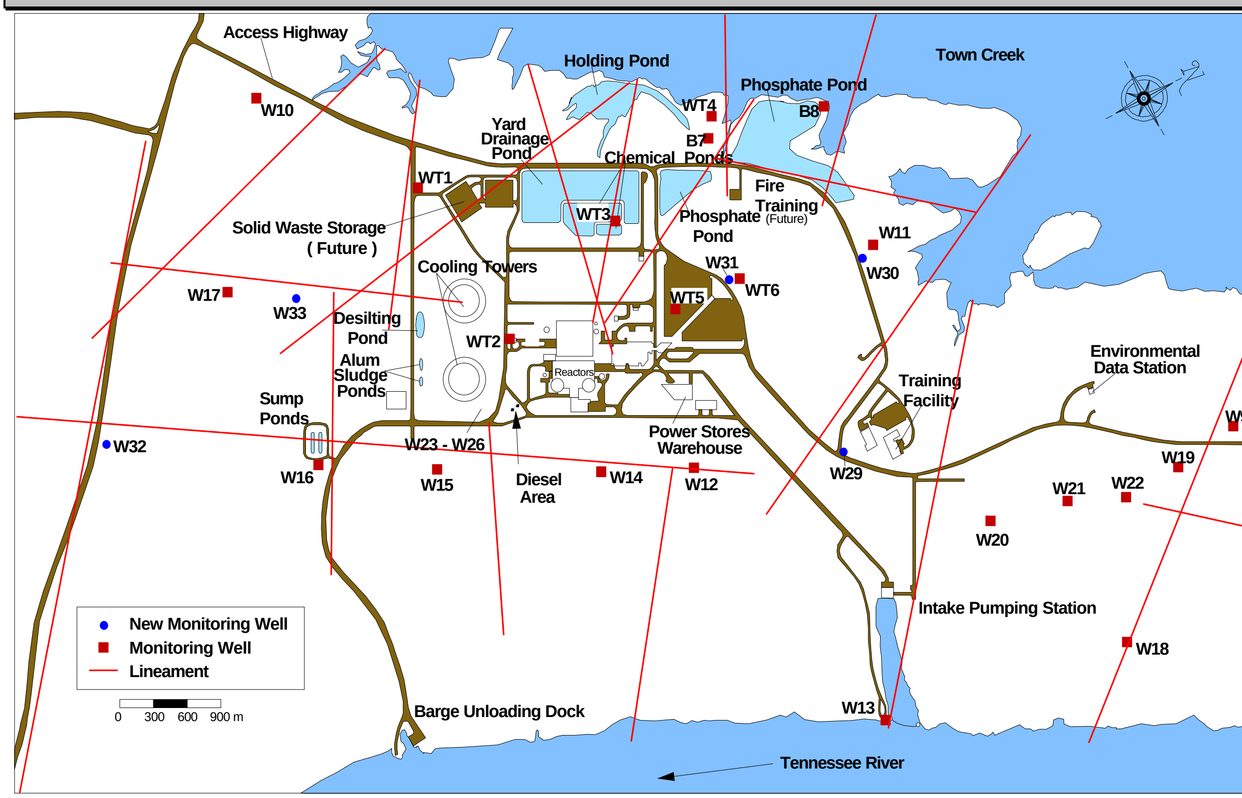
[a]Clay phases identified in each sample are given in parentheses beside the estimate of total amount of clay in each sample. Identified clay phases are as follows: I=illite, K=kaolinite, M=montmorillonite, and C=muscovite.

Site Bedrock and Lineaments

There is no intense folding or major faulting of the site bedrock. The strata strike N39° to 40° and dip to the southeast (toward the Tennessee River) at angles of about 17°. Throughout the plant site, fault zones are present that contain small shears and larger thrust faults. Three prominent joint sets have been mapped. One nearly parallels the strike N30° to 50° and dips steeply 70-80° to the northwest, another set strikes N80°E with dips ranging from 70° to the northwest to near vertical, and the last set strikes N50° to 80°W and is near vertical.

Figure 2 shows lineaments at the site that were derived from 1972 (predisturbed) and 1990 aerial photographs. The term lineament is used to describe linear topographic features of regional extent. Lineaments may represent long, narrow, relatively straight vegetation, soil tonal features, or drainage (subsurface or surface) features. Lineaments can be attributed to joints, faults, fractures, bedrock openings, and major structural relief forms on a localized basis. The dominant lineaments in Figure B.1-2 are oriented parallel and orthogonal to bedrock strike and may represent solutionally enlarged joints and/or fractures that can serve as privileged routes for groundwater movement. These features are generally referred to as strike/dip joints and are oriented well with those joint sets delineated in the Bellefonte FSAR. It is important to note that no field reconnaissance has been performed to verify these lineament locations.

Figure 2 Lineament Map



Characteristically, a large number of joints are parallel. However, the apertures of joints in three dimensions are rarely known. For example, in an area of low relief, even with 100% exposure, the vertical dimension of the joints is unknown. The size of joints is also difficult or impossible to analyze statistically. However, preferred orientations and attitudes of joints might provide some insight regarding the local movement of groundwater.

Differential weathering at the soil/bedrock interface has produced a zone of material above bedrock that consists of gravel and weathered shales in a silty clay matrix. This irregular weathering front also results in a bedrock surface that appears corrugated along bedrock strike due to the occurrence of purer limestone units and fracturing. Recharge from rainfall is relatively diffuse through the overburden, depending on cover, and percolating water usually accomplishes 50-80% of its solutional work within about 9 m of the ground surface. This is supported by exploratory drilling logs.

Appendix G ¾ Surface Water

Supporting table for Section 3.6.3, Surface Water Quality, Bellefonte Vicinity.

Average Water Quality Characteristics

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
Sample Height	% RT BANK	70	40	60		
Temperature	C	18.47	18.063	18.91	25.355	25.758
Sample Weight	g	-	-	-	685.9	-
Incident Light	%	-	-	15.35	-	-
Sample Length	mm	-	-	-	369.2	-
Stream Flow	inst-cfs	-	-	-	42507	-
Surface Elevation	ft	593.92	593.78	593.79	594.51	-
Turbidity	JTU	-	-	8.86	-	-
Turbidity	HACH FTU	-	-	8.83	-	-
Transp	m	1.2175	1.3075	1.54	1.8377	1.4478
Color, Total	PT-CO UNITS	10.046	10.2	10.29	10.572	10.79
Apparent Color	PT-CO UNITS	14.909	14.8	20.11	17.945	15
Redox	mV	324.01	331.74	326.25	406.34	466.08
Conductivity,Field	umhos/cm	174.43	176.94	170.88	177.16	180.19
Conductivity,Lab	umhos/cm	-	-	168.04	-	-
Sample Depth	m	-	-	3.15	6.8509	3.5042
Dissolved Oxygen	mg/L	8.4889	8.5759	7.81	6.5418	7.0302
Bod 5 Day	mg/L	1.16	1.2	1.48	-	-
Chemical Oxygen Demand Low Level	mg/L	5.5	4.9	6.29	-	-
Ph, FIELD	SU	7.5679	7.4831	7.26	7.4457	7.4943
Ph, LAB	SU	-	-	7.28	-	-
Total Alkalinity,Lab	mg/L	-	-	51.06	-	-
Phen-Ph-Lfin Alk	mg/L	-	-	0.00	-	-
Total Alkalinity,Field	mg/L	61.05	60.8	52.10	55.333	58.5
Residue,Total Nonfilterable	mg/L	9.5455	10.667	8.22	3.4524	3.4737
Oil-Grease Freon-Gr	mg/L	13	13	12.00	-	-
Organic Nitrogen	mg/L	0.145	0.1571	0.20	0.2824	0.2411
Nh3+Nh4-N Total	mg/L	0.04409	0.0505	0.08	0.0385	0.0406
Ammonia- Mud	MG/KG-N	-	-	-	61.333	61
Un-Ionzdnh3-N	mg/L	-	-	-	0.0006	0.0007
Un-Ionzdnh3-Nh3	mg/L	-	-	-	0.0008	0.0009
Kjeldln Total-Mud	MG/KG	-	-	-	793.33	1200
No2&No3n-Total	mg/L	0.32955	0.3405	0.44	0.2276	0.2971
Phosphorus,Total	mg/L	0.05909	0.057	0.04	0.0291	0.0339
Phosphorus-Dissolved	mg/L	0.025	0.025	0.02	-	-
Phosphorus -Ortho,Dissolved	mg/L	-	-	-	0.0082	0.0161
Total Organic Carbon	mg/L	1.3773	1.45	2.73	2.4581	2.379

Average Water Quality Characteristics (cont'd)

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
Dissolved Organic Carbon	mg/L	-	-	12.00	2.0556	2.4
Bm Organic Carbon	GM/KG-C	-	-	-	19	-
Cyanide,Total	mg/L	0.02	0.02	0.02	-	-
Sulfide,Total	mg/L	0.02	0.02	0.02	-	-
Calcium,Total	mg/L	20.773	20.75	19.53	18.375	19.889
Calcium-Mud	MG/KG-CA	-	-	-	3266.7	3650
Mercury-Mud	MG/KG-MG	-	-	-	4133.3	2450
Magnesium, Total	mg/L	5.4818	5.555	4.64	4.95	4.8111
Sodium,Total	mg/L	6.8273	6.88	6.29	-	-
Potassium,Total	mg/L	1.4636	1.46	1.40	1.3792	1.4445
Chloride, Total	mg/L	7.5909	7.7	7.50	-	-
Sulfate,Total	mg/L	15.381	15.6	14.21	-	-
Fluoride,Total	mg/L	0.15	0.1	0.17	-	-
Silica, Disolved	mg/L	3.7	3.45	3.94	-	-
Arsenic, Dissolved	µg/L	1	2	1.00	-	-
Arsenic,Total	µg/L	1	1	3.17	-	-
Barium,Dissolved	µg/L	19	20	18.75		-
Barium,Total	µg/L	22	21.539	60.04		-
Berylium,Dissolved	µg/L	1	1	1.00		-
Berylium,Total	µg/L	1	1	5.42		-
Boron,Total	µg/L	145	120	81.86	-	-
Cadmium,Dissolved	µg/L	1.7263	1.3533	1.42	-	-
Cadmium,Total	µg/L	0.15	0.125	0.60	-	-
Cadmium,Total	µg/L	0.10909	0.105	0.67	-	-
Cadium-Mud	SED MG/KG-CD	-	-	-	4	2
Chromium-Mud	SED MG/KG-CR	-	-	-	45.8	21
Chromium,Dissolved	µg/L	1.5	1.3333	1.75	-	-
Chromium,Total	µg/L	1.5	2	4.79	-	-
Cobalt,Dissolved	µg/L	1	1	1.00	-	-
Cobalt,Total	µg/L	1.2	1.25	1.00	-	-
Copper,Dissolved	µg/L	25	90	10.00	-	-
Copper,Total	µg/L	11.429	12	34.75	40	10
Copper-Mud	SED MG/KG-CU	-	-	-	42.6	25.5
Iron,Total	µg/L	528.57	577	504.47	204.58	275
Iron,Dissolved	µg/L	10	10	65.07	10	-
Ferrous Iron	µg/L	-	-	96.25	-	-
Lead,Dissolved	µg/L	2.75	1.6667	4.83	-	-
Lead,Total	µg/L	2.125	2.4286	10.57	-	-
Lead-Mud	SED MG/KG-PB	-	-	-	63.8	26.5

Average Water Quality Characteristics (cont'd)

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
Manganese-Mud	SED MG/KG-MN	-	-	-	3966.7	2250
Manganese,Total	µg/L	61.947	70	63.15	28.227	21.667
Manganese,Dissolved	µg/L	13.4	10.5	17.18	2300	-
Thallium,Dissolved	µg/L	50	50	50.00	-	-
Thallium,Total	µg/L	93.333	76.667	90.00	-	-
Moly,Total	µg/L	20	20	25.00	-	-
Nickel,Dissolved	µg/L	3	2.5455	2.50	-	-
Nickel,Total	µg/L	1.6667	2	11.04	-	-
Nickel-Mud	SED MG/KG-NI	-	-	-	38.6	18
Nickel-Wet	TIS MG/KG-NI	-	-	-	0.8556	-
Thallium-Wet	TIS MG/KG-TH	-	-	-	0.6625	-
Silver,Dissolved	µg/L	10	10	10.00	-	-
Silver,Total	µg/L	10	10	10.00	-	-
Strontum,Dissolved	µg/L	120		-	-	-
Strontum,Total	µg/L	50	50	50.00	-	-
Vanadium,Total	µg/L	10	10	10.00	-	-
Zinc,Dissolved	µg/L	88	67.5	72.50	-	-
Zinc,Total	µg/L	108.57	116.67	62.28	26.25	50
Zinc-Mud	SED MG/KG-ZN	-	-	-	280	175
Antimony,Total	µg/L	2.4286	1.6	2.83	-	-
Antimony-Wet	TIS MG/KG-AN	-	-	-	1.55	-
Tin,Total	µg/L	175	190	235.00	-	-
Aluminum,Total	µg/L	429.5	431.5	496.48	100.53	157.14
Aluminum- Mud	SED MG/KG-AL	-	-	-	39,200	15,000
Lithium,Total	µg/L	10	10	10.00	-	-
Silicon,Total	µg/L	2,645	2,777.8	2876.20	-	-
Selenium,Dissolved	µg/L	2	1	1.50	-	-
Selenium,Total	µg/L	1.2	1	2.33	-	-
Selenium-Wet	TIS MG/KG-SE	-	-	-	0.33	-
Titanium,Total	µg/L	24.333	25.333	21.88	-	-
Iron Mud	SED MG/KG-FE	-	-	-	42600	27,500
Tot Coli	MFM-FCBR/100ML	-	-	214.38	-	-
Fec Coli	MFM-FCBR/100ML	38.833	27.125	39.47	281.14	12.111
Diclbrmt, Total	µg/L	10	10	10.00	-	-

Average Water Quality Characteristics (cont'd)

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
Carbntet, Total	µg/L	10	10	10.00	-	-
Bromofrmwhl-Wtr	µg/L	10	10	10.00	-	-
Cldibrmt, Total	µg/L	10	10	10.00	-	-
Chloroform, Total	µg/L	10	10	10.00	-	-
Chlrphyl A	µg/L	-	-	1.38	7.3256	3.4211
Chlorophyl B	µg/L	-	-	1.38	1.0769	1.5
Chlorophyl C	µg/L	-	-	2.04	1.2222	1.1
Pheophtna	µg/L	-	-	1.49	1.6487	1.3333
Phenols,Total	µg/L	0.91318	0.007	0.87	-	-
Toluene, Total	µg/L	10	10	10.00	-	-
Benzene, Total	µg/L	7.5	6.6667	6.67	-	-
Acenaphthylene. Total	µg/L	5	5	5.00	-	-
Acenaphthene, Total	µg/L	5	5	5.00	-	-
Acrolein, Total	µg/L	100	100	100.00	-	-
Acrylonitrile, Total	µg/L	100	100	100.00	-	-
Anthracene, Total	µg/L	5	5	5.00	-	-
Benzbfluorant, Total	µg/L	10	10	10.00	-	-
Benzo(K)Fluorant, Total	µg/L	10	10	10.00	-	-
Benzo(A)Pyrene, Total	µg/L	10	10	10.00	-	-
Berylium-Wet	TIS MG/KG-C	-	-	-	0.0175	-
Beta Bhc-Mud	µg/L	-	-	-	10	10
Beta Bhc-Wet	TIS MG/KG	-	-	-	0.01	-
Delta Bhc, Total	µg/L	0.01	0.01	0.01	-	-
Delta Bhc-Mud	mg/KG	-	-	-	10	10
Delta Bhc-Wet	TIS MG/KG	-	-	-	0.01	-
Bis-2-Chloroethyl Ester, Total	µg/L	5	5	5.00	-	-
Bis-2-Chloroethoxymethane, Total	µg/L	5	5	5.00	-	-
Bis-2-Chloroisopropyl, Total	µg/L	5	5	5.00	-	-
Nbb Phth,Total	µg/L	5	5	5.00	-	-
Chlorobenzene, Total	µg/L	10	10	10.00	-	-
Chloroethane, Total	µg/L	10	10	10.00	-	-
Chrysene, Total	µg/L	10	10	10.00	-	-
Diethylphthalate, Total	µg/L	5	5	5.00	-	-
Endsulsf, Total	µg/L	0.01	0.01	0.01	-	-
Endsulsf-Mud	mg/KG	-	-	-	10	10
Endsulsf-Wet	TIS MG/KG	-	-	-	0.01	
B-Endosulfan, Total	µg/L	0.01	0.01	0.01	10	10
Bendosul-Mud	µg/L	-	-	-	0.01	-

Average Water Quality Characteristics (cont'd)

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
Bendosul-Wet	TIS MG/KG	-	-	-	-	-
A-Endosulfan, Total	μg/L	0.01	0.01	0.01	-	-
Dimethylphthalate, Total	μg/L	5	5	5.00	-	-
Aendosul-Mud	mg/KG	-	-	-	10	10
Aendosul-Wet	TIS MG/KG	-	-	-	0.01	-
Endrinaldehyde, Total	mg/L	0.01	0.01	0.01	406	505
Endrinal-Wet	MG/KG-CD	-	-	-	0.01	-
Ethylbenzene, Total	μg/L	10	10	10.00	-	-
Fluoranthene, Total	μg/L	5	5	5.00	-	-
Fluorene, Total	μg/L	5	5	5.00	-	-
Hexachlorocyclopentadiene, Total	μg/L	5	5	5.00	-	-
Hexachloroethane, Total	μg/L	5	5	5.00	-	-
Indeno(123cd)Pyrene, Total	μg/L	10	10	10.00	-	-
Isophorone, Total	μg/L	5	5	5.00	-	-
Methylbromide, Total	μg/L	10	10	10.00	-	-
Methylchloride, Total	μg/L	10	10	10.00	-	-
Methylenechloride,Total	μg/L	10	10	10.00	-	-
Nitrosodipropylamine, Total	μg/L	5	5	5.00	-	-
Nitrosodiphenylamine, Total	μg/L	5	5	5.00	-	-
Nitrobenzene, Total	μg/L	5	5	5.00	-	-
Parachlorometacr, Total	μg/L	30	30	30.00	-	-
Phenanthrene, Total	μg/L	5	5	5.00	-	-
Pyrene, Total	μg/L	5	5	5.00	-	-
Silver-Wet	TIS MG/KG	-	-	-	0.1	-
Tetrachloroethylene, Total	mg/L	10	10	10.00	-	-
Trichlorofluoromethane, Total	μg/L	10	10	10.00	-	-
1-1-Dichloroethane, Total	μg/L	10	10	10.00	-	-
1-1-Dichloroethylene, Total	μg/L	10	10	10.00	-	-
1-1-1-Trichloroethane, Total	μg/L	10	10	10.00	-	-
1-1-2-Trichloroethane, Total	μg/L	10	10	10.00	-	-
1-1-2-2-Tetrachloroethane, Total	μg/L	10	10	10.00	-	-
Benzo(Ghi)Peryle, Total	μg/L	10	10	10.00	-	-
Benzo(A)Anthrace, Total	μg/L	5	5	5.00	-	-
1-2-Dichloroethane, Total	μg/L	10	10	10.00	-	-
1-2-Dichlorobenzene, Total	μg/L	5	5	5.00	-	-
1-2-Dichloropropane, Total	μg/L	10	10	10.00	-	-
1-2-Dichloroethene, Total	μg/L	10	10	10.00	-	-

Average Water Quality Characteristics (cont'd)

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
1-2-4-Trichlorobenzene, Total	µg/L	5	5	5.00	-	-
Dibenz(Ah)Anthrace, Total	µg/L	10	10	10.00	-	-
1-3-Dichlorobenzene, Total	µg/L	5	5	5.00	-	-
1-4-Dichlorobenzene, Total	µg/L	5	5	5.00	-	-
2-Chloroethylvinyl, Total	µg/L	10	10	10.00	-	-
2-Chloronaphthale, Total	µg/L	5	5	5.00	-	-
2-Chlorophenol, Total	µg/L	5	5	5.00	-	-
2-Nitrophenol, Total	µg/L	5	5	5.00	-	-
Dinoctph, Total	µg/L	10	10	10.00	-	-
2-4-Dichlorophenol, Total	µg/L	5	5	5.00	-	-
2-4-Dimethylphenol, Total	µg/L	5	5	5.00	-	-
2-4-Dinitrotoluene, Total	µg/L	5	5	5.00	-	-
2-4-Dinitrophenol, Total	µg/L	20	20	20.00	-	-
2-4-6-Trichlorophenol, Total	µg/L	20	20	20.00	-	-
2-6-Dinitrotoluene, Total	µg/L	5	5	5.00	-	-
3-3-Dichlorobenzide, Total	µg/L	25	25	25.00	-	-
4-Bromophenylphenol, Total	µg/L	5	5	5.00	-	-
4-Chlorophenylphenol, Total	µg/L	5	5	5.00	-	-
4-Nitrophenol, Total	µg/L	30	30	30.00	-	-
4-6-Dinitroorthocr, Total	µg/L	30	30	30.00	-	-
Pcb-1221-Wet	TIS MG/KG	-	-	-	0.1	-
Pcb-1232-Wet	TIS MG/KG	-	-	-	0.1	-
Pcb-1248-Wet	TIS MG/KG	-	-	-	0.0938	-
Pcb-1260-Wet	TIS MG/KG	-	-	-	0.165	-
Pcb-1016, Total	µg/L	0.1	0.1	0.10	-	-
Phenol, Total	µg/L	5	5	5.00	-	-
Napthalene , Total	µg/L	5	5	5.00	-	-
Trans-1,3-Dcp, Total	µg/L	10	10	10.00	-	-
Cis-1,3-Dcp,Total	µg/L	10	10	10.00	-	-
Mbas	mg/L	0.1	0.1	0.10	-	-
Pcp, Total	µg/L	30	30	30.00	-	-
B2ethhxlphthalate, Total	µg/L	5	5	5.00	-	-
Dnb Phth,Total	µg/L	5	5	5.00	-	-
Benzidin, Total	µg/L	50	50	50.00	-	-
Vinyl Chloride. Total	µg/L	10	10	10.00	-	-
Trichlorethylene. Total	µg/L	10	10	10.00	-	-
P,P'ddt, Total	µg/L	-	0.02	-	-	-
P,P'ddd, Total	µg/L	0.01	0.01	0.01	-	-

Average Water Quality Characteristics (cont'd)

Analyte	Units	Tennessee River Mile 392.2 Point B	392.2 Point C	391.2 Point D	350	375.2
P,P'dde, Total	μg/L	0.01	0.01	0.01	-	-
Aldrin, Total	μg/L	0.01	0.01	0.01	-	-
Alpha Bhc, Total	μg/L	0.01	0.01	0.01	-	-
Beta Bhc, Total	μg/L	0.01	0.01	0.01	-	-
Gamma Bhc, Total	μg/L	0.01	0.01	0.01	-	-
Chlrdanetech&Met	μg/L	0.01	0.01	0.01	-	-
Dieldrin, Total	μg/L	0.01	0.01	0.01	-	-
Endrin, Total	μg/L	0.01	0.01	0.01	-	-
Toxaphene, Total	μg/L	0.5	0.5	0.50	-	-
Heptchlr, Total	μg/L	0.01	0.01	0.01	-	-
Hpchlrep, Total	μg/L	0.01	0.01	0.01	-	-
Methoxychlor,Total	μg/L	0.01	0.01	0.01	-	-
Pcb-1221, Total	μg/L	0.1	0.1	0.10	-	-
Pcb-1232, Total	μg/L	0.1	0.1	0.10	-	-
Pcb-1242, Total	μg/L	0.1	0.1	0.10	-	-
Pcb-1248, Total	μg/L	0.1	0.1	0.10	-	-
Pcb-1254, Total	μg/L	0.1	0.1	0.10	-	-
Pcb-1260, Total	μg/L	0.1	0.1	0.10	-	-
Pcbs	μg/L	0.1	0.1	0.10	-	-
Hcb, Total	μg/L	5	5	5.00	-	-
Hexclbd, Total	μg/L	5	5	5.00	-	-
Hardness	mg/L	74.5	74.7	67.87	-	-
Residue,Dissolved-180	C mg/L	100	100.5	93.82	-	-
Residue, Total Volitile	%	-	-	4.47	-	-
Phosphorus-Ortho, Total	mg/L	-	-	0.02	-	-
Bromide, Total	mg/L	0.1	0.1	0.10	-	-
Mercury,Dissolved	μg/L	0.2	0.2	0.20	-	-
Mercury,Total	μg/L	0.2	0.2	0.20	-	-
Total Sedsieve	%<.062mm	-	-	50.22	-	-
Total Sedsieve	%<.125mm	-	-	65.35	-	-
Total Sedsieve	%<.500mm	-	-	89.64	-	-
Total Sedsieve	%<2.00mm	-	-	95.07	-	-
Turbidty -Lab	NTU	7.8182	7.8	8.50	-	-

Appendix H ¾ Groundwater

1.0 Groundwater Occurrence and Movement

All water at the site is derived from precipitation or is imported by pipeline from the Tennessee River. Additional groundwater recharge may occur from leaking water and wastewater pipelines, process pipelines, and impoundments. All water eventually leaves the site as streamflow and runoff, is removed by pumping, or is consumed by evapotranspiration. Except for barren landscape features, paved and roofed areas, the land surface is permeable. Water that is not removed by runoff, evapotranspiration, or the site drainage system moves laterally through the subsurface to the Town Creek embayment and the Tennessee River. It appears that all groundwater is discharged to surface waters and none is known to leave the site as underflow.

Groundwater Levels

A total of 35 groundwater monitoring wells have been installed at the site since 1973. The well locations are shown in Figures 1 and 2 with pertinent construction data provided in Table 1. Groundwater movement is generally toward the Town Creek Emabyment at all times. Groundwater levels normally reach maximum elevations during the months of January through March. During September and October water levels are usually at a minimum. The water table generally ranges from 0 to 22 ft below land surface at the plant site.

Figures 3 and 4 show water levels for several monitoring wells across the site. Figure 3 shows the groundwater level data from 3 deep bedrock wells (WT1, WT3, and WT4) located on the western side of the main plant site. The plot indicates that groundwater movement is generally towards Town Creek embayment at all times. The horizontal hydraulic gradient form WT3 and WT4 is about 0.006 and the gradient from WT1 to WT3 is about 0.002. The large shifts in groundwater elevations during the period from 1973 to 1976 are attributed entirely to plant construction activities.

Table 1 Site Groundwater Monitoring Wells

Well ID	Date Installed	Depth Range (m)	Soil or Bedrock	Purpose	Reference
WT1 - WT6	1973	13.9	Bedrock	Background Water Quality and Water Level Data	TVA (1976)
B7 & B8	1981	6.5 - 7.4	Bedrock	Monitor Groundwater Quality Near TSP[a] Ponds	Lindquist (1990)
W9 - W11	1984	0.9 - 1.3	Soil	Monitor Groundwater Quality Near TSP[a] Land Applications	Lindquist (1990)
BNP01 - BNP03, BNP06 & BNP07	1987	0.4 - 0.5	Soil	Monitor Groundwater Quality Near Diesel Tanks	Young and Lindquist (1988)
W12 - W19	1990	0.9 - 3.3	Both	Background Water Quality and Water Level Data	Julian (1990)
W21 - W22, B & C	1992	3.8 - 4.4	Bedrock Soil	Monitor Groundwater Quality Near Landfill	Browman (1994)
W23 - W26	1993	0.9 - 1.4	Bedrock	Monitor Groundwater Quality Near Diesel Fuel Tanks	Julian (1993)
W27 & W28	1994	1.4	Both	Monitor Groundwater Quality Near Diesel Fuel Tanks	Julian (1994)

Figure 1 Monitoring Well Locations

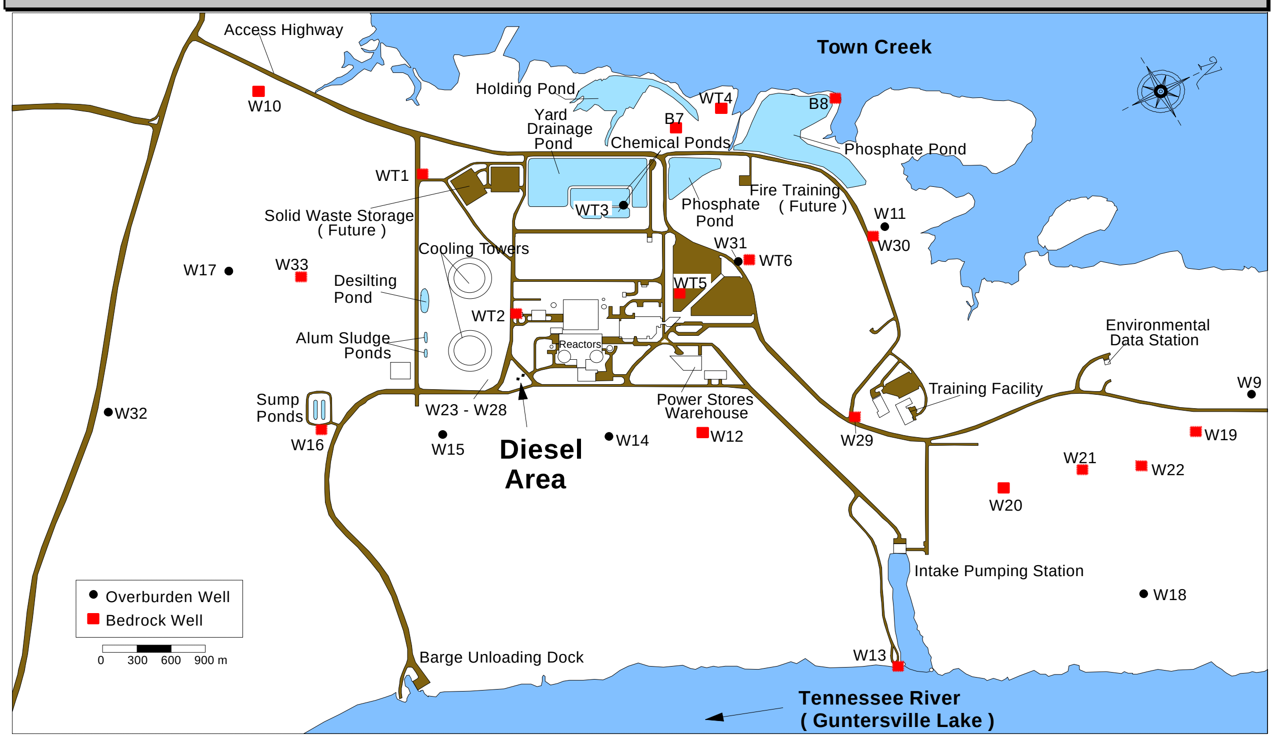


Figure 2 Groundwater Wells and Elevations Near Diesel Tanks

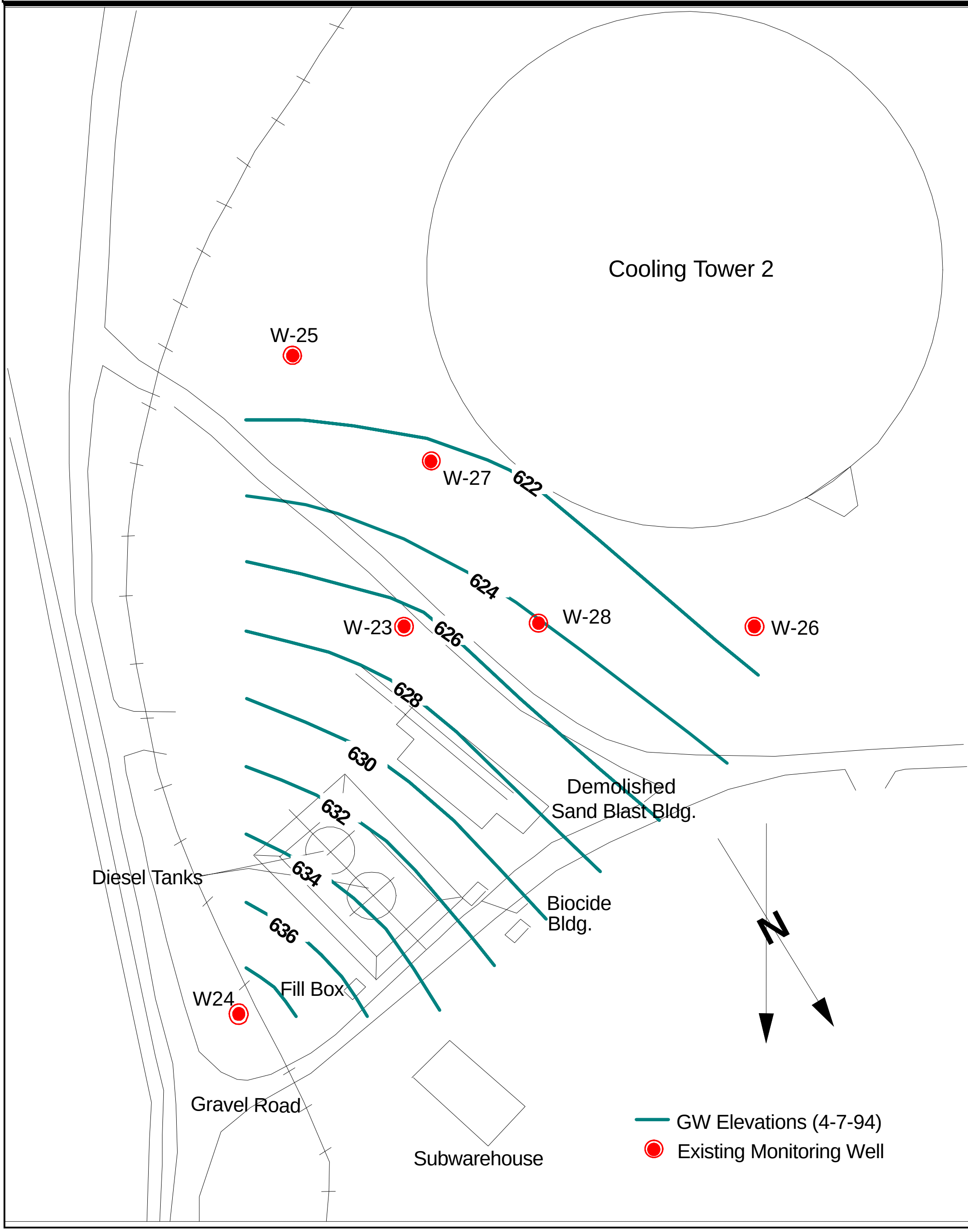


Figure 3 Groundwater Levels at Wells WT1, WT3, and WT4

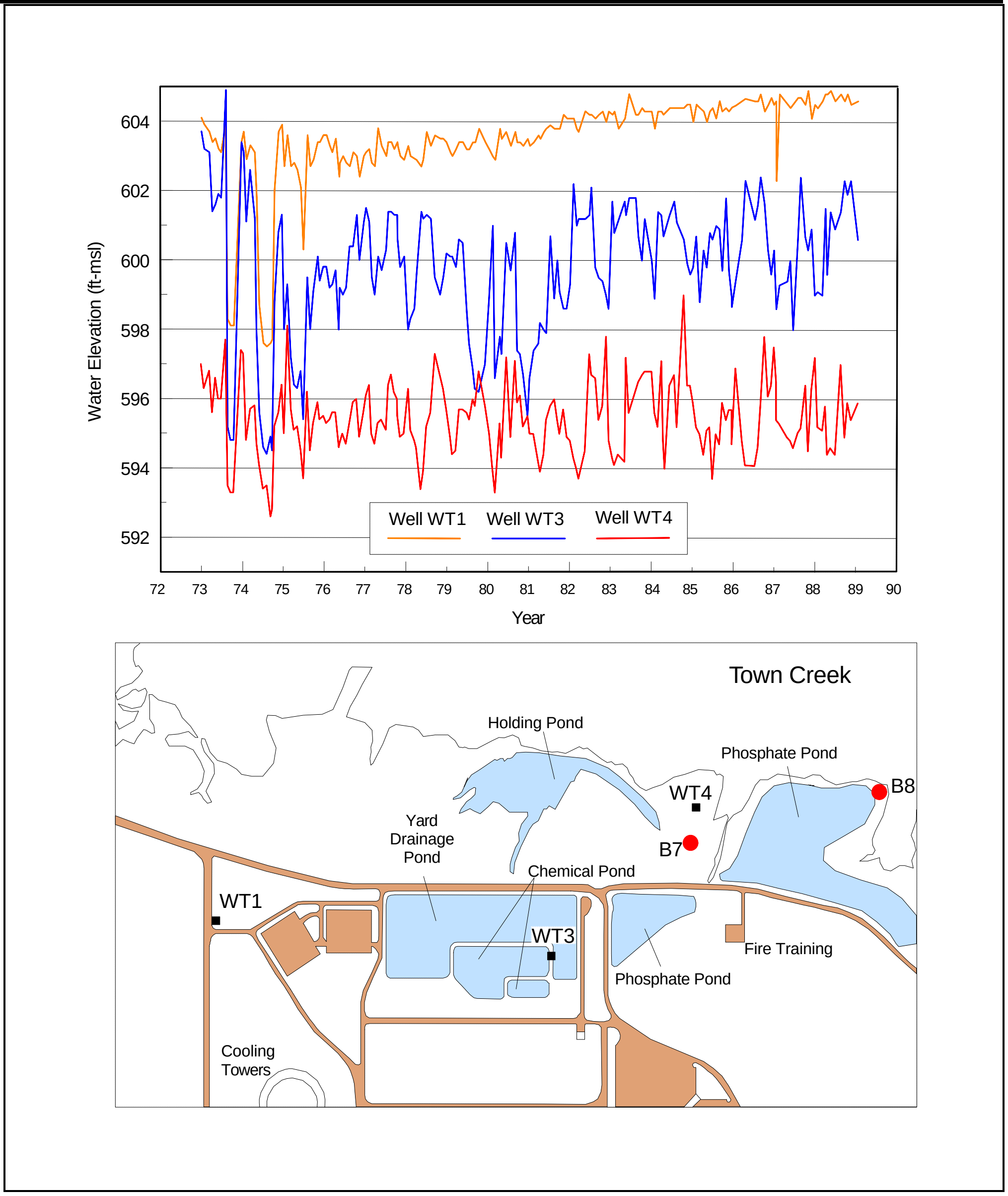
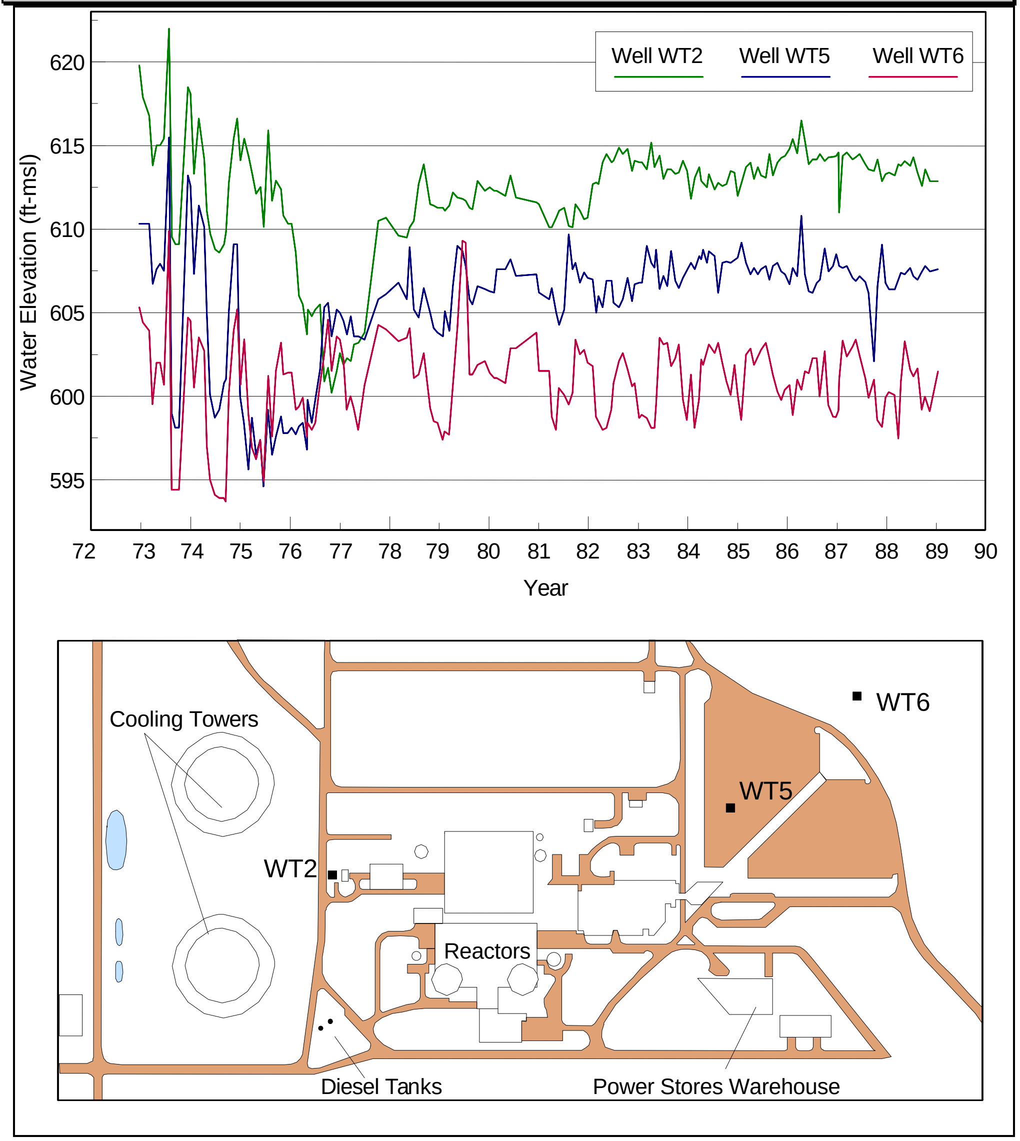


Figure 4 shows the groundwater level data from deep bedrock wells WT2, WT5 and WT6 that are located across the approximate middles of the main plant. The data indicate that the direction of groundwater in this vicinity (west of the main parking lot) is also in the general direction of Town Creek embayment. Horizontal hydraulic gradients in this vicinty range from about 0.004 to 0.007. The large fluctuations in water levels during the first 2 ½ years can again be attributed to plant construction.

Figure 4 Groundwater Levels at Wells WT2, WT5, and WT6



Examination of remaining groundwater level data indicates that the general trend in groundwater movement is north-northwest toward Town Creek Embayment and from topographic highs to lows. Exceptions occur from the east side of the main parking lot toward the intake channel (roughly along the route of the ERCW pipeline) and possibly from the southern corner of the site (near the sump collection ponds) toward the barge unloading dock.

Groundwater levels normally reach maximum elevations during the months of January through March. During September and October water levels are usually at a minimum. The water table generally ranges from 0 to 22 ft below land surface at the plant site.

2.0 Groundwater Occurrence

Certain amounts of overland flow occur in the study area as a result of precipitation on urban facilities and barren landscape features (i.e. gravel roads, bare soil areas, and rock outcrops. Surface runoff, stormflow, and groundwater move from higher elevations toward discharge points at lower elevations (i.e. Town Creek Embayment). The water table generally occurs at depths of 0 to 7 m below land surface at the plant and is typically at or below the bedrock/overburden interface in the plant area during the dry season and very near the interface during the wet season.

The subsurface flow of water that eventually discharges to Town Creek Embayment occurs both in a shallow zone just beneath land surface and in a deeper zone below the water table. Transient lateral flows of water probably are rare in the intervening vadose zone. The properties of the hydrologic subsystems are locally influenced by hydrostratigraphic units. Although many factors influence groundwater flow on the site, topography, surface cover, geologic structure, lithology, and human disturbance exhibit strong influence. Variations in these features result in water flux variations. Because of topographic relief and a marked decrease in permeability, subsurface flow is predominately shallow. In addition to groundwater flow, contaminant migration rates are strongly influenced by geochemical processes, including ion exchange, sorption, and precipitation/dissolution of mineral phases. The retardation of contaminants at the site resulting from geochemical processes is specific to each contaminant.

The geologic units beneath the site primarily constitute aquitards, in which flow is dominated by fractures. The subsurface flow system in the aquitard units can be divided as follows: the stormflow zone; the vadose zone; the groundwater zone (which can be subdivided into the water table interval, the intermediate interval, and the deep interval); and the aquiclude (Figure 3.1.8-5). These hydrologic subsystems are defined on the basis of water flux, which decreases with depth. The largest flux is associated with the stormflow zone (where present and well developed) and the smallest with the deep interval. Note that these zones are vertically gradational and are usually not separated by discrete boundaries. It is important to understand that major processes within a subsystem, as well as interactions that occur between subsystems, are functions of the system as a whole.

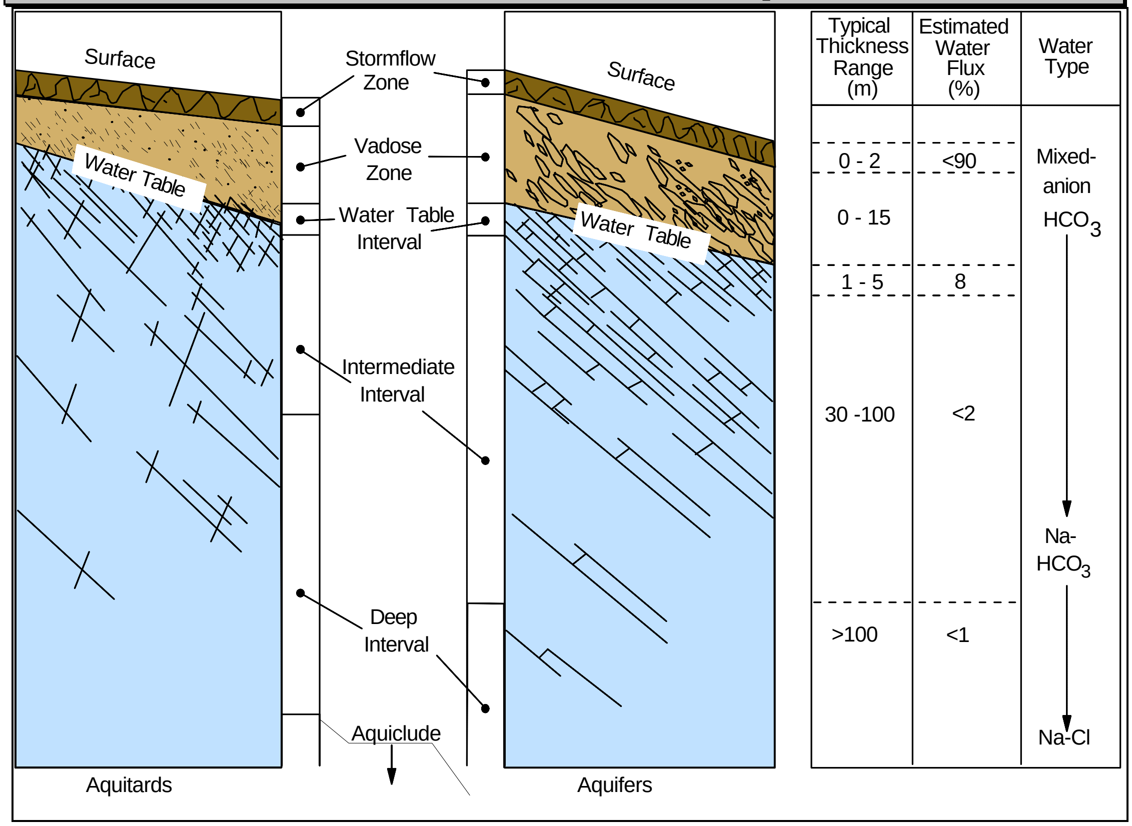
Stormflow Zone - Where present, the majority of active subsurface flow occurs through the 1 to 2-m deep stormflow zone. Undisturbed area of the site are heavily vegetated, and the stormflow zone approximately corresponds to the root zone. Across the site, the stormflow zone might be described as poorly to well developed. In heavily vegetated areas, it is probably well developed. In areas extremely disturbed by construction and compaction (the majority of the active plant site), the stormflow zone might be absent or penetrate to much more shallow depths such that it is considered poorly developed.

Vadose Zone **-** A vadose zone exists through the site except where the water table is at land surface. The thickness of the vadose zone is greatest beneath topographic highs, and thins toward drainage boundaries. The vadose zone consists of a regolith composed primarily of clay and silt, most of which is derived from the weathering of bedrock materials and which has significant water storage capacity. The downward percolation of water in the vadose zone is controlled by vertical hydraulic conductivity, which may be considerably smaller than the infiltration rate because of anisotropy.

Water Table Interval **-** Flow paths in the groundwater zone (Figure 5) generally follow topographic trends but are tortuous. Water-bearing (active) fractures are ubiquitous below the water table, but enlarged fractures and cavities are common only at shallow depths and most of these are fully to partially infilled with clayey sediments. The groundwater zone can be described as consisting of closely spaced, connected fractures in an otherwise impermeable bedrock. The water table is the level at which water stands in shallow wells and is presumed to be the same level as in a fracture at that point. Cyclic changes in water table elevations alter the saturated thickness of the permeable groundwater zone and may result in an order-of-magnitude fluctuation in groundwater discharge rates.

Intermediate and Deep Intervals **-** Below the water table interval (Figure 5), fracture control becomes dominant in the flow path direction. In the intermediate interval of the groundwater zone, groundwater movement occurs primarily in permeable fractures that are poorly connected in three dimensions. Below the intermediate interval, it is estimated that only small quantities of groundwater are transmitted through discrete fractures in the deep interval. The active fractures in the deep interval are probably fewer in number, shorter in length, and more greatly spaced than in other intervals. Fracture orientations are likely, however, to be similar to overlying intervals.

Figure 5 Schematic Profile Showing Subsurface Flow Zones, General Thickness Layers, and Estimated Water Flux With Depth



3.0 Groundwater Movement

Within the vadose zone, groundwater movement is essentially vertical and relatively diffuse with average saturated hydraulic conductivities (K_{sat}) generally ranging from 10^{-6} to 10^{-8} cm/s. The smaller values of K_{sat} are associated with residual silty clay (10^{-7} to 10^{-8} cm/s), while larger values might be related to alluvial activity and reworking of residual soils(10^{-6} cm/s). Studies at sites with similar soils (i.e. Widows Creek Fossil Plant) indicate that these residual silts and clays can be expected to display a vertical to horizontal hydraulic conductivity ratio of about 1:10. The downward percolation of water in the vadose zone is controlled by vertical hydraulic conductivity (K_v).

Vestigial solution activity along bedding planes, joints, and fractures has produced enlarged openings and effective routes for groundwater movement. With regard to groundwater movement, the most transmissive zone is generally the weathered zone. The bedrock drainage matrix yields a very complex groundwater flow system and there is a probability for relatively rapid movement of groundwater via the bedrock fractures. These drainage networks may have groundwater velocities several orders of magnitude greater than those expected in the regolith. Thin shale beds and clay seams in the Chickamauga Formation generally serve as lithologic controls to the movement of groundwater in this flow regime. Additionally, fissures that are considerably widened by corrosion close with depth. As a result, infiltration into the epikarstic aquifer may be much easier than drainage out of it (Wouldiams, 1983). The ratio of vertical to horizontal flows depends on the contrast in hydraulic conductivity in the upper and lower parts of this zone. In the well bedded, near horizontal carbonates at Bellefonte, this depends preeminently on the frequency and pattern of solutionally corroded joints and bedding planes.

Based on packer tests, a hydraulic conductivity range of 3.28 to 0.004 m/d is provided in the Bellefonte FSAR (TVA, 1986) with 92 % of the values being less than 0.30 m/d Slug testing by Julian (1994) provided hydraulic conductivity values of 1.38 to 0.008 cm/s for bedrock fracture zones near the Aboveground Diesel Fuel Storage Area. Recent single-well pumping and recovery tests were conducted at nine Bellefonte bedrock wells distributed across the site. With the exception of two outlying (low K) results from recovery curve analyses, the distribution of hydraulic conductivity values is lognormal. The geometric mean K values from analyses of these pumping and recovery test data are 0.043 and 0.032 m/d, respectively.

Appendix I ¾ Aquatic Ecology

This table supports information presented in section 3.1.10.

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q[a]	1994
TRM 420.0 (Inflow)								
HYDROIDA	Hydridae	*Hydra americana*						1
TRICLADIDA	Planariidae	*Dugesia tigrina*				21.8	19.1	64
		Dugesia sp.		1.7	25.3			
HAPLOTAXIDA	Naididae							7
		Nais sp.					1.8	
	Tubificidae			5	201.1	163.6	190.9	49
		Branchiura sowerbyi			45.3			
		Limnodrilus hoffmeisteri	14.5		103.2		5.5	3
		Limnodrilus sp.				10		
LUMBRICULIDA	Lumbriculidae				1.1		2.7	
		Lumbriculus sp.				19	6.4	
HIRUNDINEA								5
RHYNCHOBDELLIDA	Glossiphoniidae				1.1	0.9		
		Helobdella sp.				0.9		
PHARYNGOBDELLIDA	Erpobdellidae				1.1			
ISOPODA	Asellidae	*Caecidotea sp.*					15.5	
		Lirceus fontinalis	3.6	11.7				
		Lirceus sp.			16.8	15.4	12.7	8
AMPHIPODA	Crangonyctidae	*Crangonyx sp.*				5.4	8.2	
	Gammaridae					7.2	8.2	
		Gammarus sp.	40	63.3	196.8	49	60	160
ODONATA	Coenagrionidae	*Argia sp.*			1.1			
		Enallagma sp.			1.1			
	Corduliidae	*Neurocordulia sp.*					0.9	
	Gomphidae	*Gomphus sp.*			1.1			
EPHEMEROPTERA	Ephemerellidae	*Ephimerella sp.*		1.7				
	Ephemeridae	*Hexagenia limbata*	3.6	23.3		29	44.6	4
		Hexagenia sp.			12.6			
EPHEMEROPTERA	Heptogeniidae						5.5	
		Stenacron interpunctatum				18.1	16.4	5
		Stenacron sp.	3.6		72.6			

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q	1994
TRM 420.0 (Inflow)								
TRICOPTERA	Hydropsychidae	*Cheumatopsyche sp.*				0.9		
		Hydropsyche sp.	1.8					
	Leptoceridae	*Ceraclea sp.*						2
		Oecetis sp.				0.9	2.7	
	Polycentropodidae	*Cyrnellus fraternus*				0.9		
MEGALOPTERA	Sialidae	*Sialis sp.*						2
DIPTERA	Ceratopogonidae	*Bezzia sp.*			2.1	3.6	10.9	4
	Chironomidae				2.1	10.9		5
		Ablabesmyia annulata			3.2	1.8	7.3	1
		Ablabesmyia mallochi			2.1			
		Ablabesmyia sp.			1.1			
		Axarus sp.		13.3				
		Chironomus sp.	1.8			4.5	1.8	3
		Cladotanytarsus sp.					1.8	
		Coelotanypus tricolor					19.1	4
		Coelotanypus sp.		1.7	6.3	19		
		Conchapelopia sp.		1.7				
		Cryptochironomus fulvus					0.9	
		Cryptochironomus sp.		1.7	15.8	0.9	5.5	3
		Dicrotendipes sp.				0.9		3
		Harnischia sp.						1
		Microtendipes sp.			2.1			
		Nanocladius sp.			1.1		0.9	
		Paracladopelma sp.					1.8	
		Parametriocnemus sp.			1.1			
		Paratendipes sp.				0.9		
		Polypedilum sp.				3.6	24.6	5
		Procladius sp.			3.2			3
		Pseudochironomus sp.				0.9	4.6	4
		Rheotanytarsus sp.			2.1			
		Stenochironomus sp.			2.1		1.8	
		Stictochironomus sp.				1.8		
		Tanytarsus sp.			1.1	0.9		
		Tribelos sp.			3.2			
		Zavrelia sp.			1.1			
	Empididae	*Hemerodromia sp.*					0.9	
		Lithasia verrucosa						5
	Pleuroceridae	*Lithasia sp.*		1.7				
		Pleurocera calaliculata	7.3					
		Pleurocera sp.		11.7		1.8		2
	Viviparidae	*Campeloma sp.*						3

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	*SPECIES*	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q	1994
TRM 420.0 (Inflow)								
DIPTERA	Tabanidae				1.1			
COLEOPTERA	Elmidae	*Ancyronyx variegatus*			1.1			
		Dubiraphia sp.	1.8		8.4	0.9		1
		Macronychus glabratus			1.1			
		Optioservus sp.			4.2			
		Stenelmis sp.				0.9	0.9	
MESOGASTROPODA	Hydobiidae	*Somatogyrus sp.*		11.7				
BASOMMATOPHORA	Ancylidae	*Ferrissia rivularis*					3.6	
		Ferrissia sp.			1.1			
UNIONOIDA	Unionidae	*Cyclonaias tuberculata*			1.1			
		Obliquaria reflexa			1.1			
		Potamilus alatus				0.9		
		Quadrula metanevra			1.1			
		Quadrula pustulosa			2.1			
VENEROIDA	Corbiculidae	*Corbicula fluminea*	92.7	512	967.4	264.5	243.6	196
	Sphaeridiae					1.8	1.8	
		Pisidium sp.				4.5		
		Total Abundance	171	662	1719	668	733	553
		Metrics:[b]						
		TAXA (Score)		3.5 (1)	9.8 (5)	6.5 (3)	7.5 (3)	7 (3)
		LONGL (Score)		0.9 (5)	1 (5)	1 (5)	0.9 (5)	1 (5)
		EPT (Score)		0.2 (1)	1.2 (3)	1.1 (3)	1 (3)	0.5 (1)
		PCHIR (Score)		3.3 (5)	4.7 (5)	2.5 (5)	4 (5)	5.3 (5)
		PTUBI (Score)		1.2 (5)	14.7 (5)	9.7 (5)	13.8 (5)	7.4 (5)
		DOMN (Score)		91.4 (1)	79.8 (3)	79.6(3)	71.8 (3)	77.7 (3)
		TOTNONCT (Score)		638 (3)	1381 (5)	452 (1)	464 (1)	468 (1)
		ZEROS (Score)		0 (5)	0 (5)	0 (5)	0 (5)	0 (5)
		Total Score		26	36	30	30	28
TRM 396.8 (Riverine)								
HAPLOTAXIDA	Tubificidae			1.7				
		Limnodrilus hoffmeisteri	1.1					
HIRUDINEA			1.1					
AMPHIPODA	Gammeridae	*Gammarus minus*	40.6					
		Gammarus sp.		8.3				

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
TRM 396.8 (Riverine)			1990	1991	1992	1993	1993-Q	1994
EPHEMEROPTERA	Ephemerellidae	*Eurylophella sp.*		1.7				
EPHEMEROPTERA	Ephemeridae	*Hexagenia limbata*	1.1					
	Heptogeniidae	*Stenacron interpunctatum*	11	5				
DIPTERA	Chironomidae	*Glyptotendipes sp.*	1.1					
		Polypedilum fallax		1.7				
		Procladius sp.	2.2					
		Tanytarsus sp.	3.3					
GASTROPODA			1.1					
VENEROIDA	Corbiculidea	*Corbicula fluminea*	70.2	13.3				
	Sphaeridae	*Musculium transversum*		5				
		Total Abundance	133	37				
TRICLADIDA	Planariidae	*Dugesia tigrina*				1.6		
		Dugesia sp.			1.7			
HAPLOTAXIDA	Tubificidae				33.3	111.6		52
		Branchiura sowerbyi			20	65		12
LUMBRICULIDA	Lumbriculidae							3
		Lumbriculus sp.				5		
RHYNCHOBDELLIDA	Glossiphoniidae	*Helobdella stagnalis*				10		15
		Helobdella sp.				1.6		
		Placobdella montifera						2
AMPHIPODA	Crangonyctidae	*Crangonyx sp.*				10		
	Gammeridae	*Gammarus fasciatus*				16.6		
		Gammarus sp.			28.3	1.6		7
	Talitridae	*Hyalella azteca*				60		218
EPHEMEROPTERA	Ephemeridae	*Hexagenia limbata*			28.3	170		195
		Hexagenia sp.			216.7			
		Stenonema sp.				1.6		
TRM 375.2 (Transition)								
TRICHOPTERA	Hydropilidae	*Hydroptila sp.*				3.3		
	Leptoceridae	*Oecetis sp.*				15		
	Polycentropodidae	*Cyrnellus fraternus*				5		
MEGALOPTERA	Sialidae	*Sialis sp.*				1.6		
DIPTERA	Ceratopogonidae				3.3			
		Bezzia sp.			1.7			
	Chironomidae				6.7	1.6		2
		Ablabesmyia annulata			35	35		18
		Ablabesmyia mallochi						3
		Axarus sp.			3.3			
		Chironomus sp.			3.3	8.3		5
		Coelotanypus tricolor				228.3		127
		Coelotanypus sp.			98.3	23.3		
		Cricotopus bicintus				1.6		

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
TRM 375.2 (Transition)			1990	1991	1992	1993	1993-Q	1994
DIPTERA		*Cryptochironomus fulvus*				16.6		
		Cryptochironomus sp.			8.3	5		33
		Dicrotendipes neomodestus				16.6		
		Dicrotendipes sp.				5		60
		Einfeldia sp.				1.6		5
		Epoicocladius sp.						2
		Glyptotendipes sp.			6.7	1.6		
		Polypedilum sp.			10			
		Procladius sp.			50	43.3		47
		Rheotanytarsus sp.						3
COLEOPTERA	Elmidae	*Dubiraphia sp.*				1.6		
HYDRACHNELLAE						3.3		
	Hydrachnidae	*Hydrachna sp.*			3.3			
	Unionicolidae	*Unionicola sp.*						3
TRM 375.2 (Transition)								
MESOGASTROPODA	Hydobiidae					13.3		
	Pleuroceridae	*Pleurocera sp.*				21.6		
	Viviparidae	*Campeloma sp.*			3.3	5		
		Viviparus sp.				8.3		2
BASOMMATOPHORA	Physidae	*Physella sp.*						2
UNIONOIDA	Unionidae	*Cyclonaias tuberculata*						2
		Potamilus alatus						2
VENEROIDA	Corbiculidae	*Corbicula fluminea*			355	345		328
	Spheariidae	*Eupera cubensis*						13
		Musculium transversum			265	66.6		123
		Pisidium sp.				6.6		
		Total Abundance			1182	1339		1284
		Metrics:[b]						
		TAXA (Score)			6.5 (3)	10.8 (5)		9.8 (5)
		LONGL (Score)			1 9 (5)	1 (5)		1 (5)
		EPT (Score)			0.8 (3)	1.5 (5)		1.3 (3)
		PCHIR (Score)			22.1 (5)	27.6 (5)		22.7 (5)
		PTUBI (Score)			6.4 (5)	11.2 (5)		5.6 (5)
		DOMN (Score)			83.3 (3)	65 (5)		73.7 (5)
		TOTNONCT (Score)			906.7 (5)	775 (5)		915 (5)
		ZEROS (Score)			0 (5)	0 (5)		0 (5)
		Total Score			34	40		38
TRM 350.0 (Forebay)								
HAPLOTAXIDA	Tubificidae			133	101.7	96.7		102
		Branchiura sowerbyi				13.3		10
		Limnodrilus hoffmeisteri	47.2		5			3

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q	1994
TRM 350.0 (Forebay)								
HIRUDINEA					13.3			
RHYNCHOBDELLIDA	Glossiphoniidae	*Helobdella stagnalis*	3.6	18.3	11.7	10		10
		Placobdella montifera	1.8			3.3		3
PHARYNGOBDELLIDA	Erpobdellidae	*Mooreobdella microstoma*				3.3		
AMPHIPODA	Gammeridae	*Gammarus minus*	47.2					
		Gammarus sp.			5			
	Talitridae	*Hyalella azteca*				1.7		
EPHEMEROPTERA	Caenidae	*Caenis sp.*		1.7				
	Ephemeridae	*Hexagenia limbata*	69	63.3	71.7	78.3		68
	Heptogeniidae	*Stenacron interpunctatum*		1.7				
TRICHOPTERA	Polycentropodidae	*Cyrnellus fraternus*				1.7		
MEGALOPTERA	Sialidae	*Sialis sp.*	3.6					
DIPTERA	Chaoboridae	*Chaoborus sp.*	3.6					
	Chironomidae							2
		Ablabesmyia annulata			6.7	23.3		33
		Ablabesmyia philosphagnos		31.7				
		Ablabesmyia sp.	20		16.7			
		Chironomus sp.	38.2	18.3	6.7			
		Clinotanypus sp.	12.7					
		Coelotanypus tricolor				208.3		278
		Coelotanypus sp.	165	475	286.7	75		
		Cryptochironomus sp.			6.7	6.7		8
		Dicrotendipes sp.				3.3		5
		Einfeldia sp.				8.3		43
		Epoicocladius sp.						2
MESOGASTROPODA	Hydobiidae	*Somatogygyrus sp.*		3.3				
	Pleuroceridae	*Pleurocera calaliculata*	3.6					
		Xenochironomus xenolabis				1.7		
	Viviparidae				3.3			
		Viviparus subpurpureus	9.1					
		Viviparus sp.				73.3		

Benthic Macroinvertebrates Collected in Guntersville Reservoir During Reservoir Ecological Health Monitoring, 1990-1994 (Continued)

ORDER	FAMILY	SPECIES	Number Per Square Meter					
			1990	1991	1992	1993	1993-Q	1994
TRM 350.0 (Forebay)								
BASOMMATOPHORA	Planorbidae					1.7		
VENEROIDA	Corbiculidae	*Corbicula fluminea*	133	183	195	140		127
		Eupera cubensis	1.8					12
		Musculium transversum	79.9	46.7	13.3	3.3		
		Total Abundance	667	1033	748.4	771.7		738
		Metrics:[b]						
		TAXA (Score)		7.2 (5)	5.9 (3)	6.8 (3)		6.9 (3)
		LONGL (Score)		1 (5)	1 (5)	0.9 (5)		1 (5)
		EPT (Score)		1.1 (5)	0.8 (3)	0.8 (3)		1 (5)
		PCHIR (Score)		58.9 (3)	43.4 (5)	50.8 (3)		54.1 (3)
		PTUBI (Score)		11.7 (5)	15.8 (3)	13.9 (5)		15.2 (3)
		DOMN (Score)		80 (5)	77.4 (5)	80.2 (3)		82 (3)
		TOTNONCT (Score)		318.3 (3)	313.3 (3)	316.7 (3)		220 (1)
		ZEROS (Score)		0 (5)	0 (5)	0 (5)		0 (5)
		Total Score		36	32	30		28

[a] - 1993Q = Quality Assurance Samples Collected from TRM 420.0 during 1993.
[b] - Metric Definitions and Criteria:

Reservior Zone:	**Forebay**			**Transition**			**Inflow**		
Rating/Criteria:	1	3	5	1	3	5	1	3	5
TAXA = average total number taxa/sample	≤4.6	4.6-6.9	>7.0	≤6.0	6.1-8.9	9.0	≤5.0	5.1-7.9	≥8.0
LONGL = proportion of samples with at least 1 long-lived organism (Corbicula, Hexagenia, mussles, and snails) present	≤0.5	0.6-0.8	≥0.9	≤0.5	0.6-0.9	1.0	≤0.5	0.6-0.8	≥0.9
EPT = average total number of Ephemeroptera, Plecoptera, and Tichoptera per sample	≤0.5	0.6-0.9	≥1.0	≤0.5	0.6-1.4	≥1.5	≤0.8	0.9-1.9	≥2.0
PCHIR = average percentage of chironomids/sample	≥60.0	45.1-59.9	≤40.0	≥60.0	35.1-59.9	≤35.0	≥40.0	10.1-39-9	≤10.0
PTUBI = average percentage of tubificids/sample	≥30.0	15.1-29.9	≤15.0	≥30.0	15.1-29.9	≤15.0	≥30.0	15.1-29.9	≤15.0
DOMN = average percentage of the two dominant families/sample (eveness score).	≥90.0	80.1-89.9	≤80.0	≥85.0	75.1-84.9	≤75.0	≥85.0	70.1-84.9	≤70.0
TOTNONCT = average number of organisms excluding chironomids and tubificids/sample	≤250	250.1-324.9	≥325	≤300	300.1-699.9	≥700	≤500	500.1-9.999	≥1000
ZEROS = number of samples with no organisms present	≤1	-	0	1	-	0	≥1	-	0

Scores: 1 = poor; 3 = fair; 5 = good

Live Freshwater Mussels Encountered During Searches of 50-Meter Transects Adjacent to Bellefonte, Tennessee River Miles 390.5-292.5, August 29-30, 1995.

Transect	2	1	3	4	5	6	7	8	9	11	10	12	13	14[a]		
Location (River Mile)	**390.5**	**390.7**	**390.9**	**391.1**	**391.1**	**391.2**	**391.3**	**391.4**	**391.5**	**391.8**	**392.0**	**392.2**	**392.5**	**392.3**		
Depth Range (ft)	**4-26**	**9-25**	**6-25**	**4-26**	**9-26**	**21-24**	**7-26**	**4-24**	**4-26**	**5-24**	**7-26**	**4-27**	**5-25**	**22-30**		
Substrate[b]	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**S/GC**	**Totals**	**Sites**
Mussel Species																
Megalonaias nervosa			12	24	4	10	11	13	6	2	3	1	3		89	11
Potamilus alatus	3	7	4	11	16	4	6	4	10	7	4	2	4		82	13
Pleurobema cordatum		3	3	13		3	1	1	1	1	1		2		29	10
Elliptio crassidens			1	7	1	1						1	2		13	6
Quadrula pustulosa			2	2		2					1				7	4
Quadrula metanevra				4	1							1			6	3
Amblema plicata	1						1	1		1					4	4
Ellipsaria lineolata				3											3	1
Obliquaria reflexa				1				1						1	3	3
Cyclonaias tuberculata		1													1	1
Tritogonia verrucosa					1										1	1
Totals																
Specimens	4	11	22	65	23	20	19	20	17	11	9	5	11	1	238	13
Species	2	3	5	8	5	5	4	5	3	4	4	4	4	1	11	

[a]Transect from Bellefonte Island into the river channel toward Bellefonte.

[b]Substrate abbreviations: C - cobble, G - gravel, S - silt/clay

Appendix J ¾ AIR QUALITY

This appendix provides technical information which supports Chapter 4 evaluations of air quality impacts. Model receptor locations and their elevations above mean sea level are shown in Figure 1. Tables 1 and 2 contain input data used to estimate ambient air pollutant concentrations for criteria pollutants using the SCREEN3 model. Note that information is presented for the five basic conversion options and seven variant option configurations. Table 3 contains SCREEN3 modeling results for each of the 12 sets of results.

Figure 1 Model Receptor Locations

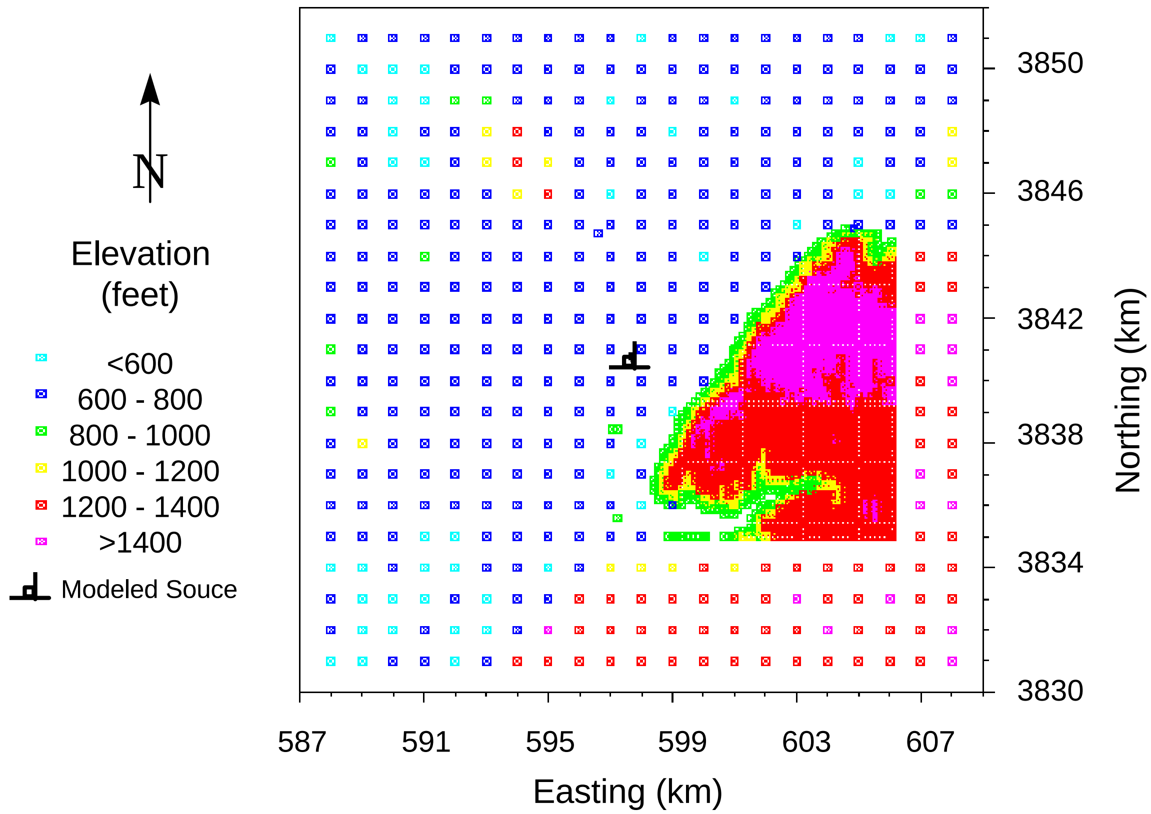


Table 1 Model Inputs: Location and Conditions

1A. PC Coal [a]

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
Stack	1	1,162.80	(795.292)	174.65	11.720	19.660	321.30
Stack	2	1,162.80	(255.000)	174.65	11.720	19.660	321.30

1B. PFBC Coal

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
Stack	1	1,162.80	(795.292)	106.68	13.42	18.3	380.00
Stack	2	1,162.80	(255.000)	106.68	13.42	18.3	380.00

2A. NGCC Natural Gas

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
F-HRSG	1	(1,967.56)	(234.686)	60.96	5.490	20.270	380.00
F-HRSG	2	(1,967.56)	(114.688)	60.96	5.490	20.270	380.00
F-HRSG	3	(1,967.56)	5.310	60.96	5.490	20.270	380.00
F-HRSG	4	(1,967.56)	125.308	60.96	5.490	20.270	380.00
F-HRSG	5	(1,967.56)	245.306	60.96	5.490	20.270	380.00
F-HRSG	6	(1,967.56)	365.304	60.96	5.490	20.270	380.00
F-HRSG	7	(1,967.56)	485.302	60.96	5.490	20.270	380.00
F-HRSG	8	(1,967.56)	605.300	60.96	5.490	20.270	380.00
F-HRSG	9	(1,967.56)	725.297	60.96	5.490	20.270	380.00

2B. NGCC Natural Gas Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	ExitVel (m/s)	Exit Temp (ºK)
F-Bypass	1	(1,813.45)	(234.686)	25.91	5.490	46.177	860.93
F-Bypass	2	(1,813.45)	(114.688)	25.91	5.490	46.177	860.93
F-Bypass	3	(1,813.45)	5.310	25.91	5.490	46.177	860.93
F-Bypass	4	(1,813.45)	125.308	25.91	5.490	46.177	860.93
F-Bypass	5	(1,813.45)	245.306	25.91	5.490	46.177	860.93
F-Bypass	6	(1,813.45)	365.304	25.91	5.490	46.177	860.93
F-Bypass	7	(1,813.45)	485.302	25.91	5.490	46.177	860.93
F-Bypass	8	(1,813.45)	605.300	25.91	5.490	46.177	860.93
F-Bypass	9	(1,813.45)	725.297	25.91	5.490	46.177	860.93

2C. NGCC Oil

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
F-HRSG-oil	1	(1,967.56)	(234.686)	60.96	5.490	20.270	380.00
F-HRSG-oil	2	(1,967.56)	(114.688)	60.96	5.490	20.270	380.00
F-HRSG	3	(1,967.56)	5.310	60.96	5.490	20.270	380.00
F-HRSG	4	(1,967.56)	125.308	60.96	5.490	20.270	380.00
F-HRSG	5	(1,967.56)	245.306	60.96	5.490	20.270	380.00
F-HRSG	6	(1,967.56)	365.304	60.96	5.490	20.270	380.00
F-HRSG	7	(1,967.56)	485.302	60.96	5.490	20.270	380.00
F-HRSG	8	(1,967.56)	605.300	60.96	5.490	20.270	380.00
F-HRSG	9	(1,967.56)	725.297	60.96	5.490	20.270	380.00

[a] - Note: x, y coordinates are based on a plant grid with the center of reactor 1 as 0,0 (in meters).
Source elevation, i.e., stack base, is 610 feet (186 m) above mean sea level.

Table 1 Model Inputs: Location and Conditions (cont'd)

2D. NGCC Oil Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
F-Byps-oil	1	(1,813.45)	(234.686)	25.91	5.490	46.177	860.93
F-Byps-oil	2	(1,813.45)	(114.688)	25.91	5.490	46.177	860.93
F-Bypass	3	(1,813.45)	5.310	25.91	5.490	46.177	860.93
F-Bypass	4	(1,813.45)	125.308	25.91	5.490	46.177	860.93
F-Bypass	5	(1,813.45)	245.306	25.91	5.490	46.177	860.93
F-Bypass	6	(1,813.45)	365.304	25.91	5.490	46.177	860.93
F-Bypass	7	(1,813.45)	485.302	25.91	5.490	46.177	860.93
F-Bypass	8	(1,813.45)	605.300	25.91	5.490	46.177	860.93
F-Bypass	9	(1,813.45)	725.297	25.91	5.490	46.177	860.93

3A. IGCC Petroleum Coke

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,116.18)	(314.458)	99.10	6.710	17.790	380.00
CT/HRSG	2	(2,116.18)	288.782	99.10	6.710	17.790	380.00
CT/HRSG	3	(2,116.18)	892.022	99.10	6.710	17.790	380.00
CT/HRSG	4	(2,116.18)	1,495.260	99.10	6.710	17.790	380.00
Tail Gas	5	(2,339.58)	(525.302)	99.10	1.220	24.690	1,033.00
Tail Gas	6	(2,339.58)	(217.736)	99.10	1.220	24.690	1,033.00
Tail Gas	7	(2,339.58)	89.830	99.10	1.220	24.690	1,033.00
Tail Gas	8	(2,339.58)	397.396	99.10	1.220	24.690	1,033.00
Tail Gas	9	(2,339.58)	704.962	99.10	1.220	24.690	1,033.00
Tail Gas	10	(2,339.58)	1,012.528	99.10	1.220	24.690	1,033.00
Tail Gas	11	(2,339.58)	1,320.094	99.10	1.220	24.690	1,033.00
Tail Gas	12	(2,339.58)	1,627.662	99.10	1.220	24.690	1,033.00

3B. IGCC Petroleum Coke Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT-Bypass	1	(1,914.45)	(434.453)	25.91	6.710	46.177	861.00
CT-Bypass	2	(1,914.45)	228.955	25.91	6.710	46.177	861.00
CT-Bypass	3	(1,914.45)	892.363	25.91	6.710	46.177	861.00
CT-Bypass	4	(1,914.45)	1,555.771	25.91	6.710	46.177	861.00
Tail Gas	5	(2,339.58)	(525.302)	99.10	1.220	24.690	1,033.00
Tail Gas	6	(2,339.58)	(217.736)	99.10	1.220	24.690	1,033.00
Tail Gas	7	(2,339.58)	89.830	99.10	1.220	24.690	1,033.00
Tail Gas	8	(2,339.58)	397.396	99.10	1.220	24.690	1,033.00
Tail Gas	9	(2,339.58)	704.962	99.10	1.220	24.690	1,033.00
Tail Gas	10	(2,339.58)	1,012.528	99.10	1.220	24.690	1,033.00
Tail Gas	11	(2,339.58)	1,320.094	99.10	1.220	24.690	1,033.00
Tail Gas	12	(2,339.58)	1,627.662	99.10	1.220	24.690	1,033.00

Table 1 Model Inputs: Location and Conditions (cont'd)

4. IGCC/C Petroleum Coke

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,059.85)	(227.034)	99.10	6.710	17.790	380.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00

5A. Combination

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,059.85)	(227.034)	99.10	6.710	17.790	380.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00
HRSG	7	(2,033.10)	924.700	99.10	5.490	20.270	380.00
HRSG	8	(2,033.10)	1,182.650	99.10	5.490	20.270	380.00
HRSG	9	(2,033.10)	1,440.600	99.10	5.490	20.270	380.00
HRSG	10	(2,033.10)	1,698.550	99.10	5.490	20.270	380.00
HRSG	11	(2,278.45)	1,358.900	99.10	5.490	20.270	380.00
HRSG	12	(2,476.40)	1,100.950	99.10	5.490	20.270	380.00

5B. Combination Bypass

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT-Bypass	1	(1,858.85)	(227.034)	99.10	6.710	46.177	861.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00
Bypass	7	(1,835.15)	924.700	25.91	5.490	20.270	860.93
Bypass	8	(1,835.15)	1,182.650	25.91	5.490	20.270	860.93
Bypass	9	(1,835.15)	1,440.600	25.91	5.490	20.270	860.93
Bypass	10	(1,835.15)	1,698.550	25.91	5.490	20.270	860.93
Bypass	11	(2,278.45)	1,358.900	25.91	5.490	20.270	860.93
Bypass	12	(2,476.40)	1,358.900	25.91	5.490	20.270	860.93

Table 1 Model Inputs: Location and Conditions (cont'd)

5C. Combination Oil

	No.	x	y	Stk Ht (m)	Stk Dia (m)	Exit Vel (m/s)	Exit Temp (ºK)
CT/HRSG	1	(2,059.85)	(227.034)	99.10	6.710	17.790	380.00
Tail Gas	2	(2,399.53)	(469.733)	99.10	1.220	24.690	1,033.00
Tail Gas	3	(2,399.53)	(45.733)	99.10	1.220	24.690	1,033.00
Tail Gas	4	(2,399.53)	378.268	99.10	1.220	24.690	1,033.00
Tail Gas	5	(2,399.53)	802.268	99.10	1.220	24.690	1,033.00
ChemStk	6	(3,514.66)	(1,000.000)	99.10	3.050	17.000	340.00
HRSG-oil	7	(2,033.10)	924.700	99.10	5.490	20.270	380.00
HRSG-oil	8	(2,033.10)	1,182.650	99.10	5.490	20.270	380.00
HRSG	9	(2,033.10)	1,440.600	99.10	5.490	20.270	380.00
HRSG	10	(2,033.10)	1,698.550	99.10	5.490	20.270	380.00
HRSG	11	(2,278.45)	1,358.900	99.10	5.490	20.270	380.00
HRSG	12	(2,476.40)	1,100.950	99.10	5.490	20.270	380.00

Table 2 Model Inputs: Criteria Pollutant and CO_2 Emissions

1A. PC Coal

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
Stack	1	397.00	575.0	43.00	37.39	-
Stack	2	397.00	575.0	43.00	37.39	-

1B. PFBC Coal

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
Stack	1	353.00	519.8	76.6	-	-
Stack	2	353.00	519.8	76.6	-	-

2A. NGCC Natural Gas

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-HRSG	1	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	2	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	3	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	4	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	5	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	6	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	7	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	8	0.27	32.21	3.78	40.32	36,451 - 289,040
F-HRSG	9	0.27	32.21	3.78	40.32	36,451 - 289,040

2B. NGCC Natural Gas Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-Bypass	1	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	2	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	3	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	4	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	5	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	6	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	7	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	8	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	9	0.27	32.21	3.78	40.32	36,451 - 289,040

2C. NGCC Oil

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-HRSG-oil	1	18.22	32.21	9.34	40.32	53,362 - 423,176
F-HRSG-oil	2	18.22	32.21	9.34	40.32	53,362 - 423,176
F-HRSG	3	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	4	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	5	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	6	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	7	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	8	0.27	32.21	3.78	40.32	36,451 - 423,176
F-HRSG	9	0.27	32.21	3.78	40.32	36,451 - 423,176

Table 2 Model Inputs: Criteria Pollutant Emissions (cont'd)

2D. NGCC Oil Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
F-Byps-oil	1	18.22	32.21	9.34	40.32	53,363 - 423,176
F-Byps-oil	2	18.22	32.21	9.34	40.32	53,363 - 423,176
F-Bypass	3	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	4	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	5	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	6	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	7	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	8	0.27	32.21	3.78	40.32	36,451 - 289,040
F-Bypass	9	0.27	32.21	3.78	40.32	36,451 - 289,040

3A. IGCC Petroleum Coke

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT/HRSG	2	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT/HRSG	3	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT/HRSG	4	34.97	150.62	5.54	31.75	184,656 - 1,464,362
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	6	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	7	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	8	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	9	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	10	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	11	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	12	5.39	0.43	2.08	0.23	715,000 -5,670

3B. IGCC Petroleum Coke Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT-Bypass	1	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT-Bypass	2	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT-Bypass	3	34.97	150.62	5.54	31.75	184,656 - 1,464,362
CT-Bypass	4	34.97	150.62	5.54	31.75	184,656 - 1,464,362
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	6	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	7	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	8	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	9	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	10	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	11	5.39	0.43	2.08	0.23	715,000 -5,670
Tail Gas	12	5.39	0.43	2.08	0.23	715,000 -5,670

Table 2 Model Inputs: Criteria Pollutant Emissions (cont'd)

4. IGCC/C Petroleum Coke

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	92,328 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-

5A. Combination

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	92,328 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-
HRSG	7	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	8	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	9	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	10	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	11	0.27	32.21	1.54	40.32	36,451 - 289,040
HRSG	12	0.27	32.21	1.54	40.32	36,451 - 289,040

5B. Combination Bypass

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT-Bypass	1	34.97	150.62	5.54	31.75	92,181 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-
Bypass	7	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	8	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	9	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	10	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	11	0.27	32.21	3.78	40.32	36,451 - 289,040
Bypass	12	0.27	32.21	3.78	40.32	36,451 - 289,040

Table 2 Model Inputs: Criteria Pollutant Emissions (cont'd)

5C. Combination Oil

	No.	SO_2 (g/s)	NO_x (g/s)	PM-10 (g/s)	CO (g/s)	CO_2 - (g/s - lb/hr)
CT/HRSG	1	34.97	150.62	5.54	31.75	92,181 - 732,181
Tail Gas	2	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	3	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	4	5.39	0.43	2.08	0.23	715,000 - 5,670
Tail Gas	5	5.39	0.43	2.08	0.23	715,000 - 5,670
ChemStk	6	-	11.33	9.11	-	-
HRSG-oil	7	18.22	32.21	7.45	40.32	53,363 - 423,176
HRSG-oil	8	18.22	32.21	7.45	40.32	53,363 - 423,176
HRSG	9	0.27	32.21	3.78	40.32	36,451 - 289,040
HRSG	10	0.27	32.21	3.78	40.32	36,451 - 289,040
HRSG	11	0.27	32.21	3.78	40.32	36,451 - 289,040
HRSG	12	0.27	32.21	3.78	40.32	36,451 - 289,040

Table 3 Dispersion Model Results

PC Coal [a]

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2383	594.00	3831.00	1360.0	82	365	24	5.393
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	111.057
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	90.063
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	573.069
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	399.519
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	971.065
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	920.409

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2383	594.00	3831.00	1360.0	82	365	24	7.811
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	160.850
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	130.444
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	830.011
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	578.648
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	1406.454
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	1333.086

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2383	594.00	3831.00	1360.0	82	365	24	0.584
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	12.029
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	9.755
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	62.070
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	43.273
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	105.178
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	99.692

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2383	594.00	3831.00	1360.0	82	365	24	0.508
High 24-hr	419	601.11	3839.64	1420.0	80	194	24	10.459
2nd high 24-hr	2699	595.00	3846.00	1231.0	82	336	24	8.482
High 3-hr	475	601.26	3836.64	1259.0	80	195	21	53.972
2nd high 3-hr	210	600.06	3838.59	1426.0	80	198	21	37.627
High 1-hr	679	602.01	3841.29	1470.0	80	212	21	91.456
2nd high 1-hr	679	602.01	3841.29	1470.0	80	179	21	86.685

[a] - This table contains detailed modeling results discussed in Section 4.2.1, “Air Quality.” Receptor x, y locations are UTM coordinates (easting, northing) and z location is terrain elevation in feet above mean sea level.

Table 3 Dispersion Model Results (cont'd)

PFBC Coal

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	178	599.91	3838.29	1410.0	79	365	24	3.717
High 24-hr	310	600.66	3839.04	1437.0	79	25	24	126.6
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	102.9
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	623.3
2nd high 3-hr	283	600.51	3839.04	1447.0	79	85	6	490.0
High 1-hr	283	600.51	3839.04	1447.0	80	184	22	783.2
2nd high 1-hr	283	600.51	3839.04	1447.0	80	197	2	781.6

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	178	599.91	3838.29	1410.0	79	365	24	2.736
High 24-hr	310	600.66	3839.04	1437.0	79	25	24	93.217
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	75.787
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	458.931
2nd high 3-hr	283	600.51	3839.04	1447.0	79	85	6	360.806
High 1-hr	283	600.51	3839.04	1447.0	80	184	22	576.683
2nd high 1-hr	283	600.51	3839.04	1447.0	80	197	2	575.536

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	178	599.91	3838.29	1410.0	79	365	24	0.403
High 24-hr	310	600.66	3839.04	1437.0	79	25	24	13.734
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	11.166
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	67.615
2nd high 3-hr	283	600.51	3839.04	1447.0	79	85	6	53.158
High 1-hr	283	600.51	3839.04	1447.0	80	184	22	84.963
2nd high 1-hr	283	600.51	3839.04	1447.0	80	197	2	84.794

CO Concentrations - not modeled due to insignificant emissions

Table 3 Dispersion Model Results (cont'd)								
NGCC Natural Gas								
SO_2 Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	0.073
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	1.806
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	1.339
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	7.316
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	5.323
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	8.417
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	8.326
NO_x Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	8.616
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	212.860
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	157.845
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	862.165
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	627.273
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	991.868
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	981.179
PM10 Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.011
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	24.980
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	18.524
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	101.179
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	73.614
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	116.400
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	115.146
CO Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	10.785
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	266.448
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	197.583
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	1079.216
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	785.189
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	1241.571
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	1228.191

Table 3 Dispersion Model Results (cont'd)

NGCC Natural Gas Bypass

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.030
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	0.881
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	0.596
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	3.817
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	2.580
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	3.895
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	3.879

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.542
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	103.755
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	70.049
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	449.677
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	303.865
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	458.796
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	456.893

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.416
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	12.176
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	8.221
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	52.772
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	35.660
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	53.842
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	53.619

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	4.434
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	129.875
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	87.683
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	562.884
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	380.363
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	574.297
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	571.917

Table 3 Dispersion Model Results (cont'd)

NGCC Oil								
SO_2 Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.137
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	28.140
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	20.863
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	113.993
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	82.939
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	131.148
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	129.730
NO_x Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.542
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	103.755
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	70.049
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	449.677
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	303.865
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	458.796
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	456.893
PM10 Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	1.341
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	33.145
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	24.579
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	134.251
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	97.676
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	154.447
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	152.783
CO Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	21	598.71	3836.79	1102.0	82	365	24	10.785
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	266.448
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	197.583
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	1079.216
2nd high 3-hr	194	600.06	3839.19	1131.0	79	249	24	785.189
High 1-hr	149	599.76	3838.89	1104.0	80	194	1	1241.571
2nd high 1-hr	149	599.76	3838.89	1104.0	80	197	2	1228.191

Table 3 Dispersion Model Results (cont'd)

NGCC Oil Bypass								
SO_2 Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.467
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	13.727
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	9.286
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	59.474
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	40.200
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	60.689
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	60.440
NO_x Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.542
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	103.755
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	70.049
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	449.677
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	303.865
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	458.796
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	456.893
PM10 Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.552
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	16.156
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	10.908
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	70.021
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	47.316
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	71.441
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	71.145
CO Concentrations								
Average Type	**Receptor**				**Ending Time**			**Concentration**
Highest:	**No.**	**X**	**Y**	**Z**	**Year**	**Day**	**Hours**	**(µg/m3)**
Annual	2427	596.00	3833.00	1357.0	82	365	24	4.434
High 24-hr	265	600.36	3839.34	1231.0	79	25	24	129.875
2nd high 24-hr	161	599.76	3838.59	1282.0	79	25	24	87.683
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	562.884
2nd high 3-hr	195	600.06	3838.44	1426.0	79	334	3	380.363
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	574.297
2nd high 1-hr	161	599.76	3838.59	1282.0	79	26	2	571.917

Table 3 Dispersion Model Results (cont'd)

IGCC Petroleum Coke

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	5.190
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	127.820
2nd high 24-hr	306	600.66	3839.64	1247.0	79	64	24	97.516
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	591.585
2nd high 3-hr	192	600.06	3839.04	1223.0	79	249	24	411.555
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	638.190
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	636.677

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	13.957
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	375.500
2nd high 24-hr	335	600.81	3839.49	1431.0	79	275	24	270.855
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	1665.050
2nd high 3-hr	192	600.06	3839.04	1223.0	79	249	24	1206.050
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	1871.041
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	1863.919

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.454
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	30.547
2nd high 24-hr	302	600.66	3839.49	1329.0	79	275	24	24.304
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	141.234
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	85	6	96.232
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	148.334
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	148.127

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	2.993
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	80.224
2nd high 24-hr	335	600.81	3839.49	1431.0	79	275	24	57.877
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	356.385
2nd high 3-hr	192	600.06	3839.04	1223.0	79	249	24	257.695
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	399.775
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	398.277

Table 3 Dispersion Model Results (cont'd)

IGCC Petroleum Coke Bypass

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	3.647
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	83.441
2nd high 24-hr	302	600.66	3839.49	1329.0	79	275	24	63.415
High 3-hr	227	600.21	3839.04	1304.0	82	354	24	297.084
2nd high 3-hr	298	600.51	3839.34	1309.0	82	287	21	233.911
High 1-hr	176	599.91	3838.74	1315.0	82	5	2	361.187
2nd high 1-hr	176	599.91	3838.74	1315.0	82	61	4	360.757

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	5.725
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	184.353
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	122.946
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	788.664
2nd high 3-hr	177	599.91	3838.44	1423.0	79	334	6	522.705
High 1-hr	214	600.06	3838.74	1417.0	82	5	2	803.094
2nd high 1-hr	214	600.06	3838.74	1417.0	79	64	22	800.847

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.255
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	24.150
2nd high 24-hr	256	600.36	3839.64	1067.0	79	28	24	19.417
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	93.337
2nd high 3-hr	66	599.16	3837.69	1151.0	82	100	21	69.978
High 1-hr	176	599.91	3838.74	1315.0	82	61	4	103.333
2nd high 1-hr	176	599.91	3838.74	1315.0	82	5	2	103.299

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	1.258
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	39.931
2nd high 24-hr	283	600.51	3839.04	1447.0	79	64	24	26.378
High 3-hr	264	600.36	3838.89	1435.0	80	366	3	166.870
2nd high 3-hr	177	599.91	3838.44	1423.0	79	334	6	110.677
High 1-hr	214	600.06	3838.74	1417.0	82	5	2	170.597
2nd high 1-hr	214	600.06	3838.74	1417.0	79	64	22	170.153

Table 3 Dispersion Model Results (cont'd)

IGCC/C Petroleum Coke

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.826
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	40.043
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	31.884
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	181.392
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	85	6	125.192
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	195.265
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	194.964

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	3.706
High 24-hr	298	600.51	3839.34	1309.0	79	25	24	91.816
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	72.069
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	408.140
2nd high 3-hr	233	600.21	3839.19	1219.0	79	249	24	301.276
High 1-hr	167	599.91	3838.89	1226.0	80	194	1	471.112
2nd high 1-hr	2557	600.00	3839.00	1229.0	80	194	1	469.584

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.049
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	19.221
2nd high 24-hr	256	600.36	3839.64	1067.0	79	28	24	17.385
High 3-hr	194	600.06	3839.19	1131.0	82	354	24	73.044
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	249	24	59.248
High 1-hr	136	599.61	3838.59	1168.0	80	197	2	96.076
2nd high 1-hr	2557	600.00	3839.00	1229.0	79	249	24	89.790

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2427	596.00	3833.00	1357.0	82	365	24	0.720
High 24-hr	298	600.51	3839.34	1309.0	79	25	24	18.325
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	13.957
High 3-hr	227	600.21	3839.04	1304.0	80	366	3	82.171
2nd high 3-hr	233	600.21	3839.19	1219.0	79	249	24	59.077
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	92.373
2nd high 1-hr	167	599.91	3838.89	1226.0	80	194	1	92.260

Table 3 Dispersion Model Results (cont'd)

COMBINATION

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.857
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	41.227
2nd high 24-hr	341	600.81	3839.64	1339.0	79	275	24	32.781
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	185.040
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	85	6	129.436
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	201.183
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	200.859

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2514	599.00	3837.00	1278.0	82	365	24	8.651
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	228.617
2nd high 24-hr	341	600.81	3839.64	1339.0	79	64	24	178.188
High 3-hr	226	600.21	3838.89	1399.0	80	366	3	981.346
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	802.064
High 1-hr	167	599.91	3838.89	1226.0	80	194	1	1169.318
2nd high 1-hr	167	599.91	3838.89	1226.0	80	197	2	1166.337

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.225
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	25.237
2nd high 24-hr	273	600.51	3839.49	1234.0	79	275	24	20.686
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	101.362
2nd high 3-hr	2557	600.00	3839.00	1229.0	79	249	24	81.114
High 1-hr	148	599.76	3838.74	1196.0	79	249	23	125.733
2nd high 1-hr	2557	600.00	3839.00	1229.0	79	249	24	122.567

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	38	598.86	3836.79	1237.0	82	365	24	7.331
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	193.946
2nd high 24-hr	265	600.36	3839.34	1231.0	79	275	24	145.373
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	890.142
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	672.559
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	976.140
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	972.358

Table 3 Dispersion Model Results (cont'd)

COMBINATION Bypass

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.467
High 24-hr	229	600.21	3839.34	1150.0	79	25	24	28.087
2nd high 24-hr	256	600.36	3839.64	1067.0	79	28	24	22.881
High 3-hr	164	599.91	3839.04	1131.0	80	366	3	109.372
2nd high 3-hr	66	599.16	3837.69	1151.0	82	100	21	82.575
High 1-hr	2557	600.00	3839.00	1229.0	80	366	1	114.513
2nd high 1-hr	167	599.91	3838.89	1226.0	80	295	23	113.959

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2383	594.00	3831.00	1360.0	82	365	24	4.981
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	131.755
2nd high 24-hr	297	600.51	3839.64	1172.0	79	64	24	92.206
High 3-hr	192	600.06	3839.04	1223.0	80	366	3	531.951
2nd high 3-hr	2557	600.00	3839.00	1229.0	82	309	3	375.320
High 1-hr	167	599.91	3838.89	1226.0	82	61	4	566.487
2nd high 1-hr	167	599.91	3838.89	1226.0	82	5	2	566.404

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	21	598.71	3836.79	1102.0	82	365	24	1.437
High 24-hr	194	600.06	3839.19	1131.0	79	25	24	30.339
2nd high 24-hr	256	600.36	3839.64	1067.0	79	275	24	25.073
High 3-hr	164	599.91	3839.04	1131.0	80	366	3	118.223
2nd high 3-hr	229	600.21	3839.34	1150.0	82	287	21	86.474
High 1-hr	136	599.61	3838.59	1168.0	80	197	2	140.761
2nd high 1-hr	148	599.76	3838.74	1196.0	80	211	20	130.779

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2383	594.00	3831.00	1360.0	82	365	24	5.212
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	144.485
2nd high 24-hr	297	600.51	3839.64	1172.0	79	64	24	99.588
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	597.728
2nd high 3-hr	229	600.21	3839.34	1150.0	82	287	21	398.311
High 1-hr	2557	600.00	3839.00	1229.0	79	26	3	605.620
2nd high 1-hr	2557	600.00	3839.00	1229.0	80	366	1	604.837

Table 3 Dispersion Model Results (cont'd)

COMBINATION Oil

SO_2 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	38	598.86	3836.79	1237.0	82	365	24	2.753
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	67.450
2nd high 24-hr	341	600.81	3839.64	1339.0	79	64	24	51.994
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	286.635
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	6	227.101
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	332.331
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	331.495

NO_x Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	2514	599.00	3837.00	1278.0	82	365	24	8.651
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	228.617
2nd high 24-hr	341	600.81	3839.64	1339.0	79	64	24	178.188
High 3-hr	226	600.21	3838.89	1399.0	80	366	3	981.346
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	802.064
High 1-hr	167	599.91	3838.89	1226.0	80	194	1	1169.318
2nd high 1-hr	167	599.91	3838.89	1226.0	80	197	2	1166.337

PM10 Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	38	598.86	3836.79	1237.0	82	365	24	1.684
High 24-hr	233	600.21	3839.19	1219.0	79	25	24	40.543
2nd high 24-hr	273	600.51	3839.49	1234.0	79	275	24	32.253
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	172.884
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	133.291
High 1-hr	148	599.76	3838.74	1196.0	79	249	23	200.788
2nd high 1-hr	148	599.76	3838.74	1196.0	80	194	1	198.740

CO Concentrations

Average Type	Receptor				Ending Time			Concentration
Highest:	No.	X	Y	Z	Year	Day	Hours	(µg/m3)
Annual	38	598.86	3836.79	1237.0	82	365	24	7.331
High 24-hr	250	600.36	3839.19	1313.0	79	25	24	193.946
2nd high 24-hr	265	600.36	3839.34	1231.0	79	275	24	145.373
High 3-hr	2557	600.00	3839.00	1229.0	80	366	3	890.142
2nd high 3-hr	161	599.76	3838.59	1282.0	79	334	3	672.559
High 1-hr	167	599.91	3838.89	1226.0	80	211	20	976.140
2nd high 1-hr	167	599.91	3838.89	1226.0	82	214	20	972.358

Appendix K ¾ FORM AD 1006 (replicated)

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART 1 (*To be completed by Federal Agency*)		Date of Land Evaluation Request Jan. 25, 1996				
Name Of Project Bellefonte IGCC Repowering Project		Federal Agency Involved Tennessee Valley Authority				
Proposed Land Use Electric Power Plant		County And State Jackson Alabama				
PART II (*To be completed by SCS*)		Date Request Received by SCS 2/1/96				
Does the site contain prime, unique, statewide or local important farmland? (*If no, the FPPA does not apply - do not complete additional parts of this form*). Yes X No		Acres Irrigated		Average Farm Size 189		
Major Crop(s) Cotton, Soybean, Patatoes	Farmable Land In Govt. Jurisdiction Acres: 355,778 %50.7	Amount Of Farmland As Defined in FPPA Acres: 151,939 %22.1				
Name Of Land Evaluation System Used LESA	Name Of Local Site Assessment System		Date Land Evaluation Returned by SCS 3/4/96			
PART III (*To be completed by Federal Agency*)		Alternative Site Rating				
		Site A	Site B	Site C	Site D	
A. Total Acres To Be Converted Directly		1610				
B. Total Acres To Be Converted Indirectly		0				
C. Total Acres In Site		1610				
PART IV (*To be completed by SCS*) Land Evaluation Information						
A. Total Acres Prime And Unique Farmland		437.9				
B. Total Acres Statewide And Local Important Farmland						
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		2.9				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		45.3				
PART V (*To be completed by SCS*) Land Evaluation Criterion Relative Value Of Farmland To Be Converted (*Scale of 0 to 100 Points*)		44				
PART VI (*To be completed by Federal Agency*) Site Assessment Criteria (*These criteria are explained in 7 CFR 658.5(b)*	Maximum Points					
1. Area In Nonurban Use	15	12				
2. Perimeter In Nonurban Use	10	8				
3. Percent of Site Being Farmed	20	1				
4. Protection Provided By State And Local Government	20	0				
5. Distance From Urban Builtup Area	15	5				
6. Distance To Urban Support Services	15	0				
7. Size Of Present Farm Unit Compared To Average	10	10				
8. Creation Of Nonfarmable Farmland	10	0				
9. Availability Of Farm Support Services	5	5				
10. On-Farm Investments	20	0				
11. Effects Of Conversion On Farm Support Services	10	0				
12. Compatibility With Existing Agricultural Use	10	1				
TOTAL SITE ASSESSMENT POINTS	160	42				
PART VII (*To be completed by Federal Agency*)						
Relative Value Of Farmland (*From Part V*)	100	44				
Total Site Assessment (*From Part VI above or a local site assessment*)	160	42				
TOTAL POINTS (*Total of above 2 lines*)	260	86				
Site Selected:	Date Of Selection		Was A Local Site Assessment Used? Yes ☐ No ☐			
Reason For Selection:						

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 - Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 - Originator will send copies A, B, and C together with maps indicating locations of site(s), to the Soil Conservation Service (SCS) local field office and retain copy D for their files. (Note: SCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the SCS State Conservationist in each state).

Step 3 - SCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide, or local important farmland.

Step 4 - In cases where farmland covered by the FPPA will be converted by the proposed project, SCS field offices will complete Parts II, IV, and V of the form.

Step 5 - SCS will return copies A and B of the form to the Federal agency involved in the project. (Copy C will be retained for SCS records).

Step 6 - The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 - The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions, list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

PART III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g., highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in 658.5(b) of CFR. In cases of corridor-type projects such as transportation, powerline, and flood control, criteria #5 and #6 will not apply and will be weighed zero; however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned, relative adjustments must be made to maintain the maximum total weight points at 160.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160.
Example: If the site assessment maximum is 200 points and alternative Site "A" is rated 180 points:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site "A."}$$

Appendix L ¾ BEST MANAGEMENT PRACTICES (BMPs)

1.0 BMPs During Construction Acitivites

State law and Alabama Department of Environmental Management (ADEM) regulations require that appropriate, effective Best Management Practices (BMPs) for the control of pollutants in storm water run-off be fully implemented and maintained for all construction and land disturbance activities regardless of permit status or size of the disturbance to prevent/minimize discharges of sediment and other pollutants to waters of the State of Alabama. Discharges of pollutants resulting from failure to implement effective BMPs are considered unpermitted discharges to state waters. [1]

A person, company, or construction operator is required to take all measures necessary to prevent sediment and other pollutants in water used in the construction process or storm water runoff from disturbed areas, from leaving the construction site or associated areas regardless of the permit status or size of the disturbance. Phase I of the storm water regulations require an operator to apply for a permit from ADEM for construction and land disturbance activities and associated areas that exceed five acres or is part of a larger common plan of development or sale that may eventually exceed five acres. Phase II of the storm water regulations currently under consideration may result in changes to current requirements or may require smaller construction and land disturbance sites to obtain a permit in the future. [1]

On August 1, 1992, ADEM issued a National Pollutant Discharge Elimination System (NPDES) General Permit (GP) ALG610000 for Storm water runoff activities, and associated areas. This GP was developed and issued to allow industry a simpler method to comply with federal regulations for discharging storm water and would expire on July 1, 1997. The GP would be reissued at that time, with any necessary changes, for a period not to exceed five years. The construction GP requires a company or individual to use BMPs to control storm water run-off. The GP requires inspections on a monthly basis, in response to rainfall accumulation, and as often as necessary to insure that adequate BMPs have been implemented. The permittee must also monitor representative discharges from the site a minimum of once every six months. These samples are to be analyzed for pH, TSS, SS, flow, and under some circumstances Oil and Grease, BOD5, and COD. Upstream and downstream turbidity in the receiving stream must be monitored to ensure compliance with State water quality standards. Onsite precipitation must also be recorded. [1]

The State of Alabama Nonpoint Source Management Program incorporates BMPs with state-wide applicability for control of erosion from construction activities that were previously developed by the Birmingham Regional Planning Commission as part of a 208 Planning project and published in a document titled Best Management Practices for Controlling Sediment and Erosion from Construction Activities. [2]

BMPs are measures to minimize runoff from a construction site. There are 3 types of BMPs that should be taken into consideration before, during and after the construction process. [3] They include:

1.1 Sediment and Erosion Control BMPs

Immediate measures to control sedimentation include use of:
- silt fences,
- staked hay bale rows,
- netting or mesh,
- rock filter check dams, etc. and
- small catch basins, if necessary.

Immediate measures to control erosion include:
- applying hay mulch,
- seeding with temporary grass mix,
- hydro-seeding,
- reducing slopes,
- netting or mesh, and
- cover with gravel or rock, etc.

Long term measures should be done as soon as possible include:
- proper grading and
- permanent revegetation.

1.2 Good Housekeeping BMPs for Pollutants Other Than Sediments

- Pesticides
    - Strict adherence to recommended practices for the use of insecticides, herbicides, and rodenticides.

- Petrochemicals

1. Used oil, grease and rags should be disposed of in proper receptacles and kept out of contact with rainfall or runoff water.
2. The dumping of waste materials, including used petrochemical containers, at the site should be prohibited.
3. Liquid and solid waste should be collected in containers and regularly transported from the site to sanitary landfills.
4. Equipment repairs and washing should be undertaken at specific locations and the runoff collected in holding ponds.

- Fertilizers
  1. Avoid applications during bad weather.
  2. Plant during periods of best plant generation to minimize use of fertilizer.
  3. Fertilize and lime according to a soil test report.

1.3 Storm water Management BMPs

- Increasing infiltration in the drainage area.
- Decreasing the time of run-off concentration by utilizing existing stable drainage ways.
- Providing temporary storage facilities to release stored water at controlled rates.

2.0 BMPs during Operation

These BMPs were identified in a current site Best Management Practices and Storm Water Pollution Prevention Plan from a TVA fossil plant located in Alabama.

2.1 Existing Baseline Best Management Practices

2.1.1 Good Housekeeping and Material Management

To maintain a high level of program effectiveness, the facility should include the following good housekeeping procedures:

1. Incorporate information sessions on good housekeeping practices into the facility’s employee training program.
2. Display signs reminding employees of the importance of good housekeeping.
3. Clearly identify the location of brooms, vacuums, absorbents, foams, neutralizing agents, and other spill response equipment.

4. Ensure that spill cleanup procedures are understood by employees.
5. Promptly remove spilled materials including coal spillage and ash wastes to prevent pollution of runoff.
6. Maintain clean floors, ground surfaces, and paved area by using brooms and sweepers.
7. Regularly pick up and dispose of waste materials, used drums, and trash.

A clean and orderly work environment reduces the probability of accidental spills caused by the mishandling of equipment and materials. The following good housekeeping measures would be adopted in locations containing hazardous substances:

1. Neat and orderly storage of containers.
2. Prompt removal of small spills.
3. Provisions for storing containers or drums to prevent them from being struck by pedestrians or mobile equipment.

Improper storage and handling of materials can result in the release of materials to the environment. Proper storage and handling techniques include the following:

1. Raw materials, such as coal, should be stockpiled in trimmed compacted piles to avoid erosion by wind and water.
2. Drum and material storage areas should be neatly organized in designated areas. Used drums should be disposed of promptly.

Dry hazardous substance spillage must be swept, vacuumed, or otherwise cleaned up in a manner such to prevent the possible washdown to floor drains or drainage ditches. Liquid hazardous substance spillage on the ground or floor would be cleaned up using absorbent or other methods to prevent further transport to other areas and possibly surface waters.

All toxic and hazardous substance containers must be labeled to show the substance type, expiration date, and health hazards. The exception to the rule of full disclosure is when a hazardous substance transferred to a portable container for immediate use and would remain in the vicinity of the user. In this case, the portable container only needs to be marked with the name or type of product using a temporary marker (such as a grease pencil).

An updated inventory of all materials (hazardous and nonhazardous) should be maintained onsite.

2.1.2 Materials Compatibility

Materials compatibility encompasses three aspects: compatibility of the material with the storage container, compatibility of the container with the environment, and compatibility of substances during storage and usage. Periodically, the BMP Program Committee would evaluate the effectiveness of the current compatibility practices by reviewing inspection record and past incidents.

All hazardous substance containers would be clearly marked. This identification would ensure positive identification of the contents by all users or handlers.

All hazardous substance containers would be compatible with their contents. The compatibility of currently used products with their containers is based on experience. New hazardous products would not be transferred from their original shipping container until a determination is made about the compatibility of the substance.

Compatibility of different hazardous substances when mixed is defined as the absence of any significant physical or chemical effects. Mixing hazardous substances that are incompatible can result in a violent reaction, fire, explosion, or release of dangerous vapors. New processes that involve the mixing of one or more hazardous substances must be reviewed by personnel with expertise in reaction chemistry before being approved for use. Hazardous substance containers would be designed, constructed, maintained, and located to ensure compatibility with their environments.

2.1.3 Hazardous Substance Spill Prevention Requirements

Spill prevention procedures should be designed to prevent any material from breaching primary containment. Spill prevention for petroleum-based substances would be addressed in the plant's SPCC *Plan*. The following spill prevention procedures address all materials stored, used, or produced at the plant:

1. Incorporate information sessions on good spill prevention practices into the facility's employee training program.

2. Display signs reminding employees of the procedure to be followed in the event of a spill.
3. Maintain accurate and updated records of reported spills.
4. Review spill reports and implement corrective action immediately after the incident.
5. Maintain an active inventory of spill response supplies and equipment.
6. Maintain a list of personnel trained in spill response and cleanup procedures.
7. Regularly review and update material handling practices to avoid spills.

During transfer operation of hazardous substances, the following procedures should be followed:

1. Trained personnel familiar with the operation should oversee the transfer.
2. The available capacity of the receiving tank should be determined.
3. Audible and/or visual overfill warning systems should be provided.
4. A warning system (lights, physical barriers, and signs) should be provided to prevent the vehicle from leaving before lines are disconnected.
5. Drip pans should be placed under all connections.
6. Emergency spill response equipment and supplies should be present during transfer operations.
7. All storm drains, catch basins, or other conveyances with the potential to receive spillage should be covered or blocked.
8. During transfer, all lines and connections should be continuously observed to ensure leaks/spills are detected as soon as possible.
9. If any leaks/spills are detected during transfers, the operation should be terminated immediately and necessary repairs or corrections made before continuing transfer operations.
10. Transfer operations should be documented and a check sheet of transfer procedures completed and signed.

During the loading and unloading of hazardous substances, the following procedures should be followed:

1. Trained personnel should oversee loading and unloading of hazardous substances.
2. Emergency spill response equipment and supplies should be present during loading and unloading of hazardous substances.
3. All storm drains, catch basins, or other conveyances with the potential to receive spillage should be covered or blocked.

2.1.4 Security

All areas handling or storing hazardous substances would be sufficiently secured and/or guarded to prevent access by unauthorized persons. Requirements such as patrolling, fencing, traffic control, visitor passes, and secured entrances are addressed in the *Joint Security Plan for Fossil Plants.* [4]

Drain valves and pump starter controls that can cause a discharge of hazardous substances into the environment shall have adequate security measures to ensure that they remain in the closed position or electrically isolated at a secure location when in non-operating or non-standby status.

Loading and unloading connections from pipelines and tanks would be plugged, capped, or blank-flanged when not in service.

Facility lighting would be commensurate with the type and location of the facility. In determining the type and location of lighting, consideration would be to the areas that have a high potential for leaks during darkness and areas prone to vandalism.

If a hazardous substance is spilled, the requirements of the plant's *Hazardous Waste Contingency Plan* must be implemented regarding spill containment and cleanup.

The cleanup of hazardous substance spills should be accomplished to the greatest extent practicable by mechanical means such as sweeping, vacuuming, absorbing, and/or pumping. Spills of dry hazardous substance should be cleaned up without the addition of any liquid substances if possible. Solvents, detergents, water, and/or chemical agents would not be used if discharging a significant amount of the hazardous substance, the liquid agent or a combination of the substance and liquid agent to the environment is possible. Spill cleanup should include provisions to prevent the eventual discharge of hazardous substances by leaching, washing, or percolating the removed contaminated soil or the equipment decontamination residue. The disposal of hazardous waste resulting from cleanup activities (i.e., used absorbent materials and/or cleanup residues) must be in accordance with all federal and state regulations. Technical assistance for hazardous substance spill cleanup and hazardous waste disposal is available from Environmental Affairs.

2.1.5 Training Program Requirements

This section outlines the needed training associated with pollution prevention and hazardous substances management. In general, the Environmental Training Procedure provides for the following:

- In-depth pollution prevention for new employees and
- Annual refresher courses

Employee training program topics include the following:

- Environmental Awareness Modular
  - Good housekeeping
  - Material handling and storage
  - General environmental laws and facility compliance requirements
- SPCC Spill Prevention Modular
  - Spill prevention techniques
  - Facility spill plan overview
  - Maintenance activities for spill prevention
  - Spill reporting

2.2 Advanced Best Management Practices

Advanced BMPs are methods used in addition to the baseline BMPs and are specific to groups of chemical substances and sources of chemical substances. An advanced BMP is any practice that reduces the risk of exposure of a hazardous substance to the environment. These practices can be grouped into the following categories: prevention of release, control through containment and flow diversion, mitigation of the release, cleanup of the release, treatment of the release, and disposal of the material.

2.2.1 Generic Advanced BMPs

Examples of each type of advanced BMPs are provided below to illustrate common effective methods.

<u>Prevention</u> - Prevention BMPs include monitoring of inventory levels to minimize storage, nondestructive tank integrity testing, proper labeling of containers, and covering volatile liquids when not in use.
<u>Containment</u> - Containment BMPs are methods used to physically contain a release of material. Flow diversion and secondary containment are examples.
<u>Mitigation</u> - Mitigation BMPs are cleanup and treatment methods used once a hazardous substance spill has been contained. Mitigation minimizes danger to plant personnel and the environment.
<u>Cleanup</u> - Cleanup BMPs include physical, mechanical, and chemical methods.
<u>Treatment</u> - Treatment BMPs are used to reduce the potential impact of the material on the environment. This may consist of treating the material before disposal or separating the material for recycling.
<u>Ultimate Disposal</u> - Disposal BMPs are associated with final disposal of a spilled material. Disposal alternatives include discharge to a receiving water (after proper treatment), reclamation, and contract disposal.

2.2.2 Specific Advanced BMPs

This section presents specific advanced BMPs recommended for implementation. These advanced BMPs address areas of concern observed as part of the Hazardous Substances Management and Risk Assessment for the facility.

The following are procedural advanced BMPs:

<u>Waste Minimization Program</u>

A program to reduce waste products produced at the facility should be developed and implemented. The EPA publication *Waste Minimization Assessment Manual (EPA625/7-88/003)* can assist with the development and implementation of a program. The guidelines listed below should be followed as a minimum for a waste minimization program:

- Obtain corporate commitment to a waste minimization initiative,
- Establish a waste minimization task force including personnel of varying expertise and experience,
- Prepare a policy statement to describe the intent and goals of the program signed by the plant manager,
- Establish measurable waste reduction goals to be achieved by the program,
- Identify waste generating sites and processes,
- Conduct a detailed site inspection,
- Prepare an assessment of each waste product detailing alternatives that would reduce waste produced and the associated costs (include using less hazardous products, adjusting operations and procedures, internal recycling of wastes, and onsite treatment),
- Formally analyze the feasibility of alternatives and adopt feasible alternatives,
- Prepare an implementation schedule with responsibilities assigned, and
- Measure the program effectiveness at least annually while continuing the reduction assessment.

<u>Hazardous Material Management Program</u>

The following guidelines should be followed in developing a hazardous materials management program:

- Develop a baseline inventory of existing hazardous materials,
- Evaluate/develop a standard list of hazardous material and adopt as an approved list,
- Evaluate/improve requisition and procurement process,
- Evaluate/improve work practices and tracking, and
- Evaluate/improve waste management.

<u>Consolidated Facility Plan</u>

Prepare a consolidated oil spill and hazardous substance response procedure.

The following are physical advanced BMPs:

<u>Drain Blocks</u>
Evaluate the feasibility of using permanent or temporary drain blocks in areas recommended.
<u>Caustic and Acid Transfers</u>
Develop a feasibility study for providing containment under the caustic and acid transfer connections. Also, evaluate the feasibility of using temporary drain blocks during acid and caustic transfers.
<u>Sluice Lines</u>
Conduct a feasibility study with an implementation schedule for developing a containment system for the ash sluice lines.

3.0 References

1. Alabama Department of Environmental Management, Permits/Compliance Section, Mining and Nonpoint Source Branch, Handout: "Stormwater Runoff Construction, Mining, and Land Disturbance General Permit Requirements," February 1, 1996.
2. ADEM, State of Alabama Nonpoint Source Management Program, April 1989.
3. Birmingham Regional Planning Commission, "Best Management Practices for Controlling Sediment and Erosion from Construction Activities," Sediment and Erosion Control BMP Manual, August 1980.
4. Tennessee Valley Authority, "Joint Security Plan for Fossil Plants."

Appendix M ¾ Evaluation of Alternatives for Combustion Waste Disposal Sites for the Pulverized Coal Conversion Option

1.0 Background

Conversion Option 1 consists of the construction of four 600 MW boilers designed to burn pulverized coal. Each boiler would be equipped with flue gas desulfurization systems and fabric filters or electrostatic precipitators. The combustion of pulverized coal results in the generation of combustion wastes which require disposal and of byproducts which could be marketed. Three solids streams are produced during normal operation: fly ash (from the fabric filters), bottom ash (from the boilers), and gypsum (from the flue gas desulfurization).

TVA would attempt to market or otherwise utilize (subsidize use, etc.) the bottom ash and gypsum produced during operation of the PC plant. Despite this, a considerable quantity (mostly off-specification material), would require disposal. To be conservative, TVA assumed that none of the combustion solids would be marketed and calculated the life of available disposal areas on this basis.

The wastes/byproducts generated for the PC Option are ash, flyash, and gypsum. The largest stream is gypsum at slightly over 1.1 million cubic yards, followed by fly ash at 771,000 and bottom ash at 228,000 cubic yards. The land area required for storage of these materials depends on the pile height, pile slope, berming technique and the shape of the available area. Three disposal choices were considered: on-site, offsite nearby, and offsite at Widows Creek Fossil Plant.

2.0 Screening of Disposal Site Scenarios

Widows Creek now operates a flue gas desulfurization system for removal of sulfur and operates a fully permitted gypsum/ash handling and storage facility. Despite the pressures that would be exerted on the available storage at Widows Creek, trucking unmarketable bottom ash, fly ash and gypsum from Bellefonte to Widows Creek (located approximately 15 miles to the northeast) is an option. Rail or barge transport is not considered economically feasible for this option because of the additional handling involved for these two modes. However, trucking wastes to Widows Creek involves a considerable cost and offers additional significant environmental and social impacts. The costs are associated with purchasing and maintaining a fleet of trucks, gasoline, and labor for truck drivers. The environmental and social impacts include increased wear and tear on highway surfaces, higher dust emissions from haul trucks, reduced highway service availability, and higher accident potential to motorists on plant access roads and U.S. Highway 72. For these mostly qualitative reasons, trucking of wastes to Widows Creek was eliminated as an option.

Another offsite disposal option would be to use land near Bellefonte that could be purchased. As with the Widows Creek option, trucking waste would be preferable over rail and barge because of the inefficiencies in loading and unloading for such short haul distances. The same costs and environmental and social impacts associated with transporting wastes, even for a short distance, would be undesirable as described above (even though haul distances would be greatly reduced; probably less than 5 miles). Utilizing offsite land would also involve significant additional costs for environmental assessments and permitting as compared with an onsite disposal option. Additional significant costs would be incurred during the purchase of suitable land from private owners located in the vicinity. Possibly associated with this option is the difficult process of acquiring land from property owners who do not wish to sell their land. For these reasons, offsite disposal near the Bellefonte site was eliminated as an option.

The third disposal option, and the one selected for accommodating the combustion residue generated at Bellefonte for the PC options, is to use land TVA currently owns at the Bellefonte site. Bellefonte consists of approximately 1600 acres divided among developed (constructed upon) site, a hilly ridge between most of the developed area and the river and some currently unused land that is mostly flat. Based on past experience it has generally been more economical to dispose of large quantities of waste products from coal fired power plants as close as possible to the source of their generation. This is due to the high transportation or pumping costs. Areas should be near existing roadways or situated to allow the construction of access roadways. Normally, bottom ash and fly ash are trucked and the gypsum is pumped to storage sites, versus other modes of delivery such as rail or conveyors.

3.0 Site Criteria

Storage/disposal areas should meet the following criteria:

- First the land used should be relatively flat. Storage/disposal areas in flat terrain are much cheaper to construct and operate than in hilly terrain, and generally result in fewer environmental impacts. For example, it is much easier and less expensive to construct liners and develop the rim-ditch method of gypsum storage in a flat area than in an area with hilly terrain. Leachate and surface runoff diversion, recovery and treatment systems, which rely heavily on gravity induced flow, would be less costly to construct and maintain on flat terrain. Less excavation and site preparation is required to be able to accept combustion residues and later recovery for utilization would be enhanced.

- Storage/disposal areas should minimize impacts to environmental resources where practical, including terrestrial habitat (i.e., wooded areas), wetlands, and natural buffer zones which provide visual and noise insulation between industrial activities and nearby residents.

- Siting of storage/disposal areas should avoid features of Bellefonte in use for another critical purpose such as buildings, power line rights-of-way, surface water bodies or treatment ponds, switchyards, or vehicle parking areas.

4.0 Characteristics of Potential Sites

Five potential on-site areas for storage were evaluated (see Figure in Appendix B). All of these areas were outside of wetlands. Characteristics and features of the five areas are presented in the following:

1. Area 1 to the north of the power plant training facility, bisected by the north access road (200 acres). This area is bounded by wetlands to the west, the TVA property boundary to the north, existing disposal facilities to the east, and the training center and proposed recycle basin to the south. This area is generally treeless which would facilitate construction and site preparation activities. In addition, the runoff water from the site can be sent back to the recycle basin without pumping. However, this area does extend slightly into the 100 year floodplain. The area would not be large

enough to store 20 years of gypsum (a conversion design criterion) if no disposal operations were allowed in the 100 year floodplain. It is not anticipated that this small encroachment on Town Creek would have any affect on the 100-year flood levels. The utilization of this area would result in the displacement of 123 acre feet of reservoir storage capacity. Approximately one-fifth of the acreage is within the 100 year floodplain, all on the northwest border of the site which is adjacent to Town Creek Embayment.

2. Area 2 located upstream of the plant cooling water intake channel and between Area 1 and Guntersville Lake (130 acres). This area contains several formerly used disposal sites, including discarded asbestos, grout, and waste paint and solvents. These sites are being addressed by TVA in a remediation effort as part of a state approved closure plan. It would be expensive to develop a new storage area on top of existing disposal facilities. In addition, the area is hilly and would be more difficult than the flat area for site preparation and storage of waste materials. The area is primarily wooded thereby providing terrestrial habitat for local species of birds and animals. This area could be used in the future if the primary storage areas for ash and gypsum are filled to capacity. Approximately 25 acres on the northeast border of the site is located within the 100 year floodplain.

3. Area 3 is the area to the north of the power plant employee parking lot (110 acres). The area is the closest to the project location of the pulverized coal plant and therefore trucking/conveying costs would be minimized. The area is relatively flat and a disposal facility would be easy to construct thereby minimizing costs for site development. The area is adjacent to the proposed location of the recycle basin so runoff water can be reused for the power plant. However, this area does extend slightly into the 100-year flood plain. However, the area would not be large enough to store 20 years of fly ash and bottom ash or gypsum if no disposal operations were allowed in the 100-year flood plain. The utilization of this area would result in the displacement of 149 acre feet of reservoir storage capacity. Approximately one-fifth of the acreage is within the floodplain, all on the northwest border of the site which is adjacent to Town Creek Embayment.

4. Area 4 is located to the southwest of the power plant adjacent to proposed coal yard location (135 acres). This land is a potential site for disposal/storage, because it is flat and open. It is relatively far removed from the generation source and would incur the highest transportation cost of the available sites. There are major (500kV) transmission lines passing through the middle of the site. The relocation of these lines would be required to enable full utilization of the storage capacity of the site (combustion residue could not be stacked beneath the line right-of-way. It would be very expensive

to move these lines nearer the Bellefonte plant boundary or offsite (which would involve acquiring new right-of way from local property owners).The site is immediately adjacent to public road (Jackson County 33) and the Bellefonte main entrance road, making it visible to passersby on Jackson County road 33 and visitors to Bellefonte. The utilization of this area would result in removal of approximately 75 acre feet from reservoir storage capacity. Over one-third of the site is at an elevation that is below the 500 year flood plain.

5. Area 5 is located to the south and southeast of the main plant center and between the plant and the river (1340 acres). The area consists of two sub-areas situated to either side of the roadway connecting the plant proper to the barge unloading area. The proposal calls for the construction of coal and limestone conveyors along the existing road bed. This area would be very expensive to develop due to its rough terrain and heavy woods. The woods provide terrestrial habitat for numerous local species of birds and animals. This area is visible from the river and special precautions would be necessary to prevent material from getting washed into the river. There are no good locations along the river to construct a sedimentation basin for surface water runoff collection and treatment.

5.0 Conclusions

Area 1 was selected as the primary gypsum disposal area and would provide 19 years of capacity (using TVA design guidelines) at maximum plant operation, based on the conservative assumption of no marketing of this material. At a pile height of 800 feet above mean sea level, this area would provide storage for 30.7 million cubic yards of gypsum. Based on the above discussion of potential onsite areas, Area 1 is the only practicable alternative for disposal of gypsum.

Area 3 was selected as the primary bottom ash and fly ash disposal area and would provide at least 14 years of capacity (using TVA design guidelines) at maximum plant operation, based on the conservative assumption of no marketing of these materials. At a pile height of 805 feet above mean sea level, this area would provide storage for 14 million cubic yards of ash and flyash. Based on the above discussion of the potential onsite areas, Area 3 is the only practicable alternative for disposal of fly ash and bottom ash.

Appendix N ¾ SUMMARY OF APPROACH IN FORECASTING NOISE LEVELS AT RECEPTOR LOCATIONS

Noise levels were predicted at each of the four receptor locations for each power plant option and for truck and automobile traffic passing along the access road connecting the plant to U. S. Highway 72.

Methodology

For power plant noise modeling, predictive methods described in Edison Electric Institute's Power Plant Environmental Noise Guide, 1984, (EEI) were adapted to this project. Equipment noise source levels and predictive algorithms from EEI were used where possible. Locations of sources and receptors were provided by TVA and terrain elevation features were obtained from USGS maps. For forecast of vehicle traffic, methods adapted from Harris's, Noise Control Handbook, were used.

Table 1 Combinations Of Equipment Projected For Each Of The Options

	Receptor Number	1		2		3		4	
	Equiv. Day/night or Equiv. Sound Level (dBA)	Ldn	Leq	Ldn	Leq	Ldn	Leq	Ldn	Leq
Pulverized Coal	Plant Operation	57	50	52	46	43	37	56	49
	Plant Operation With Flare	NA	NA	NA	NA	NA	NA	NA	NA
	Plant Operation With Barge Unloading	57	50	52	46	43	37	57	52
NGCC	Plant Operation	43	37	35	29	21	15	14	9
	Plant Operation With Flare	NA	NA	NA	NA	NA	NA	NA	NA
	Plant Operation With Barge Unloading	NA	NA	NA	NA	NA	NA	NA	NA
IGCC	Plant Operation	55	49	45	39	35	28	56	49
	Plant Operation With Flare	NA	64	NA	62	NA	53	NA	60
	Plant Operation With Barge Unloading	55	49	45	39	35	28	57	52
IGCC/C	Plant Operation	55	49	45	39	33	27	47	41
	Plant Operation With Flare	NA	64	NA	62	NA	53	NA	57
	Plant Operation With Barge Unloading	55	49	45	39	33	27	48	44
Combination	Plant Operation	55	49	45	39	34	28	53	46
	Plant Operation With Flaring	NA	64	NA	62	NA	53	NA	57
	Plant Operation With Barge Unloading	55	49	45	39	34	28	54	49

Sound Power Level (Lw)

Sound power level of each source was obtained from both EEI and supplemented by TVA staff and TVA contractors.

Acoustic Center

At large distances, an array of noise sources would acoustically behave as a single source. The combination of noise sources may be represented as a single source by combining all sources at a single location using ratioing techniques. This location may then be used as the acoustic center for prediction purposes. Equipment of the power plant for Locations A and B in Figure 4.2.17-1 of this EIS were analyzed and the acoustic center calculated for each option. The coal dock, being at a large distance from the power block, was treated as a separate acoustic center.

Attenuation of Noise Emissions

Attenuation of noise emissions from source to receptor was determined by combining the effects of standard day atmospheric molecular absorption (Am), hemispherical spreading (Ah), barrier of terrain elevation (At), and effects of ground attenuation (Ag). Acoustically "soft ground" was used in the latter attenuation component.

Source - Receptor Relationship

The sound level at a receptor location of interest was approximated by the relationship:

$$Lr = Lw - 10 \times \log R - Am - Ah - Ag - At$$

where:

Lr is the sound level at a receptor,
Lw is the sound power level of the source at its acoustic center,
R is the distance from the source to receptor,
Am is the attenuation in sound level as a consequence of molecular absorption,
Ah is the attenuation in sound level as a consequence of hemispherical spreading,
Ag is the attenuation in sound level as a consequence of ground effects, and
At is the attenuation in sound level as a consequence of terrain acoustical barrier effects.

Equivalent Day Night Sound Level (Ldn)

Once the sound level was determined at each receptor location, Ldn was calculated by logarithmically combining the daytime (0700-2200) and night time (2200-0700) sound levels and adding ten dB to the night-time values.

Traffic Noise Prediction

An algorithm for computing the equivalent continuous sound level (Leq) was adopted to forecast the sound level experienced by a receptor from the passing of trucks and automobiles on the access road to U. S. Highway 72.

$$Lr = Lref - 10xLog\,(Rr/Rref) - 5xLog(Rr/Rref)$$

where:

Lr is the equivalent continuos sound level (Leq) at the receptor location,
Lref is the sound level at a known distance from vehicle passage,
Rr is the distance from the vehicle to the receptor, and
Rf is the distance from the reference location to the receptor,

Once the sound level and time of exposure to that level was determined at the receptor location, Ldn was calculated by logarithmically combining the daytime (0700-2200) and night time (2200-0700) sound levels and adding ten dB to the night time values.

Assumptions And Inputs

Table 2 lists the assumptions and source inputs used in the modeling by option.

Table 2 Assumptions And Specific Source Inputs Used In The Modeling

Noise Source	PC	NGCC	IGCC	IGCC/C	Combination	EEI Ref.	Lw Basic Relationship
Power Block							
Net MW (unit based)	2,400	2,230	2,370	450	2,880		All in Overall SPL
Location	B	A	A	A	A		
Existing Steam Turbine	2	1	1	1	1		
(MW/Turbine)	1,200	700	850	260	1,200	4.8	Lw=113+4Log(MW)
Boilers	4	NA	NA	NA	NA	4.4	Lw=115+15Log(MW)
ID fans	4	NA	NA	NA	NA	4.54	Lw=42+10LogQ+20LogSP
(cfm/fan)	1,000,000	NA	NA	NA	NA		
Pumps and motors	30	30	30	30	30	4.24	Lw=113 Overall
(avg hp/motor)	5,000	5,000	5,000	5,000	5,000		
Gasification Units	0	0	8	4	4	4.34	Lw=89+10Log(hp)
(Compressors/unit)	0	0	4	4	4		
(avg hp/compressor)	0	0	5,000	5,000	5,000		
Combustion Turbines	0	9	8	1	7		
(MW/turbine)	0	170	190	190	240	Msmt.	72@426' (TVA comm)
Coal Yard							Overall SPL
Location	B	A	A	A	A		
Coal Crushers	4	NA	4	2	2	4.83	Data
Limestone Mill	4	NA	NA	NA	NA	4.9	Data
Conveyor Tower	4	NA	4	2	2	4.85	Data
Vehicles	4	NA	4	4	4	4.87	Lw=98+10Log(hp)
(hp/vehicle)	250	NA	250	250	250		
(duty cycle/vehicle)	0.25	NA	0.25	0.25	0.25		
Vehicular Traffic						Harris Hand Book Of Noise Control	
Trucks							
Haul Capacity (tons)	25	NA	25	25	25		
(no./hour)	14	NA	4	2	2		
Haul Period (hrs/day)	24	NA	Daytime	Daytime	Daytime		
Average Speed (mph)	30	NA	30	30	30		
Passenger							
(no./hour)	25	8	20	8	27		
Period (hrs/day)	24	24	24	24	24		
Average Speed (mph)	30	30	30	30	30		
Location	U. S. Highway 72 access road						
Flares						Hydrocarbon Processing, December, 1988	
Number	NA	1	1	1	1		General dBA
Elevation (feet)	NA	200	200	200	200		
Capacity (cal/second)	NA	115,360,000	115,360,000	115,360,000	115,360,000		Lw=10Log(G/R^2)+96
Coal Dock							
Bucket shell unloaders	2	NA	2	1	1	4.81	Data - 25% duty
location	river dock	NA	river dock	river dock	river dock		

Appendix O ¾ Permit Applicability and Requirements

1.0 Air Quality

1.1 Relevant Statutes and Regulations

State

(1) Law - Alabama Air Pollution Control Act of 1971, Act No. 769, Regular Session, 1971.
(2) Regulations:
- -- Alabama Air Pollution Control Regulations, Chapter 335-3-14
- -- Control of Particulate Emissions, Chapter 335-3-4
- -- Control of Sulfur Compound Emissions, Chapter 335-3-5
- -- Standards of Performance for New Stationary Sources, Chapter 335-3-10

Federal

(1) Law - Clean Air Act, as amended, 42 United States Code, Section 7401 et seq.
(2) Regulations:
- -- 40 CFR Part 60 - New Source Performance Standards (NSPS), Subpart GG Stationary Gas Turbines
- -- 40 CFR 60.250 - NSPS for Coal Preparation Plants
- -- 40 CFR Parts 51 and 52 - Prevention of Significant Deterioration of Air Quality
- -- 40 CFR Part 70 - Operating Permits
- -- 59 FR 12407-12450 and 59 FR 19402-19625 (amendments to 40 CFR Part 63) National Emission Standards for Hazardous Air Pollutants for Source Categories.
- -- 40 CFR Part 63, Synthetic Organic Chemical Manufacturing Industries (SOCMI)

1.2 Required Permits

- State construction permit which includes the federal Prevention of Significant Deterioration (PSD) and nonattainment permitting requirements. This permit must be issued prior to construction.
- State operating permit for operation of proposed IGCC/C plant.
- Federal Clean Air Act Title V Operating permit. This permit must be applied for within 12 months after the facility starts operation.

1.3 Applicability

Construction

The ADEM has received PSD and nonattainment permitting delegation from the U.S. EPA Region IV. Therefore, the state is the permit issuing entity; Region IV has the opportunity to comment on any draft permits. Jackson County is redesignated as attainment for all criteria pollutants, so nonattainment issues are not addressed here.

Each of the conversion options is a named source category; therefore PSD applies if emissions of any regulated pollutant are 100 tpy or greater (which all conversion options do) and therefore, PSD applies. Once PSD applies for any pollutant, PSD applicability for the remaining regulated air pollutants is determined by comparing the proposed maximum emission rates with PSD significance levels.

The estimated annual emissions and PSD significance levels are presented in the following table. The pollutants for which PSD applies are shown in bold type.

Estimated Annual Air Pollutant Emissions for Bellefonte Conversion Options

	Annual Emissions (tons/yr)					
Pollutant[a]	**PSD Significance Levels**	**PFBC**	**NGCC**	**IGCC**	**IGCC/C**	**Combination**
Particulate Matter	25	**2,269**	**427**	**1350**	**797**	**893**
PM10	15	-	-	-	-	-
Sulfur Dioxide	40	**20,948**	**76**	**7,500**	**2,581**	**2650**
Nitrogen Dioxide	40	**30,341**	**20,993**	**21,000**	**5,690**	**25,480**
Carbon Monoxide	100	**1,973**	**1,400**	**4,470**	**1,130**	**2,760**
VOC	40	-	-	**152**	**51**	29
Lead	0.6	0.54	-	0.557	0.009	0.009
Mercury	0.1	-	-	**5.16**	0.085	0.085
Beryllium	0.004	**0.027**	-	**0.32**	**0.005**	**0.005**
Fluorides	3	-	-	**12.3**	0.204	0.204
Sulfuric Acid Mist	7	0.96	-	**37.6**	**18.8**	**18.8**
Hydrogen Sulfide	10	-	-	**14.1**	7.05	7.05

a - PSD significance levels also exist for asbestos, vinyl chloride, and reduced sulfur compounds, but no data were available for the emission of these compounds for the conversion options.

Operation

An operating permit, under Title V of the Federal Clean Air Act Amendments of 1990, must be applied for within 12 months after start of operation.

In March 16 and April 22, 1994 amendments to 40 CFR Parts 60, 61, and 63, EPA published comprehensive rules affecting the operation of chemical plants and other sources. The regulations in part 63 begin to regulate the emissions of certain organic hazardous air pollutants from synthetic processes which are part of major sources under section 112 of the Clean Air Act as amended in 1990. This rule is called the hazardous organic NESHAP or the HON. The HON requires sources to achieve emission limits reflecting the application of the maximum achievable control technology (MACT) consistent with the Act. The rule addresses over half of the listed hazardous air pollutants emitted from both existing and new sources, and includes certain wastewater discharges.

Sections with information for determining the applicability and requirements for the conversion options involving a chemical plant are 40 CFR Part 63 subpart F (lists regulated HAPs and present general industry standards), subpart G (explains how MACT standards for specific process vents, storage vessels, transfer operations and wastewater are determined) and subparts H and I (presents MACT standards for equipment and process leaks). It is not possible to define specific standards of the BEP project at this time. The regulations are long (about 275 pages in the Federal Register) and complicated. Specific process design plans and specifications would be needed to define specific MACT requirements and limits for sources. Emissions averaging is allowed to demonstrate compliance.

From a preliminary inspection of the SOCMI regulations, it would appear that emission limits may not apply to all of the coproducts under evaluation. Specific monitoring, record keeping and reporting requirements are contained in the regulation.

The following performance standards may apply to a conversion option at Bellefonte:

- State - Chapter 335-3-10.02 (33), Standards of Performance for New Stationary Gas Turbines.
- Federal: NSPS for Gas Turbines and Coal Preparation Plants. These standards are incorporated by reference into Alabama Regulations.
- Federal: Synthetic Organic Chemical Manufacturing Industries, Maximum Achievable Control Technology required for air and wastewater emissions.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- PSD Ambient Monitoring -Normally includes preparation and coordination of PSD monitoring plan, the actual monitoring, data validation, and data analyses and reporting. ADEM has approved the use of data collected earlier in the vicinity of Bellefonte for this conversion project, so no new ambient air data would be needed.
- PSD Best Available Control Technology (BACT) Analysis - Evaluate control technology alternatives, based primarily on incremental cost of the controls, provided no air quality problems are expected. BACT would apply for each pollutant emitted in "significant amounts" (i.e., SO_2, CO, NO_x, PM and PM_{10}). “Top down” approach would be used.
- PSD Ambient Air Quality Analysis - Evaluate project's impacts with respect to PSD ambient air increments and National Ambient Air Quality Standards.
- PSD Additional Impact Analyses - Evaluate project impacts on growth, soils, vegetation, and visibility in any Class I area. No Class I area is located within 50 miles of Bellefonte.
- ADEM Air Toxics Policy - Evaluate project's impacts of any pollutants that do not have state or federal air quality standards and which have emission rates greater than 0.1 pounds per hour. Project impacts are compared to a specified fraction of the pollutant's Threshold Limit Value (TLV), either 1/40th of TLV for 1-hour average of 1/420th of TLV for annual average.
- SOCMI Analysis, Tests, and Record keeping - Determine allowable emission limits, evaluate MACT technology alternatives and compliance strategies for meeting 40 CFR Part 63 requirements for chemical manufacturing. Develop wastewater management and treatment methodology.

2.0 Wastewater Discharges

2.1 Relevant Statutes and Regulations

State

(1) Law - Alabama Water Pollution Control Act, Title 22 Code of Alabama Chapter 22.

(2) Regulations:
-- Alabama NPDES Permit Regulations, Alabama Administrative Code (AAC) Chapter 335-6-6.
-- Alabama Water Quality Criteria Standards, AAC, Chapter 335-6-10.

Federal

(1) Law - Federal Water Pollution Control Act, as amended, 33 USC Section 1251 et seq.

(2) Regulations:
-- 40 CFR Part 122 - NPDES Permit Regulations
-- 40 CFR Part 400 et seq. - National Categorical Effluent Limitations and Guidelines

2.2 Required Permits

- National Pollutant Discharge Elimination System (NPDES) storm water permit for construction activities.
- NPDES permit for direct discharges of pollutants to surface waters during operation of the facility.

2.3 Applicability

Construction

The ADEM requires a state-administered National Pollutant Discharge Elimination System (NPDES) storm water permit before site construction activities can commence. The NPDES permit would include direct discharges of pollutant during construction for those outfalls which are active. Bellefonte Nuclear Plant is currently operating with an NPDES Permit at the proposed site. Specific site outfall and storm water monitoring is being performed routinely. This permit (AL0024635), issued September 30, 1992, is due to expire September 30, 1997. Once the new facilities are operational, the NPDES permit would cover both the process and storm water discharge of pollutants.

During periods of active construction where areas greater than five acres have been disturbed, the affected storm water points shall be monitored for pH, TSS, SS, BOD, COD, Oil & Grease, Flow, and Precipitation. As part of the existing NPDES Permit, five uncontaminated storm water runoff points are presently being monitored. No discharge limits have been applied to these discharges, but are observed at least once per month for evidence of oil contamination, as evidenced by an oil sheen on the surface. The upstream and downstream turbidity of all affected watercourses would need to be monitored during construction.

Operation

The analytical results of sampling for all priority pollutants for all outfalls within one year of first achieving 100% power must be submitted to ADEM. The runoff from any coal piles would require special treatment and handling requirements. Coal pile drainage results from percolation of rainfall through stored coal. The water quality of the drainage is affected by the leaching of oxidation products of metallic sulfides associated with the coal. If the runoff water that enters the coal storage runoff pond is hazardous (i.e., by characteristic or listing), or if a hazardous waste is generated in the pond (e.g., by concentration or precipitation), the pond is a hazardous waste unit and would then be regulated as a waste storage facility under RCRA (Subpart K - Surface Impoundment) requiring a permit, double liner, and a leachate collection and removal system. In addition, spills and leaks of listed hazardous waste that accidentally enter non-RCRA ponds may cause these ponds to become RCRA units (see Section 4.1.5 Hazardous Waste Disposal).

Performance standards may apply to a conversion option at Bellefonte. Performance standards may take the form of technology-based effluent limitations, based in part on national categorical effluent limits and guidelines, or water quality-based limitations specified in applicable ADEM regulations:

State water quality-based limitations include the following:

- Use classification of upper stretch of Tennessee River Basin is public water supply (PWS), swimming, fish and wildlife protection
- Select water quality criteria for PWS-designated segments are (1) maximum instream temperature less than or equal to 86.5°F and maximum allowable increase in ambient temperature less than or equal to 5°F (unless alternate limits demonstrated), (2) dissolved oxygen more than or equal to 5mg/L, (3) concentrations of toxic pollutants in state waters cannot exceed criteria derived from calculations in rule, taking into account designated water uses. Effluent limits are back calculated from criteria, as needed.
- All industrial, sanitary, and/or combined discharges are subject to secondary treatment or its equivalent for biologically degradable waste. Parameters of interest are BOD_5, SS, and pH.

Federal requirements and limits include:

- Steam electric power generation (40 CFR Part 423), includes new source performance standards for cooling water (pH, total residual chlorine), low volume wastes (TSS and Oil & Grease), chemical metal cleaning wastes (TSS, Oil & Grease, Copper, Iron), bottom ash transport water (TSS, Oil & Grease), and coal pile runoff (TSS).
- Fertilizer manufacturing (40 CFR Part 418), includes NSPS for the area subcategory (Ammonia Subpart B) applicable to discharges of ammonia and pH resulting from the manufacture of ammonia.
- Fertilizer manufacturing (40 CFR Part 418), includes NSPS for the area subcategory (Urea Subpart C) applicable to discharges of ammonia, and organic nitrogen resulting from the manufacture of urea.
- Fertilizer manufacturing (40 CFR Part 418), includes NSPS for the area subcategory (Ammonium Nitrate Subpart D) applicable to discharges of ammonia, and nitrate resulting from the manufacture of ammonium nitrate.
- Organic Chemicals, Plastics, and Synthetic Fibers (40 CFR Part 414), includes NSPS for the area subcategories (Subpart F - Commodity Organic Chemicals, and Subpart G - Bulk Organic Chemicals) applicable to discharges of acetic acid, ethanol, formaldehyde, methanol, and methyl tert-butyl ether resulting from the manufacture of ammonium nitrate.

- Recent NESHAPS for cooling tower blowdown prohibit the use of chromium containing chemicals.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Best Management Practices - A Best Management Practices (BMP) Plan addresses containment of any or all process liquids or solids that these materials do not present a significant potential for discharge. When submitted and approved, the BMP becomes a part of the NPDES Permit and all requirements of the BMP Plan become requirements of this permit. One component of the plan is a pollution prevention plan for new site construction exceeding 5 acres. The applicant must provide spill prevention, control and/or management sufficient to prevent any spills of pollutants from entering the waters of the state, or a publicly owned treatment works (POTW).
- Spill Prevention Control and Countermeasures (SPCC) Plan - The SPCC Plan, prepared in accordance with 40 CFR Section 112, addresses chemical and fuel oil storage facilities and their operation.
- Facility Response Plan - Operators of any non-transportation-related onshore facility that, because of it location, could reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters or adjoining shorelines must prepare and submit a facility response plan to the EPA Regional Administrator. This plan includes an emergency response action plan.
- Engineering Report - Before construction of new, or modification of existing waste treatment facilities or ponds, an Engineering Report, in accordance with the State Regulations, must be submitted to ADEM and final comments from ADEM shall be received by the permittee.

3.0 Solid Waste Disposal and Byproduct Management

3.1 Relevant Statutes and Regulations

State
(1) Nonhazardous wastes:
Law - Alabama Solid Waste Act
Rules - Alabama Administrative Code (AAC) Ch. 335-13.
(2) Hazardous wastes:
Law - Alabama Hazardous Wastes Management and Minimization Act, Title 22, Ch. 30.
Rules - AAC Ch. 335-14.

Federal
(1) Nonhazardous wastes:
Law - Resource Conservation and Recovery Act (RCRA), as amended, 42 USC Section 6901 et seq, Subtitle D.
Rules - No federal Subtitle D rules for industrial nonhazardous wastes
(2) Hazardous wastes:
Law - RCRA, Subtitle C.
Rules - 4O CFR Parts 260-270.

3.2 Required Permits

- None for materials handling and storage.
- Permit required for on-site disposal of nonhazardous wastes such as sludges. If any of these non-hazardous wastes are sluiced to surface impoundments they are typically managed by NPDES, not solid waste.
- No hazardous waste permit if no on-site treatment, storage (for > 90 days), or disposal of any hazardous wastes.

3.3 Applicability

Construction
No applicable requirements or standards

Operation

There is no state or federal permitting program for materials handling and storage facilities that may impact groundwater resources. Design considerations for these types of facilities would likely be involved, however, in issuance of an NPDES permit.

All of the solid wastes generated by the project that are not exempt from RCRA Subtitle C regulation pursuant to 40 CFR Sec. 261.4(b)(7)(vi) are required to be assessed to determine whether they are a characteristic or a listed hazardous waste. [Two gasification process streams, process wastewater and gasifier ash, are exempt from Subtitle C regulation pursuant to 40 CFR Sec. 261.4(b)(7)(vi) and (vii) and AAC Sec. 335-14-2-.01(4)(a)7]. If any of these streams are hazardous wastes, then certain management standards apply to the on-site storage for <90 days. Industrial nonhazardous wastes may be sent to certain municipal landfills.

The ADEM issues permits for the on-site disposal of industrial nonhazardous waste. According to a state contact, there are no rules or guidelines on what constitutes “disposal" vs long-term “storage" of industrial by-products; he indicated that it depends on the intent of the facility with respect to the material. The state contact knows of some facilities that have been accumulating and storing by-products on-site long term without a state permit, while others (a tire recycler and an on-site landfill for non-utility ash) went ahead and secured a permit to resolve any long-term questions the state might have. Legal advice may be needed to resolve TVA's position regarding the time limit distinction between accumulation of waste for subsequent marketing and "disposal".

Certain materials handling activities and land-based wastewater/byproduct (slag) storage facilities have the potential to impact ground water resources. Operation of the IGCC plant would result in generation of a number of solid wastes, such as fly ash, spent sorbent, water and wastewater treatment sludges and residuals, used oils, and maintenance wastes (solvents and paints). ADEM has determined that ash "Resulting from the combustion of coal or other fossil fuels at Electric Generating Plants" is not solid waste. Hazardous wastes and wastewater treatment plant sludge would be disposed of off site.

The following are applicable performance standards:

- <u>Groundwater quality</u> - [see Section 4.1 Alabama Wastewater Discharges Performance Standards, (Subsection 3) design guidance for ponds and Other Considerations, (Subsection 3) Best Management Practices Plan]
- <u>Hazardous Wastes</u> - a large-quantity generator (generates >1,000 kg/mo.) can store hazardous waste on site for up to 90 days prior to off-site disposal without needing a RCRA permit for storage. The standards for “temporary accumulation" of hazardous waste, found at 40 CFR Sec. 26234 and AAC Sec. 335-14-3-.03(5), require that the hazardous waste be stored in labeled containers or tanks [the tank(s) must meet certain design standards] and that certain emergency preparedness, prevention, and response procedures be implemented (including a contingency plan). Lesser standards apply to generators of <1,000 kg/mo. who wish to temporarily accumulate hazardous waste on site.
- <u>Industrial nonhazardous wastes</u> - are considered as state special wastes per AAC Sec. 335-13-1-.03 definition also depends on handling and processing requirements. Special wastes can be sent to municipal landfills as long as state prescribed procedures are met.
- The technical standards for on-site disposal of industrial nonhazardous wastes are determined on a site by site basis. However, for sites located in northern Alabama, the guidance provided for ponds would equally apply to solid waste cells (i.e., a prior hydrogeological investigation, probably lining and modified groundwater monitoring requirements). One recently permitted inert landfill in North Alabama has been required to install a 5-foot thick chert-free clay liner, while a proposed landfill for boiler ash for a major paper processing company would include a 3-foot clay and synthetic liner.

The following analyses/evaluations may apply to a conversion at Bellefonte:

- For solid waste permitting, the results of hydrogeologic investigations, hazard determinations, and marketability studies (for slag and fly ash) would be necessary.
- Solid waste permits typically require groundwater monitoring and reporting.
- Hazardous waste generators are required to register with the USEPA regional office and state per 40 CFR Sec. 262.12 and AAC Sec. 335-14-3-.01(3) as a hazardous waste generator and secure a USEPA/State identification number. This is not a permitting procedure; however, it is basically an administrative procedure to secure an identification number.
- All special waste must be characterized by the Toxicity Characteristic Leaching Procedure and this characterization submitted to the ADEM on a solid/hazardous waste determination form. The ADEM would issue a letter accepting the form and confirming the facility’s selection of an off-site disposal facility. Sanitary landfills can dispose of special wastes as

long as they have groundwater monitoring and the waste is generated within their permitted geographical area.

- The permit application requirements for industrial nonhazardous waste disposal facilities are patterned after the requirements for municipal solid waste landfills (in AAC Ch. 335-13), but should be negotiated first with the state to tailor the requirements for the specific site. The state allows the process to take place in two stages: first, the hydrogeologic review and site suitability determination by the state (particularly important for northern Alabama), and, if the site is suitable, submittal and review of the technical design for the facility.

4.0 Surface Water

4.1 Relevant Statutes and Regulations

- Section 10 of the River and Harbor Act (33 USC 403)
- Section 26a of the Tennessee Valley Authority Act
- 33 CFR 330 - Nationwide Permits
- Section 404 of the Clean Water Act

4.2 Required Permits

A section 10 permit is required from U.S. Army Corps of Engineers for the placement of structures in navigable waters. (In the past TVA has not been required to obtain Section 10 permits for water use facilities constructed in the Tennessee River Basin. However, TVA remains subject to obtaining Section 404 permits when such activities require the discharge of dredged or fill material in waters of the U. S.)

4.3 Applicability

Construction

Alabama does not require approval to use the surface waters in the Tennessee River. However, permits are required from the U.S. Army Corps of Engineers under authority of Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act for the construction of water use facilities such as water intake and outfall structures and barge terminal facilities. An intake structure has been constructed to serve the nuclear plant but modifications may be needed to support the BEP. Alabama has recently passed legislation requiring the annual reporting of water withdrawals but TVA's position is that this legislation does not apply to TVA.

Section 10 of the River and Harbor Act prohibits the obstruction or alteration of navigable waters without a permit. Section 26a of the TVA Act ensures that construction, in, across, and along the Tennessee River and its tributaries that can potentially affect navigation, flood control, or public lands is reviewed and approved by TVA. The review process for TVA's projects would be conducted through the NEPA process. Site-specific criteria are used in the evaluation of the applications by the COE to ensure that navigation, flood control, and public river uses are not impaired.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Application and supporting documentation should be combined with 404 wetlands permit, if required.
- Completion and submission of ENG Form 4345 and supporting documentation related to project need, wetland avoidance and minimization, mitigation plans, drawings, etc., and Draft EIS.
- COE would issue public notice upon receipt of complete application package. With rare exceptions, the dredge and fill (404) application and the River and Harbor Act Section 10 (see water rights/withdrawals and obstruction to navigation) application are processed together.

5.0 Land Use

5.1 Relevant Statutes and Regulations

The relevant legislation affecting land use is the Farmlands Protection Policy Act of 1981, (7 USC 4201 et seq), Farmland Protection Policy (7 CFR 658).

5.2 Required Permits

No land use/zoning permits apply. As part of this draft EIS, the potential for converting prime farmland to other uses is addressed.

5.3 Applicability

As a federal agency, TVA is not subject to local land use laws.

6.0 Wetlands

6.1 Relevant Statutes and Regulations

- USC 1344 (Section 404 of the Clean Water Act of 1977)
- USC 1341 (Section 404 of the Clean Water Act of 1977)

6.2 Required Permits

- Army Corps of Engineers (COE) Section 404 Dredge and Fill Permit.
- Under Section 401 of Clean Water Act, the state is required to certify that the proposed activity would meet applicable water quality standards.

6.3 Applicability

Construction activities that result in the discharge of dredged or fill material in waters of the U. S. including wetlands are subject to regulations. A permit would be required only if construction affected these waters. A wetlands determination should be made by a qualified expert, based upon the COE's 1987 manual for wetlands determination. There are two types of 404 permits: individual and general. The latter are generally for activities that affect smaller areas or less critical wetland habitats and often do not require an application (although reporting may be required). If the affected wetlands area is more than 3 acres, an individual permit would be required, and could be required for non-tidal wetlands of between 1 and 3 acres.

Generally, applicants for 404 individual permits must demonstrate the public and private need for the project, that these projects cannot practically avoid waters of the U. S. , that the project minimized impacts to these waters, and that compensatory mitigation would be performed to offset losses. Typical compensatory mitigation for wetland losses requires at least 2 acres restoration/enhancement for every 1 acre disturbed.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Completion and submission of ENF Form 4345 and supporting documentation related to project need, wetland avoidance and minimization, mitigation plans, drawings, etc.
- COE would issue public notice upon receipt of complete application package. With rare exceptions, the dredge and fill (404) application and the River and Harbor Act Section 10 (see water rights/withdrawals) and (obstructions to navigation) application are processed together.

7.0 Floodplains

7.1 Relevant Statutes and Regulations

- Executive Order No. 11988

7.2 Required Permits

- The project siting must be consistent with Executive Order No. 11988.
- Floodplain analyses (including those required for E.O. 11988) must be included in the EIS. This information would also be used to ensure compliance with local floodplain regulations adopted by communities for participation in the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA).

7.3 Applicability

The analysis for flood risk involves ensuring that the proposed facilities would be sited to provide a reasonable level of protection from flooding. Because federal funds are involved in the plant's construction, the E.O. 11988 applies, and because of the nature of the project itself (e.g., flooding of the plant would be an added element of flooding disaster), the plant is a "critical action" under E.O. 11988. This means it should be located above the 500-year floodplain.

Applicable performance standards are as follows:

- Project structures should avoid contributing to a rise in flooding (i.e., cannot obstruct the floodway).
- Project structures should be above 500-year floodplain.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- Floodplain analyses (e.g., hydraulic modeling and flooding profile and floodway determinations, hydrological profiling and modeling).

8.0 Biological Resources

8.1 Relevant Statutes and Regulations

- Endangered Species Act (ESA) (16 USC 1536)
- 50 CFR Parts 17, 222, 225, 226, 227, and 402 implement the ESA.
- Fish and Wildlife Coordination Act (16 USC 661)
- Alabama non-game species regulation is Conservation Regulation 220-2-92 and Alabama's invertebrate species regulation is CR. 220-2-.98

8.2 Required Permits

A consultation process (documented by clearance letters) between TVA and the U.S. Fish and Wildlife Service (F&WS) must be completed prior to construction under the following regulations:

- Section 7 Endangered Species Act
- Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act does not apply to TVA but could apply to the project because of USACE involvement.

8.3 Applicability

Construction and operation of the plant could potentially affect wildlife resources including endangered or threatened species (listed for protection by the federal or state government). Because the project involves major construction, and is subject to NEPA, the federal consultation process with F&WS (Section 7 of

ESA) must occur if listed, threatened, or endangered species may be affected. Consideration should also be given to state-protected species during the NEPA review process.

If applicable, evaluations of impacts are based on biological assessments. The standard for determining whether a species is "jeopardized" under ESA is whether the project would likely result in its "diminished survival" and "recovery." State standards may include "harassment" of a protected species. The ESA Section 7 consultation process includes "listed" and "proposed to be listed" species. "Candidate species" are also frequently assessed both in the Section 7 consultation process and in the NEPA review process. State listings overlap, but may include different species.

The first set of data is usually provided by the F&WS and/or the state's "heritage program." It includes a list of species that may be in the project area. This list is sent upon request in response to the project developer's project and site description. The biological assessment, if required, is conducted by the project applicant and based upon field surveys of the project site area, estimations of the occurrence of listed species, and estimations of project impacts.

The Section 7 ESA consultation is focused on endangered species; the Fish and Wildlife consultation is focused more broadly on aquatic wildlife. Both are usually handled by the F&WS office in a parallel process. The state agencies are usually involved in the consultation to address any state-specific concerns (or listed species). The typical process is as follows:

1. Project sponsor sends letter to F&WS field office providing project description and site locations (on a USGS map). The F&WS responds with a list and information about ESA compliance.
2. Project sponsor conducts a biological assessment pursuant to 50 CFR 401.12 if a "may affect" situation exists. This is submitted to the F&WS (and applicable state agencies).
3. If TVA were to conclude that there is no adverse impact on listed species and if F&WS were to concur, the F&WS would document this is a letter and the consultation process would be completed. The clearances letters (from F&WS for both the ESA Section 7 and Fish and Wildlife Coordination Act and from the state agencies) could be published in the EIS along with the results of the biological assessment.
4. If F&WS concludes that adverse impacts are likely, a 90-day formal consultation process begins with TVA's agreement to enter consultation. At the end of this period F&WS would issue either a "no jeopardy" opinion or a "jeopardy" opinion along with "reasonable and prudent" alternatives.
5. If TVA and F&WS agree on measures that would avoid jeopardy to all listed species, these are documented in a letter, and the consultation process if completed.

9.0 Cultural Resources

9.1 Relevant Statutes and Regulations

- National Historic Preservation Act (NHPA), (16 USC 470)
- CFR 800 “Protection of Historic and Cultural Properties” (51 FR 31118-311125, 9/2/86)
- Native American Graves Protection and Repatriation Act (NAGPRA), (25 USC 3001-13).

9.2 Required Permits

Completion of a “Section 106 review process” is required prior to the approval of the expenditure of any federal funds on construction of the project. The product of this review process is as follows:

1. Concurrence by the State Historic Preservation Officer (SHPO) in TVA’s determination that the project would have <u>no effect</u> on historic properties.
2. SHPO concurrence in a determination of <u>no adverse effect</u>.
3. A memorandum of agreement (MOA) with the Advisory Council on Historic Preservation (ACHP) and/or the SHPO on how <u>adverse effects</u> would be taken into account. Any of these documents is equivalent to a permit to proceed with the project.

9.3 Applicability

Section 106 of the NHPA requires federal agencies to take into account the effects of their proposed actions on properties listed in or eligible for listing in the National Register of Historic Places (National Register). The National Register is a listing of sites, buildings, areas, objects, and structures significant in American history or culture. Because of the size, scope, and federal involvement in this Project, the NHPA Section 106 consultation would apply and would require a historic properties survey unless the site has been previously surveyed. NAGPRA requires the protection of Native American graves and other cultural items. The law encourages avoidance of archaeological sites that contain burials or those portions of sites that contain graves through in situ preservation, but may encompass other actions to preserve these remains and items.

Criteria for listing in the National Register are provided in the implementing regulations (36 CFR 60) and in the National Register. Efforts to identify historic properties that may be affected are conducted in consultation with the SHPO. Identification efforts should follow the Secretary of Interior’s “Standards and Guidelines for Archaeology and Historic Preservation” (48 FR 44716).

Under Section 106, TVA is required to perform the following:

1. Review existing information on historic properties that could be affected.
2. Request the views of the SHPO on further actions to identify historic properties.
3. Seek information from local governments, Indian tribes, public and private organizations, etc., likely to have knowledge of historic properties in the area.
4. Based on the above information, TVA then determines the need for further actions, such as field surveys, to identify historic properties. TVA, in consultation with the SHPO, would then determine the National Register eligibility of all sites within the area affected by the project. If no eligible sites would be affected, the project may proceed. If eligible sites would be adversely affected, TVA would execute on MOA with the ACHP and/or the SHPO stipulating measures to be taken to avoid or minimize adverse effects.

Normally, these measures would include such actions as data recovery excavations at eligible archaeological sites and recording of historic structures. The Section 106 consultation process is documented as part of the EIS. Historic property identification results are summarized in the EIS.

Section 106 consultation is required for all federal undertakings. The submittal of the letter of inquiry to the SHPO and the submittal of a Phase I Survey trigger the 106 consultation process, which leads to a finding of no effect or no adverse effect or a MOA stipulating measures to avoid or minimize adverse effects.

NOTE: Construction activities for the plant and ancillary facilities (e.g., pipelines) would not adversely affect historic properties (any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places). The entire Bellefonte site has been surveyed and investigated for relevant properties and cleared of any protected elements.

10.0 Air Navigation

10.1 Relevant Statutes and Regulations

- Federal Aviation Act, 49 USC Section 1304 et seq.
- CFR Part 77 “Obstruction Standards.”

10.2 Required Permits

A determination of no hazard to air navigation from Federal Aviation Administration (FAA) is required.

10.3 Applicability

The highest structures (buildings, stacks) should avoid causing a hazard to aircraft navigation. The highest structures at the plant are the existing cooling towers at 477 feet above ground level. Review is required for all structures that exceed 200 feet above ground level. Because the plant has at least one structure at 350 feet, the no hazard determination would be needed.

Developer is required to notify FAA if either the height of tallest structure exceeds 200 feet or if the proposed location of the structure is within 20,000 feet of the nearest public-use airport runway and if the height of the structure exceeds X, where:

$$X = \frac{\text{distance to runway in feet}}{100}$$

Where height exceeds either the 200 feet or X value above, FAA would either issue a determination-of-no-hazard letter (with or without conditions) or would require further study, including negotiating with project developers which could lead to either project modifications or a rejection by FAA.

11.0 Noise

11.1 Relevant Statutes and Regulations

- Noise Control Act of 1972 (PL92-574) and Quiet Communities Act of 1978 (PL95-609).
- 40 CFR 201 addresses railroad noise.
- 40 CFR 202 addresses heavy truck traffic.
- 40 CFR 204 addresses air compressors.
- 40 CFR 1910 addresses occupational limits.

11.2 Required Permits

No permits are required, although evaluation of noise impacts are required as part of EIS and local standards may exist that must be met. No local standards were identified.

11.3 Applicability

Intermittent and temporary noise impacts would be from operation of construction equipment. Permanent impacts would be associated with operation of plant, particularly coal handling and crushing, gasification, turbines, air compressors, boiler feed pumps, and trains and trucks. The equipment noise standards and occupational limits would also apply. Equipment specific standards and occupational safety standards have been promulgated.

There are no state or federal environmental noise limits that apply to facility operation, This Draft EIS uses EPA's "Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (March 1974)" as a guideline. The EPA document sets a day/night level (Ldn) of 55 dBA as adequate protection for residential areas. Similar guidelines from the U.S. Department of Housing and Urban Development are also used. Equipment-related standards include trucks (80 dBA at 50 feet) and portable air compressors (76 dBA at 23 feet). OSHA noise exposure for construction and operating personnel is set at 90 dBA for a 8-hour shift with hearing conservation programs for when noise levels reach 85 dBA.

The following analyses/evaluations may apply to a conversion option at Bellefonte:

- A background noise survey and noise modeling to estimate operational impacts at the fence line and at nearby sensitive receptors (e.g., homes, schools) would probably be necessary at a minimum.
- Estimates of the effectiveness of mitigation techniques (e.g., equipping turbine air inlets with silencers) may also be required as part of the EIS noise analysis.

12.0 Emergency Planning

12.1 Relevant Statutes and Regulations

- Emergency Planning and Community Right-to-Know Act of 1986 (42 USC 11001 et seq.).

12.2 Required Permits

No permits are required, but periodic reporting is required. Compliance demonstration is not required before construction.

12.3 Applicability

Use, processing, or storage of certain chemicals for use in operation and maintenance would subject the plant to the Emergency Planning and Community Right-to-Know Act (EPCRA). (TVA is technically exempt from EPCRA but complies as a matter of internal policy.)

The plant would use, process, and/or store many substances subject to the EPCRA reporting requirements. These substances are likely to include laboratory chemicals, maintenance chemicals (e.g., oil, degreasers, compressed gases), water treatment and wastewater materials (e.g., chlorine), feedstocks and fuel (e.g., ammonia, fuel oil), and products and by-products (e.g., fly ash).

Reporting requirements under EPCRA are linked to the presence, production, release of various lists of chemicals (e.g., 360 "extremely hazardous substances," the CERCLA Sec. 102(a) substances, OSHA hazardous chemicals, the 337 "toxic chemicals"). It is almost certain that the plant would trigger some or all of these reporting requirements. The planning and reporting involves the facility, a local planning committee and local fire marshals, and a state emergency planning commission.

There are no performance standards as such. Generally, EPCRA requires planning and reporting based on the presence, use, production, or discharge (accidental and routine) of various chemicals. These are as follows:

- Section 301-303 of EPCRA requires that facility develop an Emergency Response Plan with the LEPC.
- Section 304 requires accidental release reporting.
- Sections 311 and 312 require that facility inform the local public of the inventory sizes and locations of certain hazardous chemicals.
- Section 313 requires annual reporting of routine and emergency releases of 337 toxic chemicals. [Not applicable to SIC Code 9911 (IGCC portion)]

As part of its voluntary compliance with EPCRA, TVA would develop estimates of use, storage, production, and release of the various chemicals by list.

13.0 Health And Safety

13.1 Relevant Statutes and Regulations

- State: None
- Federal: 29 CFR Part 1910 - general industry standards 29 CFR Part 1926 - construction standards
- TVA's Occupational Health and Safety Manual

13.2 Required Permits (None)

13.3 Applicability

Construction and operation of the plant could potentially impact worker health and safety. OSHA does not directly apply to federal agencies. However, TVA must implement equivalent standards. Also, OSHA would apply directly to contractors. The standards include requirements relating to walking-working surfaces, means of ingress and egress from structures, operation of powered equipment, occupational exposure monitoring and controls for chemical and physical agents, hazard communication training, process safety evaluations, fire protection, and electrical equipment safeguards.

Glossary

Acidic Deposition - The wet or dry deposition of acidic chemical compounds from the atmosphere.
Acid Rain - A complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on Earth in a wet form. The wet forms, popularly called "acid rain," can fall as rain, snow, or fog.
Ambient - Surrounding.
Anaerobic - Living in the absence of air or free oxygen.
Anistropy - The condition under which one or more of the hydraulic properties of an aquifer vary according to the direction of flow.
Aquifer - A geologic formation or structure that contains and transmits water in sufficient quantity to supply the needs for water development. Aquifers are usually saturated sands, gravel, or fractured rock.
Aquitards - low-permeability units that can store ground water and also transmit it slowly from one aquifer to another.
Attainment Areas - Those areas of the U. S. that meet National Ambient Air Quality Standards as determined by measurements of air pollutant levels.
Benthic Invertebrates - An animal lacking a backbone or spinal column and living on lake bottoms.
Biodiversity - The diversity of life in all its forms and all its levels of organization. Also termed "biological diversity".
Boiler - A pressurized system in which water is vaporized to steam, the desired end product, by heat transferred from a source of higher temperature, usually the products of combustion from burning fuels.
Boiler Slag - Ash that has been melted during the combustion process and then solidified as it is removed from the boiler.
Bottom Ash - Heavier ash (noncombustible component of coal or other fuels) that settles in the bottom of the boiler rather than being carried out with flue gas.
Carboniferous Age - noting or pertaining to a period of the Paleozoic era, including the Pennsylvanian, Mississippian, and formerly the Permian periods as epochs: from 270 million to 350 million years ago.
Carbon Dioxide (CO_2) - A colorless, odorless, nonpoisonous gas that results from fossil fuel combustion and is normally a part of the ambient air.
Carbon Monoxide (CO) - A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.
CH_4 - Methane
Chemical Coproduction - The production of a chemical product while simultaneously producing electricity.
Class I Areas - National parks and wilderness areas designated by the Prevention of Significant Deterioration section of the Clean Air Act amendments. These amendments and the implementing regulations provide special protection to air quality and air quality-related values in such areas. Only very slight deterioration of air quality is allowed in Class I areas.
Class II Areas - Most of the country not designated as Class I is designated as Class II. Class II areas are generally cleaner than air quality standards and moderate increases in new pollution are allowed after a regulatory mandated impacts review.
CO - Carbon Monoxide
CO_2 - Carbon Dioxide
Coal Gasification - The process of converting coal into gas. A gasifier burns coal in a fluidized bed with less air than is required for complete combustion. The resulting gas contains a high concentration of combustible material.
Cogeneration - The sequential production of electricity and useful thermal energy (generally steam or hot water) from a single fuel source.
Cooling Tower Drift - The dispersion and deposition of wet or dry aerosols emitted from natural or mechanical draft cooling towers.
Coproducts - A secondary product that is produced, usually in an industrial process, in addition to the primary product.

Cumulative Impact - The impact on the environment that results from an action when added to other past, present, and reasonably foreseeable future action. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Cryogenic - The branch of physics that deals with very low temperatures especially those at, near, or below zero.

Deciduous - Shedding leaves at a certain season.

Diploid - Having two sets of chromosomes; the 2*n* (diploid) chromosome number is characteristic of the sporophyte generation.

Dolomite - A carbonate mineral, CaMg $(CO_3)_2$, or the chemical sedimentary rock made predominantly of that mineral.

Effluent - Waste water, treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall; generally refers to wastes discharged into surface waters.

Electomagnetic Fields (EMF) - Two types of energy fields which are emitted from any device that generates, transmits, or uses electricity.

Electrostatic Precipitators - Devices used to remove particles from flue gas whereby electrically charged particles migrate and adhere to a grounded surface.

Embayment - A body of water forming a bay.

Emission - A material discharged into the atmosphere from a source operation or activity.

Endangered Species - Any species in danger of extinction throughout all or a significant portion of its range or territory.

Exothermic - A chemical change that is accompanied by a liberation of heat.

Fly Ash - The small ash particles that are carried out of a combustor with the flue gas.

Flue gas - Gaseous combustion products from a furnace or boiler.

Fluidized-bed Combustion - A method of burning fuel in which the fuel is continually fed into a bed of reactive or inert particles supported by upflowing air which causes the bed to behave like a turbulent fluid.

Furfural - A liquid heterocyclic aldehyde, derive from bran, corncobs, etc.; used chiefly in the manufacture of plastics and as a solvent in the refining of lubricating oils.

Gasifier - A collection of equipment that produces a fuel gas from a fossil fuel. This gas is suitable for use as a fuel in a combustion turbine or as a feedstock for a chemical processing plant.

Global Warming - The theory that certain gases such as carbon dioxide, methane, and chlorofluorocarbon in the earth's atmosphere effectively restrict radiation cooling, thus elevating the earth's ambient temperatures.

Gypsum - Calcium sulfate; material produced from the removal of sulfur dioxide from flue gas using a limestone-based scrubbing solution.

Habitat - The environment occupied by individuals of a particular species, population, or community.

HAP - Hazardous air pollutants

Hazardous Waste - A by-product of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appears on special Environmental Protection Agency lists.

HRSG - *Heat Recovery Steam Generator* - Captures the heat from the exhaust of a combustion turbine generator for additional electrical power generation.

Heavy Metals - Natural elements such as lead, mercury, cadmium, and nickel.

IGCC - *Integrated Gasification Combined Cycle* - Gas is produced when coal is burned and expanded through a gas turbine, with the exhaust gas heat used to generate steam for a steam turbine generator.

Karst (Topography) - The relief of an area underlaid by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Lacustrine - Living or growing in lakes; of or related to lakes.

Lignites - An imperfectly formed coal, usually dark brown and often having woody texture.

Liquefaction - Liquid-like behavior of a solid material.

Macrophyte - A member of the macroscopic plant life, especially of a body of water.

Megawatts (MW) - The amount of power equal to 1,000 kW or 1,000,000 watts.

Methane (CH_4) - A greenhouse gas that is colorless, nonpoisonous, and flammable and is naturally created by anaerobic decomposition of organic compounds.

NAAQS - National Ambient Air Quality Standards.

NAPAP - National Acid Precipitation Assessment Program **-** A 10-year scientific study conducted by the federal government from 1980 to 1990 to determine the effects of, and sources contributing to, acid deposition.
National Ambient Air Quality Standards - Uniform, national air quality standards established by the Environmental Protection Agency that restrict ambient levels of certain pollutants to protect public health (primary standards) or public welfare (secondary standards). Standards have been set for ozone, carbon monoxide, particulates, sulfur dioxide, nitrogen, nitrogen dioxide, and lead.
NGCC - Natural Gas Combined Cycle
N_2 - Nitrogen
Nitrogen (N_2) - Colorless, odorless gaseous element that constitutes about four fifths of the volume of the atmosphere.
Nitrogen saturation - An excess supply of ecosystem nitrogen that cannot be used by biota. This excess nitrogen is then leached into surface waters and exported from the watershed. This condition can be caused by nitrate and ammonium in deposition, and by changes in nutrient cycling due to forest maturation and insect infestation.
Nonattainment - An area which does not meet air quality standards set by the Clean Air Act for specified localities and time periods. Locations where pollutant concentrations are greater than the NAAQS.
Olefin - Any member of the alkene series.
Optimization - Obtaining maximum efficiency.
Ordovician Age - Pertaining to a period of the Paleozoic era occurring 440 to 500 million years ago.
PFBC - Pressurized Fluidized Bed Combustion
PM2.5 - Particulate matter comprised of particles whose diameters are smaller than equal to 2.5 micrometers in diameter.
PM10 - Particulate matter comprised of particles whose diameters are smaller than equal to 10 micrometers in diameter.
Palustrine - Living or thriving in a marshy environment.
Particulate Matter - *PM* - Fine solid particles that remain individually dispersed.
Permutation - Changing the order of elements arranged in a particular order.
Plume - A flowing, often somewhat conical, trail of emissions from a continuous point source.
Pooled (lentic) - Pertaining to or living in still water.
Pozzolana - A siliceous volcanic ash used to produce hydraulic cement.
Prevention of Significant Deterioration - An Environmental Protection Agency program in which state or federal permits are required that are intended to restrict emissions for new or modified sources in places where air quality is already better than required to meet primary and secondary ambient air quality standards.
Prime Farmland - The best suited land for producing food, feed, forage, fiber, and oil seed crops and also available for other uses (the could be cropland, pasture land, range land, forest land, or other land, but not urban built-up land or water).
Pyrolyzer - Instrument by which organic compounds are subjected to very high temps.
Radionuclides - Radioactive particles.
Regolith - the layer of disintegrated and decomposed rock fragments, including soil, just above the solid rock of the earth's crust.
Riparian - Pertaining to, situated, or dwelling on the bank of a river or other body of water.
Scrubber - A device that removes noxious gases from flue gases (such as sulfur dioxide) by using absorbents suspended in liquid solution.
Scrubber Sludge - The effluent from a scrubber used to remove SO_2 from flue gases, as calcium sulfate.
SO_2 - Sulfur dioxide**.**
Sorbent -A substance that takes up and holds, adsorbs, or absorbs.
Syngas - Synthetic fuel gas, also called synthesis gas, produced by the gasification of a fossil fuel.
Threatened Species - Any species that is likely to become an endangered species within the foreseeable future.
TSP - Total suspended particulate matter.
Turbine - A machine for directly converting the kinetic energy and/or thermal energy of a flowing fluid (air, hot gas, steam, or water) into useful rotational energy.
Vadose Zone - An unsaturated zone below the ground surface, in which pores are filled partly with water, partly with air.

Vascular - Pertains to any plant tissue or region consisting of or giving rise to conducting tissue; e.g., xylem, phloem, vascular cambium.

Veliger Larvae - Free swimming larval stage unique to mollusks.

Visibility Impairment or Degradation - Aesthetic damage where the ability to discern form, color, or texture is reduced and therefore the scenic value is diminished.

Volatile Organic Compounds (VOCs) - Any organic compound that participates in atmospheric photochemical reactions, except for those designated by the Environmental Protection Agency administrator as having negligible photochemical reactivity.

Wetlands - An area where the soil experiences anaerobic conditions because of the inundation of water during a portion of any given year. Indicators of wetland include types of plants, solid characteristics, and hydrology of the area.

Zebra Mussel - An imported mussel which interferes with, among other things, water intake structures.

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APPENDICES P AND Q

Tennessee Valley Authority
October 1997

Appendix P ¾ Individuals And Agencies Providing Comments

Individuals and agencies providing written comments are listed below:

Allan Stewart
Managing Director - Global Electric Power Group
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Anonymous Comment
Via Richard Hoesly
Bellefonte - Nuclear Operations

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Individuals providing comments at the public meeting are listed below:

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Also attending the public meeting were:

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Mitchell Carter
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Appendix Q ¾ Responses To Public Comment

(Index included on last page.)

Index

Note: All pages are in Appendix Q

Comment ID: 11

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: Executive Summary

Comments: *Editorially, we note that the Executive Summary indicates that up to 3,000 MW (pg. 5) could be generated through plant conversion. However, Table 2 shows a maximum peaking capacity of only 2,895 MW (Combination option). The FEIS should clarify.*

Response: The FEIS has been revised to clarify this issue.

Comment ID: 22

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: Executive Summary

Comments: *Editorially, it is noted that page 4-94 of the text appears to be inconsistent with page 32 of the Executive Summary since the former indicates 12 acres of wetland losses and the latter lists 20 acres. The FEIS should clarify.*

Response: On page 4-94 of the DEIS, the barge handling facility would impact 4.9 hectares (ha) (12 acres) of wetlands. Construction of docking facilities and dredging for barge access would eliminate 1.7 ha (four acres) of forested wetland islands and 3.2 ha (8 acres) of rooted aquatic bed wetlands. A total of 24 acres of wetlands would be affected. The FEIS Executive Summary will be revised to state 24 acres.

Comment ID: 94

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: Executive Summary

Comments: *Now then, if TVA, which they again, it's ironic, did not really spend as much time looking at the potential natural gas options. Of all the options that are even mentioned in this thing in the draft EIS, the natural gas options seemed to be the ones that have, if anything, the most potential.*

Response: TVA has selected NGCC as the preferred conversion option.

Comment ID: 10

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 1.1

Comments: *...projected need for "...16,600 MW of new capacity between 1998 and 2020." The FEIS should further discuss this project need. In the absence of a Public Service Commission in Alabama, how are these capacity projections reviewed and verified? We also note that one of the alternatives (IGCC/C) would only generate 450 MW as opposed to 2,400 MW to 2,895 MW for the others and the 2,424 MW design capacity for the nuclear facility. It is unclear as to how such an alternative would satisfy a projected need of 16,600 MW by 2020? Conversion to such a low capacity would seem counterproductive.*

Response: TVA projections of power needs are not reviewed or approved by a public utilities commission as is done for other utilities. However, the development of Energy Vision 2020, TVA's Integrated Resource Plan which addressed load forecasting and the need for power in future years, provided for diverse and frequent opportunities for review and input from the public and private sectors. This scrutiny, while dissimilar to the regulatory controls embodied in a PUC type review, provides for a highly effective type of overview and oversight needed for future power system planning.

Load forecasting is driven by four key variables that influence electricity use:

(1) regional economic growth, (2) the price of electricity, (3) the price of alternative energy sources, and (4) TVA's competitive success. These drivers are discussed in detail in Energy Vision 2020 and are the basis of TVA's projections that 16,500 MW (medium forecast) would be needed by 2020. Energy Vision 2020 presented flexible short-term and long-term plans for meeting future power needs. Both plans involve a diverse mix of technologies and strategies, both supply-side and demand-side, but are firmly founded on the need for wise investment of resources and capital. The reader is referred to Energy Vision 2020, from which this EIS tiers, for more detailed information about load forecasting and the future need for power.

In addition to plans to convert Bellefonte, other supply-side actions included in the short-term action plan are (1) purchase call options - up to 3000 MW, (2) hydro modernization projects - 150 MW, (3) use of renewables - no estimate of MW, and (4) planning for future consideration of advanced turbine systems and energy storage technologies.

The IGCC/C option would not fully convert the existing facilities at Bellefonte to electricity production. The purposes of converting Bellefonte are to make use of assets already constructed at the site, and to deliver power to its customers at the lowest cost commensurate with other corporate goals and obligations. As noted above, Energy Vision 2020 identified a mix of options for expanding capacity to a production level of 16,500 MW by 2020. Energy Vision 2020 commited to further evaluation and planning of each alternative to ensure they were economically attractive and involved low risk to TVA and its customers before implementation.

The IGCC/C option, because of the associated revenue stream provided by the marketing of chemicals produced from synthesis gas as well as natural gas, appears to offer high potential for delivering electricity at a price much lower than conventional fossil fuel powered systems. The IGCC/C option also meets the test of flexibility in its ability to adapt to uncertain load growth, future market conditions, and changes in environmental regulations. While this option does not fully utilize all of the current assets at Bellefonte, it does not preclude the future consideration of additional power production at the site (not under consideration at this time).

Comment ID: 73

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.1

Comments: *I am extremely confused about how TVA can segment the conversion of this plant relative to finishing it as a nuclear power plant.*

Response: The environmental impacts of constructing and operating Bellefonte as a nuclear plant were evaluated and documented in an Environmental Impact Statement issued prior to beginning construction in 1974. The Nuclear Regulatory Commission issued its own EIS in 1974 and issued Environmental Assessments for contruction license extensions in 1987 and 1994. Due to the passage of time, TVA in 1993 conducted a staff review of the currency of the information contained in its 1974 EIS and found that the information remained accurate and that conclusions had not changed.

TVA chose not to readdress the construction and operation of Bellefonte as a nuclear plant in the fossil conversion EIS because (1) no environmental issues are outstanding for this implementation pathway, (2) the complete and recent array of NEPA review documentation produced by TVA and NRC continues to remain valid relative to the impacts of the nuclear plant, and (3) the purpose of this EIS is to assess the impacts of alternatives for conversion of the nuclear plant to a fossil plant.

Comment ID: 74

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.1

Comments: *But it's (the Nuclear Option) still considered a viable option for this plant?*

Response: In 1994, the TVA Board announced that Bellefonte would not be completed as a nuclear plant without a partner. Thus, completion of Bellefonte as a nuclear plant is a viable option if partners are available to share the cost of completion.

Comment ID: 80

Name: Frank Holms

Affiliation:

DEIS Section: 1.1

Comments: *TVA was already blowing smoke back then to people about why Bellefonte number one didn't go on line in 1983. If we had worked on it from '81 to '83 like we did from '78 to '81, they couldn't have kept us from putting unit one on line.*

Response: Construction activities at Bellefonte were slowed and eventually deferred in 1988 because TVA projected it would not in the foreseeable future need the electricity that would be produced by the two 1200 MW units at this plant. Construction of several other TVA nuclear units was further along at the time the decision to slow construction was made, thereby making Bellefonte the likely choice. Construction at Phipps Bend, Yellow Creek, Hartsville was cancelled before the decision to defer construction at Bellefonte was reached. Energy Vision 2020, issued in December 1995, stated that Bellefonte would not be completed as a nuclear plant without partners.

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Comment ID: 81

Name: Frank Holms

Affiliation:

DEIS Section: 1.1

Comments: *I want to ask any representative of TVA here that knows to answer this question for the people that are here. Of that four-and-a-half billion dollars, how much of it was spent out there on the site and on the engineering in Knoxville that went into the site and how much of it has been spent on interest?*

Response: For the Power Program, TVA follows the practice of capitalizing an allowance for funds used during construction, excluding generating units in a deferred status. TVA ceased capitalizing interest on Bellefonte effective July 1988. At that time, approximately $1.7 billion interest had been capitalized for Bellefonte.

Comment ID: 82

Name: Frank Holms

Affiliation:

DEIS Section: 1.1

Comments: *Of the four-and-a-half billion dollars, the 8 million people that TVA is here to serve have got invested or going to have to pay for the interest on that maybe for the next 50 years, how much interest has been paid on the loans that went into building Bellefonte to date?*

Response: TVA borrows money for its Power Program as a whole and does not match capital borrowings to specific projects. Over the past 25 years, TVA's average interest rate has ranged from a low in 1972 of 5.9% to a high of 10.4% in 1982. Over the past decade, TVA's average interest rate has declined from 10% to about 7.5%. TVA continues to aggressively manage its debt portfolio to reduce interest expense and passes those savings on to its customers. Also, TVA plans to reduce its debt by 50% over the next 10 years.

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Comment ID: 83

Name: Frank Holms

Affiliation:

DEIS Section: 1.1

Comments: *How much of that money ($4.6 Billion) has been spent on studies? I know for a fact that in 1992 the Board authorized a half a billion dollars for a study on Bellefonte after they had run all the people off that knew anything about it.*

Response: After nuclear plant construction activities at Bellefonte were terminated in 1988, TVA conducted several studies to determine the feasibility and practicality of conversion to fossil fuel. However, the cost of those studies is not included in the 4.5 billion dollars. The total cost of these previous studies, all conducted by independent contractors prior to the issuance of Energy Vision 2020 (TVA's integrated resource plan) in December 1995, was less than $5 million. Three studies were conducted, focusing primarily on repowering costs and plans, implementation schedules, cash flows and expected operation and maintenance costs. All three studies were based on the assumption that existing Bellefonte equipment would be utilized to the maximum extent economically practical.

The first study report, conducted in 1989 and 1990, addressed conversion to pulverized coal or natural gas fired combined cycle power plants. The second study report, issued in 1994, updated information in the first report and included conversion scenarios for integrated gasification combined cycle (IGCC) and (in lesser detail, because of technical incompatibility) atmospheric fluidized bed combustion. The third study report, issued in late 1994, addressed the cost benefit and technology aspects of producing chemicals, in addition to electricity, for the IGCC conversion option.

In response to public comments received on Energy Vision 2020, the Board authorized an independent engineering assessment to verify the results of the 1994 study of conversion options for Bellefonte. This study is nearing completion with a total expenditure to date of less than $1 million. The information from this study has been used in the Environmental Impact Statement for the Bellefonte Conversion Project. The report will show that capital cost and market changes during the last few years have improved the viability of natural gas options.

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Comment ID: 103

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.1

Comments: *Craven Crowell is thinking about selling stock to finish Bellefonte. Somebody needs to explain to me from TVA how in the world Craven Crowell can unilaterally say that he is going to start his own corporation, sell stock and complete Bellefonte.*

Response: TVA has no specific plans to sell stock for the completion of BLN. The way TVA finances, partner, and signs agreements in the future will certainly be quite different from the way TVA has built and sold power facilities in the past.

Comment ID: 108

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.1

Comments: *…it is my opinion and our organization's opinion that TVA needs to take no action on this alternative until some of the issues relative to deregulation have been fleshed out…*

Response: TVA recognizes that deregulation will have a profound effect on the electric utility industry nationwide. However, in order to remain competitive and meet projected power needs, TVA must continue to operate as a business and determine where opportunities exist. Delaying decisions to wait on more information on deregulation could jeopardize timely completion of construction programs needed to meet projected power capacity needs.

Comment ID: 110

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.1

Comments: *And the last thing that I do want to comment on is again my belief that it should be TVA's role--and I believe this is part of TVA's charter, unbeknownst to some comments that have been made by TVA employees recently--that they do have a commitment to protecting the environment; that they do have a commitment to promoting such environmentally benign technology as renewable technology as fuel cells.*

Response: Renewable fuels were considered in Chapter 2 of the DEIS. This technology is not currently commercially or economically viable at the scale needed to meet load capabilities identified for the conversion of Bellefonte.

Comment ID: 132

Name: Stephen Smith and Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.1

Comments: *Nuclear Options*

It is misleading that TVA has not been more up front about the negotiations with the Department of Energy (DOE) on the nuclear options for Bellefonte. Apparently these include using MOX (mixed-oxide) fuels and having the reactor generate weapons grade tritium. If these proposals are still on the table, TVA needs to be open about them and include them in any future EIS. TVA's attempt to thwart analyzing this option is based on the so-called fact that an earlier EIS was completed for this option; however, when that EIS was completed TVA was not in discussion with the DOE on partnering and completing this plant to burn mixed-oxide fuel nor the production of weapons grade tritium. There are several issues that need to be discussed regarding this proposal such as how can TVA segment this project under NEPA guidelines, and Why TVA has not indicated to this community that it may become one of the first commercial reactors in the country to burn MOx fuel and produce tritium.

Response: TVA is not considering the use of mixed-oxide fuels in this EIS. The purpose of this FEIS is to evaluate environmental impacts associated with conversion to fossil fuels. TVA is considering nuclear options with partners. If a nuclear option is chosen, the appropriate level of environmental review will be conducted as necessary in support of the 1974 Bellefonte Nuclear Plant EIS and other reviews completed to support renewal of construction licenses.

Comment ID: 12

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 1.2

Comments: *In the event that the nuclear option is selected, a review of the original 1974 EIS on the Bellefonte Nuclear Plant would be needed to determine if significant changes have occurred at Bellefonte. If so, the original EIS would be considered "stale" by CEQ and would likely need upgrading in the form of a Supplemental EIS.*

Response: TVA will perform the appropriate level of NEPA review before a decision to pursue a nuclear option is made. This review would involve a determination of the continuing validity of the 1974 EIS for the BLN plant.

Comment ID: 104

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.2

Comments: ** TVA has a memorandum of understanding between the Department of Energy and the Tennessee Valley Authority on looking at MOX fuel options at Bellefonte.*

** Is somebody from TVA going to address the fact there is a memorandum of understanding between the Department of Energy and TVA on looking at* *plutonium production as well as potentially exploring Bellefonte as an option for tritium production.*

** You have a memorandum of understanding between the Department of Energy and TVA, you are engaged in discussions with looking at finishing Bellefonte as a nuclear option, possibly using plutonium fuel, and generating nuclear weapons.*

Response: There are no plans to produce nuclear weapons at Bellefonte. TVA has no agreement or memorandum of understanding with the Department of Energy with regard to the use of mixed oxide fuel at Bellefonte. TVA has no memorandum of understanding with DOE regarding the production of tritium at Bellefonte.

In December 1995, TVA submitted a letter to DOE expressing interest in DOE's tritium production and mixed oxide fuel disposition programs. This letter merely indicated TVA's willingness to evaluate its options in the best interest of ratepayers, but did not constitute a TVA commitment or agreement.

In September 1997, TVA has responded to a Request for Proposals issued June 4, 1997, by the Department of Energy for the acquisition of services to support tritium production. Tritium, a strategic material needed for national defense purposes, would be obtained by irradiating specially designed (and DOE supplied) absorber rods in a commercial light water reactor, followed by tritium extraction at DOE's Savannah River facility. Providing irradiation services to DOE would involve loading and removing absorber assemblies along with fresh and spent nuclear fuel in a normal power production cycle. The superimposition of this program on normal operations would likely involve no significant differences in operation. Tritium is produced as a by-product and monitored during normal power production activities at any nuclear plant.

Should TVA be selected as a provider, DOE would prepare and circulate an EIS before the program was put into effect. TVA would provide irradiation services only if TVA decides it is in the best interest of its customers and after obtaining TVA Board approval. NRC would have to approve an operating license for the operation of Bellefonte.

Tritium and nuclear power production at Bellefonte is outside the scope of the actions addressed in this fossil conversion EIS and consequently, the environmental impacts of these activities are not addressed in this EIS.

Comment ID: 45

Name: Gary Canaday

Affiliation:

DEIS Section: 1.3

Comments:

Nuclear Option -- Back in 1987 Unit 1 was supposed to be 89 percent complete and we were told that it could be on-line within one year if given the go ahead to complete the project. I think it would be totally irresponsible to not complete Unit 1 as a nuclear plant. I can see very few pieces of equipment that would be compatible with a fossil fuel plant. I am not even sure that a fossil fuel plant would be capable of supplying the necessary steam pressures to drive the steam turbine.

My understanding is that TVA just does not need the power. Unit 1 alone would be capable of delivering 1250 MW of power ...Unit 1 should be completed as designed.

By staying with a nuclear plant, the environmental impact is greatly reduced. There are no sulfur emissions, acid rain, ash, or radioactivity that is inherently in coal, being released to the atmosphere.

I would hope that one of the options is completing only Unit 1. I truly believe that the plant should remain nuclear.

Response:

For all fossil conversion options, a significant number of existing Bellefonte assets could be used to reduce the cost of constructing a fossil plant. These items include the steam turbines and condenser systems, natural draft cooling towers, many station auxiliaries such as compressed air and service water, switchyard and transmission systems, and many service and office buildings. These systems and equipment items are significant cost items for a new plant, and their use will offset construction costs. The steam produced from the combustion of fossil fuel will include high pressure steam, which will require additional turbine capacity in order to remove energy prior to using the existing steam turbines.

Both types of plants can be and are operated safely and within applicable regulations for protecting environmental quality.

Conversion of facilities to a fossil plant would introduce new types of sources and new areas of the site would be affected. These construction-related impacts are described in Chapter 4 of the EIS and would be greater than if Bellefonte were completed as a nuclear plant.

Comment ID: 46

Name: J. C. Clemons

Affiliation:

DEIS Section: 1.3

Comments: *Nuclear -- I would like to urge TVA to complete Bellefonte and start producing power which will be needed to replace the old part of Widows Creek which is now very old. Our County and this part of the state need the jobs. I would like to see it completed whether by using coal, natural gas, or Nuclear. I understand that Unit one is about 90% complete so why not complete it as Nuclear.*

This plant should be completed even if it required more bonds to be issued.

If this plant is not put to use to produce electricity, it will forever be a monument to the stupidity of a few TVA people in top management.

Response: Construction activities at Bellefonte were slowed and eventually deferred in 1988 because TVA projected it would not in the foreseeable future need the electricity that would be produced by the two 1200 MW units at this plant. Construction of several other TVA nuclear units was further along at the time the decision to slow construction was made, thereby making Bellefonte the likely choice. Construction at Phipps Bend, Yellow Creek, Hartsville was cancelled before the decision to defer construction at Bellefonte was reached. Energy Vision 2020, issued in December 1995, stated that Bellefonte would not be completed as a nuclear plant without partners.

Comment ID: 60

Name: Lynn Leach

Affiliation:

DEIS Section: 1.3

Comments: *Who is to say that we won't buy from the state of Iowa or California and how can TVA keep their rates artificially low anymore?*

Response: The deregulation of the utility industry will expand the options now available to industrial and residential electricity users nationwide. However, TVA expects users in the TVA service region and elsewhere to consider TVA's high dependability and level of services, as well as price in selecting an electricity provider. However, there are practical transmission limits imposed on the wheeling of electricity caused by resistance in the line itself, thereby making the purchase of power from producers located in California or other distant places unattractive. After 10 years of stable rates, TVA will increase its rates to achieve a 5.5 percent increase in revenues for use in debt reduction beginning in fiscal year 1998.

Comment ID: 144

Name: James H. Lee

Affiliation: United States Department of the Interior

DEIS Section: 1.3

Comments: *In February 1992, the Department of the Interior (DOI) published in the Federal Register a Preliminary Notice of Adverse Impact on Great Smoky Mountains National Park Under Section 165 (d)(2)(C)(ii) of the Clean Air Act (57FR4465ff., February 5, 1992). The National Park Service had determined through monitoring and research that the air pollution-sensitive resources (air quality related values - AQRVs) at the park, a mandatory Class I area, were being adversely impacted by air pollution from existing sources. Specifically, the impacts were the acid deposition of nitrates, visibility reduction in the form of uniform haze, and vegetation damage (chlorosis and necrosis of pine needles and leaf mottling of deciduous trees and other plants). The Federal Register notice requested the states surrounding the park to not approve any air quality permit applications for new or modified sources until they took appropriate action to reduce, minimize, or eliminate air pollution from existing sources, since such additional permit approval would only exacerbate the problem.*

One result of the notice has been the establishment of the Southern

Appalachian Mountains Initiative (SAMI), whose members include the NPS, TVA, the Forest Service, the Environmental Protection Agency, states, industry, and citizen representatives. SAMI's objectives include assessing the air pollution in the region, its sources, its movement, and its impacts on the Class I national parks and wilderness areas in the region.

A major goal of the organization is to minimize air pollution impacts on the Class I areas. To achieve this goal, one short-term objective agreed to by the participants is to consider energy conservation as a viable alternative to the construction of new power plants in the region. This goal seems to be counter to the objectives of the TVA Energy Vision 2020, which, among other things, identifies the need for 16,600 MW of new generating capacity by 2020 (converting the Bellefonte power plant would add 3,000 MW of new capacity to that goal). The DEIS does not identify energy conservation as an alternative to converting the Bellefonte power plant to a fossil fuel-fired generating station. Was this an oversight, or merely not considered? [In polluted California, for example, the major power companies studied various alternatives, including adding generating capacity and energy conservation, to accommodate the projected future population growth. In essence, they all adopted energy conservation as the preferred alternative, and have not added any significant new generating stations in this decade, even though the population has increased to over 30 million.]

The NPS suggests that the DEIS be revised to add an energy conservation alternative to its list. In addition, appropriate studies should be conducted to determine it's viability as an alternative approach which would result in no increased emissions of air pollutants in an area where there are already adverse impacts from existing sources.

Response: This EIS relies on and tiers from information contained in Energy Vision 2020, which provides a programmatic umbrella.

Four customer service option "blocks" combining various energy efficiency and load management activities were developed, based on resource cost, impact on rates, the opportunity for all customers to participate, the preservation of long-term customer relationships, and other evaluation criteria.

The DEIS did not identify energy conservation as a conversion alternative since this approach would not meet both of the stated needs for converting the plant's facilities to allow the combustion of fossil fuel, which are to meet future power demands and to utilize existing Bellefonte assets. It would be inappropriate to consider an energy conservation option in this EIS that did not meet both needs for action.

Comment ID:	49
Name:	Randy Eminger and John Paul
Affiliation:	The Center for Energy & Economic Development
DEIS Section:	1.4
Comments:	*TVA should select the resource alternative which provides the lowest cost power over the life of the plant which factors in fuel availability and price. ....no environmental reasons to eliminate any of the selected five resource alternatives. In fact, since the proposed plant would displace older less efficient generation and be subject to tighter new source limitations, overall environmental emissions would be reduced and the Bellefonte conversion project should provide a net environmental benefit.*
Response:	Comment noted.

Comment ID:	59
Name:	Lynn Leach
Affiliation:	
DEIS Section:	1.4
Comments:	*How many years will it take for TVA to make a profit on this plant?*
Response:	TVA has voluntarily capped its borrowing limit and is implementing a 10-year plan to cut its debt in half. The plan includes a 5.5-percent increase in revenues beginning in fiscal year 1998. TVA recognizes the need to reduce its debt to ensure a firm competitive posture for the coming deregulation of the electricity production industry. Funds for new construction will come from partnerships and alliances which provide investment capital for new business ventures. It is not anticipated that new borrowing would be needed, although that cannot be ruled out. All businesses must divert a portion of its income to fund capital improvements. Without this reinvestment in the future, no business would be self-sustaining.

A decision to proceed with a capital expenditure is based on the degree of risk associated with a project and its expected return on investment. The cost effectiveness of a conversion option would be measured (along with other more complex methods) by commonly accepted investment metrics which incorporate the time value of money, such as Net Present Value (the present value of future cash flows from a project minus the cost of equipment) and Internal Rate of Return (provides information about the "payback" time based on the equipment's useful life).

Preliminary engineering studies are being conducted concurrently with the development of this EIS. The results of those studies are not yet final, but a preliminary ranking of conversion options has been included in the FEIS as Section 2.2.7.

TVA intends to remain a competitive low-cost producer of electricity. TVA decisions on power supply options will be consistent with this goal.

Comment ID: 61

Name: Cliff Griggs

Affiliation:

DEIS Section: 1.4

Comments: *They are 27.7 billion in debt. Where are you going to get the money to build this?*

Response: TVA has voluntarily capped its borrowing limit and is implementing a 10-year plan to cut its debt in half. The plan includes a 5.5-percent increase in revenues beginning in fiscal year 1998. TVA recognizes the need to reduce its debt to ensure a firm competitive posture for the coming deregulation of the electricity production industry. Funds for new construction will come from partnerships and alliances which provide investment capital for new business ventures. It is not anticipated that new borrowing would be needed, although that cannot be ruled out.

Comment ID: 63

Name: Cliff Griggs

Affiliation:

DEIS Section: 1.4

Comments: *I notice also in here that TVA has just bought some 90 million dollars worth of pollution credits.*

Response: At the 1997 EPA Allowance Auction, TVA purchased 87,000 emission allowances for $9.7 million as an investment and to replenish our emission allowance "Bank." The purchase was a prudent business practice since the price of allowances is rising and expected to continue to increase. TVA plans to continue to participate in the emission allowance market (buying and selling) as business conditions and deregulation dictate. Since 1992, TVA has purchased 122,000 allowances, but have not used them to offset TVA emissions. We have sold or contracted to sell 125,000 allowances through 1999. TVA currently complies and will continue to comply with the Clean Air Act Amendment of 1990.

Comment ID: 64

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *The draft environmental impact statement does not adequately address the following issues: First, the need for the project.*

Response: The need for the project was adequately addressed in Section 1.4. The primary drivers are the need to meet power requirements while effectively utilizing the Bellefonte assets.

Comment ID: 65

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *TVA in their outlining the need for power completely failed to mention this lignite plant that TVA now has contracted with over in Mississippi for approximately 440 megawatts.*

Response: Section 1.4.1 of the FEIS has been revised to reflect the agreement regarding the purchase of power from the Mississippi facility.

Comment ID: 66

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *TVA must do a better job in this environmental statement to justify the need and to explore the options which would include conservation efficiency and demand-side management.*

Response: Energy Vision 2020 evaluated and developed a portfolio of supply-side and demand-side energy resource options. Bellefonte conversion is one alternative for a supply-side option. The use of demand-side options to meet energy needs is still planned.

For further information, the reader is referred to Tennessee Valley Authority, Energy Vision 2020, Integrated Resource Plan Environmental Impact Statement, Volumes 1 and 2, TVA, December 21, 1995.

Comment ID: 68

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *TVA is looking at building a base-load facility here at the Bellefonte facility without adequately looking at a way to shave the peak.*

Response: Energy Vision 2020 identified the need for additional power, including baseload, which was based on an analysis of the ability of TVA's existing power facilities to meet the projected electricity needs of its customers in the future.

Energy Vision 2020 also considered the actions that end-use customers can take on their side of the electric meter to obtain energy efficiencies and improve their productivity and quality of life. TVA considered over 60 customer service options, which included traditional demand-side management (i.e., energy efficiency and load management), self-generation, beneficial electrification, and rate options. TVA has included the existing and emerging technology and electric rate options into a variety of program packages to meet the changing needs of its customers and the TVA power system.

For further information, the reader is referred to Tennessee Valley Authority, Energy Vision 2020, Integrated Resource Plan Environmental Impact Statement, Volumes 1 and 2, TVA, December 21, 1995.

Comment ID: 70

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *TVA has not--in my opinion and in our group's opinions--adequately looked at the possibility for clean, cost-effective renewable resources as they had agreed to in the Integrated Resource Plan.*

Response: As presented in Energy Vision 2020, TVA anticipates that renewable energy resources will fulfill a portion of the capacity needs in the 1995 - 2020 period. In fact, as committed to in the short-term action plan, TVA is implementing a hydroelectric modernization program that will add 150 MW of renewable capacity by 2006. Non-renewable supply-side actions such as the BLN conversion are also needed.

Comment ID: 71

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *TVA has failed in the economic analysis of this plant to truly look at what are the underlying economic motivations for this particular facility.*

Response: Adequate information was presented in Energy Vision 2020 to support the initiation of conversion activities at Bellefonte. The scope of this EIS is to focus on environmental impacts, not a cost comparison study. As stated in the DEIS in section 1.2, TVA has embarked on a study of conversion options to identify which options offer the best investment opportunities and least financial risk. The results of that study will become available at about the same time that the FEIS is being finalized. The completion of these two efforts will allow TVA to make an investment decision based on the best and most timely economic, technical, and environmental information. An economic ranking of conversion options based on the Net Present Value concept has been included in Section 2.2.7 of the FEIS.

Comment ID: 72

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *TVA has not adequately done nor did they adequately address in the Integrated Resource Plan is exploring options for how to write this plant down.*

Response: TVA considers the existing Bellefonte plant an asset and will look at alternatives to utilize this asset to meet future power needs. The focus of this EIS is to evaluate environmental impacts associated with conversion to fossil fuel technologies.

Since the "no-action" alternative is not to write the plant down, this analysis is not within the scope of the EIS. See Response to Comment ID 129.

Comment ID: 98

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: ** I also want to express concern here that TVA has purchased 87 thousand tons of pollution credits for sulfur dioxide at a cost of about 9.7 million dollars.*

** The fact that TVA is buying these pollution credits indicates to me that they are looking at possibly finishing this as a fossil plant with high sulfur emissions and they may be trying to skirt the law by using these, banking these credits and using these credits again to the detriment of the regional air quality, human health, and economic tourism.*

Response: At the 1997 EPA Allowance Auction, TVA purchased 87,000 emission allowances for $9.7 million as an investment and to replenish our emission allowance "Bank." The purchase was a prudent business practice since the price of allowances is rising and expected to continue to increase. TVA plans to continue to participate in the emission allowance market (buying and selling) as business conditions and deregulation dictate. Since 1992, TVA has purchased 122,000 allowances, but has not used them to offset TVA emissions. We have sold or contracted to sell 125,000 allowances through 1999. TVA currently complies and will continue to comply with the Clean Air Act Amendments of 1990.

Some of these allowances may be used to offset the SO2 emissions from the different conversion options. Allowances under CAA have to be used in a manner such that the NAAQS are not violated. Thus, the use of these allowances will not be to the detriment of regional air quality, human health, and tourism.

Comment ID: 116

Name: Alan Qualls

Affiliation:

DEIS Section: 1.4

Comments: *We need Bellefonte. We are going to need it pretty soon.*

Response: Comment noted.

Comment ID: 117

Name: Deon Smith

Affiliation:

DEIS Section: 1.4

Comments: *One of the things I did note about was you didn't use high pressure. If you want to convert that thing to burn fossil fuel, you might use the generator but you are going to change all the pipe, you are going to build a boiler, you have to change all the feed wire. It will probably be cheaper to build a new plant next door.*

Response: The use of fossil fuels will result in the generation of higher pressure and temperature steam than is normally produced in a light water pressurized reactor. In preliminary engineering studies, it has been determined that high pressure turbines and topping turbines would be needed to ensure highest efficiency. These systems will be incorporated into the plant design once a conversion option is selected. Much of the existing piping to and from the existing low pressure steam turbines could be used, but insulated high pressure lines from the HP turbines to the LP turbines would obviously be needed.

These items will be included in cost estimates. Making judicious use of existing equipment where economically advantageous will result in a cost lower than the cost of a totally separate plant at the Bellefonte site.

Comment ID: 119

Name: Cliff Griggs

Affiliation:

DEIS Section: 1.4

Comments: *If they are in that need of power, how come we haven't had any brown outs, how come we haven't had any of these contracts where we could cut some of these industries off. If there is a need for it, why haven't we had those things?*

Response: TVA strives to provide its customers with reliable low cost power. "Brown outs" are symptomatic of system availability problems that TVA avoids. TVA has contracts with several industrial customers to allow interruptable power supplies during periods of especially heavy demand. These contracts provide tools for managing system load (i.e., shaving peaks) without affecting service to other customers. Such contracts are advantageous to large industrial users because they offer lower rates during normal operating circumstances.

Comment ID: 120

Name: David Baker

Affiliation:

DEIS Section: 1.4

Comments: *Widows Creek has been brought up several times tonight and something that TVA has got to look at soon is doing away with Widows Creek. It's a very old, decrepit, polluting plant and it's maintenance is just out of hand. And if a new plant could be used to get rid of some of the old obsolete polluting plants, any option would be good.*

Response: Comment noted.

Comment ID: 129

Name: Stephen Smith and Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *No-Action alternative*

The No-Action alternative in the draft EIS does not adequately address the financial implications of not doing anything to the mothballed Bellefonte plant. A period of longer than ten years needs to be explored in regards to writing-off the $4.6 billion of non-power producing asset. The possibility of selling the facility to recoup some of the costs was not discussed.

TVA should not make an investment of this magnitude until some of the larger questions about competition and deregulation of the industry has been answered. Because of this very issue, TVA should not complete this plant at this time.

Response: We agree it is likely that a better decision could be made about the merits of using Bellefonte's assets if the larger questions about competition and deregulation of the utility industry were already answered. However, studying alternative uses of those assets now has value. Moreover, it may not be possible to defer making a decision until those larger questions are answered. TVA's Energy Vision 2020 integrated resource plan addressed the potential need for additional energy resources on the TVA system to meet future power demands. Making use of the Bellefonte assets was one of the recommendations in that plan. Future uncertainties were addressed and accounted for in the development of the Energy Vision 2020 plan.

The first part of this comment incorrectly assumes that the No-Action Alternative is selling the Bellefonte assets or canceling the project and writing down the undepreciated value. The No-Action Alternative is to continue to maintain the plant in deferred status as other options are explored, such as a nuclear partnership. See Response to Comment ID 252.

Comment ID: 133

Name: Stephen Smith and Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments:

Conservation and Efficiency
TVA should invest in conservation, efficiency, and renewables. Until this is accomplished, there is no justification for bringing additional base-load capacity on-line. In fact TVA does a poor job in this document on justifying why it needs additional base-load capacity in the Eastern part of its service territory. There should also be no additional generation acquired until TVA "shaves its peaks." After implementing proper use of Demand Side Management to "shave the peaks," there may be need for natural gas peaking. However, this cannot be determined until cost effective conservation is implemented.

Response:

This EIS relies on and tiers from information contained in Energy Vision 2020, which provides a programmatic umbrella. Energy Vision 2020 identified the need for additional power, which was based on an analysis of the ability of TVA's existing power facilities to meet the projected electricity needs of its customers in the future. TVA created an extensive list of generating options to meet new peaking, intermediate, base-load, and storage power supply needs through the year 2020. These included traditional technologies (i.e., coal plants, combustion turbines), as well as potential renewable and advanced combustion facilities. In addition, TVA identified options that would give TVA greater flexibility in its planning. These included purchasing competitively priced power from other suppliers, buying options on future power delivery, and entering business partnering arrangements. Overall, TVA characterized over 100 supply-side resource options based on their performance, cost, and environmental impacts.

Energy Vision 2020 also considered the actions that end-use customers can take on their side of the electric meter to obtain energy efficiencies and improve their productivity and quality of life. TVA considered over 60 customer service options, which included traditional demand-side management (i.e., energy efficiency and load management), self-generation, beneficial electrification, and rate options. TVA has included the existing and emerging technology and electric rate options into a variety of program packages to meet the changing needs of its customers and the TVA power system.

For further information, the reader is referred to Tennessee Valley Authority, Energy Vision 2020, Integrated Resource Plan Environmental Impact Statement, Volumes 1 and 2, TVA, December 21, 1995.

Comment ID: 251

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *My concern is--and I participated in the Integrated Resource Plan as a member of the review group--is that TVA is yet to justify the need for this power, particularly base-load power.*

Response: Energy Vision 2020 projected a need for additional baseload capacity. TVA has confidence in its load forecasting which is updated periodically.

The flexibility of the portfolio of energy resource options developed in Energy Vision 2020 will allow TVA to respond to changing needs.

Comment ID: 252

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4

Comments: *The need for the project inaccurately addressed costs for the project relative to the no-option alternative about how we could write it down over an extended period of time so it won't impact the rate base in such a profound way needs to be more adequately addressed so that the no-option alternative can be clearly and seriously considered instead of just one or two paragraphs in the proposal.*

Response: TVA’s Energy Vision 2020 environmental impact statement (the IRP EIS) addressed the need or benefits of converting Bellefonte to another generating technology and contrasted potential conversion options to canceling the project entirely and writing down the undepreciated value of the project. IRP EIS Volume 2, Technical Document 8, contains a section on "TVA’s Nuclear Options" that provides detailed information on the issue raised in this comment (T8.65-T8-79). It was determined that short-term rates would be approximately 45.0 mills/kWh if Bellefonte was converted to combined cycle or to integrated gasification combined cycle. In contrast, short-term rates associated with canceling the Bellefonte units would be approximately 45.5 mills/kWh (T8.74 Figure T8.66, T8.75). This information was derived from a report titled, "TVA’s Nuclear Options, A Report on Bellefonte Units 1 and 2, Watts Bar Unit 2, and Browns Ferry Unit 1."

The commentor is correct that writing down Bellefonte over a longer period of time would lessen the potential impact on TVA’s rates. TVA has written down other nuclear assets over an 11-year period and it has considered the possibility of using even longer periods to do this (T8.72). If TVA decided to cancel the project, it would certainly explore all feasible ways of lessening potential impacts on its rates base, including longer write down periods. However, the No-Action alternative is not canceling the project as this comment assumes. Rather, the No-Action alternative is to continue to maintain the plant in deferred status as other options are explored, such as a nuclear partnership.

Comment ID: 115

Name: Alan Qualls

Affiliation:

DEIS Section: 1.4.1

Comments: *We are going to require more power generation. I think the power demands right now is increasing at about 2-1/2 percent approximately per year and it's estimated in about the year 2,002 that the power generation from Bellefonte will be a necessity in order to keep supplying our people with the luxuries that we have today.*

Response: Comment noted.

Comment ID: 84

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 1.4.2

Comments: *Cost estimate development for TVA Integrated Resource Plan completing unit one has nuclear as 1.3 to 3.5 billion dollars; and for unit two, 9 to 2.4 billion dollars. A more recent study conducted by NUS Corporation in 1996 determined a completion cost of two Bellefonte units to be 2.88 billion dollars. Now, my confusion is what that addresses. There is mentioned that those statistics were relative to the nuclear option and it's not very clear to me on how any type of economic analysis is derived for some of the other options that's presented in this document.*

Response: Adequate information was presented in Energy Vision 2020 to support the initiation of conversion activities at Bellefonte. As stated in the DEIS in Section 1.2, TVA has embarked on a study of conversion options to identify which options offer the best investment opportunities and least financial risk. The results of that study will become available at about the same time that the FEIS is being finalized. A preliminary ranking of conversion options has been included in the FEIS as Section 2.2.7. The completion of that study and this EIS will allow TVA to make an investment decision based on the best and most timely economic, technical, and environmental information.

Comment ID: 139

Name: Dolores Howard

Affiliation:

DEIS Section: 1.4.2

Comments: *First: in making a judgement of cost vs. benefit, we must learn to distinguish between cost and true cost; benefit and real benefit, short term benefit and long term cost; and who benefits and who pays the cost! For example, if my company downsizes, and we produce more goods, faster, for less cost, make* *more sales because we can drop the price by a penny or two and still give the shareholders a great dividend, pay the CEO another six figure bonus, you might say that is a benefit, providing you are the shareholders, the CEO or the few who kept their jobs. But how will the ones who lost their jobs see this? And what benefit to the asthma patients, to the local health care system, and the environment if this increase means additional air and water pollution? What if some other area suffers strip mines and loss of their natural areas to supply the ore, coal or raw materials that this plant uses to produce more and more goods. How long will the resource last, is this the best use of a limited resource? What of the workers in the small business that go under because of the cheaper increased production of the now big and growing bigger company? And what happens now that more are dependent on this big company for jobs, if the environmental regulations are fewer or tax breaks are bigger in another area, a few years down the road and they pick up and move? All is connected, and all must be considered when doing a cost/benefit study!*

We all know that we do not need the additional power here in this area, now or in the near future, so the benefit to the area is nil and the cost is very high. All existing environmental, cultural and recreational resources may potentially and in fact will probably be affected and the health of many. The coal mines to supply fuel, the additional barges to an already crowded waterway, the loss of the recreational potential of that area, the air and water pollution. If you want to avoid these impacts, do not complete any kind of power plant at the Bellefonte Site. Period. It is throwing good money after bad! I suppose this is an appropriate time to say "we told you so." The public gave the same dire predictions concerning the economics of the "nukes" and TVA ignored us then and now has this huge debt, mostly as we predicted, from the "nukes"…better listen this time! We have a much clearer vision, not clouded by delusions of giant utility empire building. We are telling you the truth…again!

Response: The TVA Board will consider environmental, economic, technical feasibility information before deciding to proceed or not proceed with the proposed action versus an alternative course of action. Conversion cost information, available for release at this time, has been included in Section 2.2.7 of the Final EIS.

The environmental review results contained in the EIS were developed using standards and impact thresholds designed to protect sensitive human and environmental receptors such as asthma sufferers. The EIS concludes that any of the five conversion alternatives could be constructed at Bellefonte with modifications in control technology or fuel quality so as to meet all state and federal regulations governing the quality of the environment. The process of acquiring permits to construct and operate a fossil plant at this location is comprehensive and provides several opportunities for public review and input.

The construction of a power plant, either nuclear or fossil, would be permanent. Regulatory or economic incentives at other locations would not result in relocating these facilities. As noted in Section 4.2.12, Socioeconomics, any of the five conversion options create substantial new job opportunities for Jackson County residents during construction and operation.

Comment ID: 142

Name: Dolores Howard

Affiliation:

DEIS Section: 1.4.2

Comments: *Now the final and very hard to solve problem: What to do with a $4.6 billion dollar, yet worthless, old, incomplete power plant?*

First, and foremost, spend as little money as possible on this white elephant. I can recall how I cringed year after year as TVA handed out multi-million dollar maintenance contracts, feasability studies as well as bonuses to themselves for such wise? decision making. If we have learned nothing else, we should know that the sooner you cut your losses from bad decisions, the better!

Response: The existing equipment at Bellefonte is a substantial asset for TVA, which can be utilized thus reducing costs of a new facility. The overall strategy is to utilize as much of the existing equipment and infrastructure as practicable and to reduce liabilities.

Comment ID: 149

Name: James H. Lee

Affiliation: United States Department of the Interior

DEIS Section: 2.0

Comments: *In order to protect the resources of the park, the monument, and three refuges, the NPS can only support the "no action" alternative or the Natural Gas Combined Cycle alternative with greater than 1- to-1 NOx offsets, resulting in a net air quality benefit.*

Response: Comment noted.

Comment ID: 58

Name: Lynn Leach

Affiliation:

DEIS Section: 2.1

Comments: *I would like to see a no-option on the Bellefonte plant.*

Response: A No-Action alternative was described in Chapter 2. Conversion options were evaluated relative to the No-Action alternative.

Comment ID: 18

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.2

Comments: *EPA Alternative Preference - As suggested above, EPA definitely prefers the NGCC option of the action options presented. The IGCC is the preferred coal option, but in light of the NGCC, would not be favored by EPA.*

Response: TVA has selected Option 2; NGCC as the preferred conversion option for the FEIS. The FEIS has been modified to reflect this.

Comment ID: 138

Name: George G. Martin

Affiliation: U.S. Department of Agriculture

DEIS Section: 2.2

Comments: *Comment on Alternative Development*
Given the magnitude of the potential emissions from the proposed project, we were surprised not to find at least one alternative that utilized a "very clean" level of technology. All of the options seemed to have high emission rates, particularly for NOx. For NOx emissions, the cleanest option was NG (combined cycle natural gas combustion turbine with heat recovery). This alternative calls for nine 245 MW units, each turning out an exhaust containing 50 ppm of NOx. In contrast to this, our review of a similar proposal in the southeast U.S. (250 MW combined cycle natural gas combustion turbine with heat recovery) found an applicant proposing to use a combustion technology that would produce an exhaust containing only 9 ppm of NOx. This seems to indicate that an 80% reduction in NOx emissions is achievable (without tailgas treatment) if there is a will among the ratepayers in your service area to bear the costs of the technology and reduced generating efficiency.

We understand that the Bellefonte project proposes to employ whatever air pollution mitigation is necessary to meet regulatory requirements. However, in an environment where there is clear evidence of natural resource impairment from air pollution, we feel that the project analysis should include at least one alternative that fully examines the costs and benefits of a "very clean" technology. We recommend that such an alternative be included in preparing the Final EIS for Bellefonte.

Response: An underlying objective of the EIS was to consider a broad range of conversion options which involved the use of fossil fuel. This approach allows the use of cleaner fuels or technologies, which of course would result in fewer environmental impacts. The EIS addressed the impacts of five basic technology configurations and seven variant configurations involving different fuels and/or operating modes. Given the purpose of the action to convert Bellefonte to a fossil-based plant, the EIS has covered a reasonable range of alternatives.

The concentrations of air pollutants evaluated for options were conservatively derived and encompass the characteristics and performance of much of the power generating equipment commercially available in today's marketplace. Concentrations of NOx in combustion turbine exhaust are dependent on burner design, operating efficiencies, type of control system, and fuel type. For example, typical uncontrolled NOx emissions are in the range of 90 to 500 ppm for natural gas and 150 to 700 ppm for distillate fuel and synthesis gas. Design improvements, such as water injection, can reduce these concentrations to 25 to 42 ppm and 42 to 75 ppm for gas and oil/synthesis gas, respectively. Other controls are available for reducing these concentrations even further.

TVA wishes to have flexibility in its operations at Bellefonte and therefore based impact evaluations on an "envelope" of emissions that would allow the use of a wide range of operating conditions and fuel combinations. A nominal NOx concentration of 50 ppm was selected for all options. This is less than half the emissions "ceiling" set by New Source Performance Standards for combustion turbines. NOx emissions from newly contructed turbines could be no higher than about 100 ppm (depending on unit efficiency), thus establishing the starting point for determining the appropriate type of control technology. Although the BACT review is "top-down" procedurally (i.e, best controls must be considered first, proceeding to less effective controls only if better controls are technically or economically burdensome), no controls that fail to reduce emissions to 100 ppm would be acceptable.

It is the purpose of the Best Available Control Technology evaluation, required to obtain Prevention of Significant Deterioration air permit from the Alabama Department Environmental Management to initiate construction, to determine the best control considering cost effectiveness and technology constraints. The BACT evaluation will be completed after a conversion option has been selected and will assess the suitability of the full range of available turbine designs, operating scenarios, and tail gas treatment systems available for minimizing NOx emissions.

Comment ID: 143

Name: Dolores Howard

Affiliation:

DEIS Section: 2.2.1

Comments: *This does seem like the perfect place to do research and development to solve some of the future power production, energy efficiency, problems. Convert it to a center (a Demand Side Management Center) to teach residential and industrial customers and retailers about energy efficiency and conservation. Include a demonstration area of low-cost, low-tech as well as high-tech ways to reduce the use of power. Even large industrial customers can use this kind of information. The folks at Muscle Shoals seem to be doing well, let them help design a program, low key, low budget at first. Take the money you would spend on capital investment for a fossil plant and apply it to the debt. The interest you could save would quickly offset the investment. Stop your stupid say-nothing TV ads (I can hardly tell TVA ads from the Champion Paper Lies!) and start doing real informational ads, about raising rates and reducing the customers bills through efficiency and conservation. It's the way of the future, some pretty big utilities are doing it and quite well in California and New England. Or if all else fails a huge recreational area featuring "cooling tower tours!" Anything is better than more of the same wasteful practices for a power plant we do not need.*

Response: After a comprehensive review, TVA concluded in Energy Vision 2020 that additional capacity would be needed at the current rate of demand growth in the industrial and residential sectors. TVA would not be responsive to nor mindful of its customers needs if this capacity demand was ignored. Even the most optimistic projections of the electricity demand offsets resulting from increased system efficiency and conservation efforts would not substantially change TVA's capacity needs. We appreciate the stated support of TVA's ongoing research programs, many of which are in cooperation with its distributors, to continually seek ways to improve efficiency of electricity delivery and use.

Comment ID: 13

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.2.2

Comments: *PC - The PC option would utilize the most existing hardware and require a relatively low amount of additional hardware, utilize plentiful domestic coal supplies, would not use or need to store fuel oil on site, and would generate marketable by-products such as gypsum. However, it notably failed initial PSD Class I increment modeling for SOx and also would need large amounts of coal (24,974 tons/day), would require coal storage and coal, is the noisiest option, and would have the most visible plume. It would also require dredging with wetland losses at the docking terminal to accommodate coal barges. Unless SOx emissions are reduced (through use of low-sulfur coal and/or more efficient tail-gas sulfur removal equipment: pg. 4-21) and pass PSD review, this option would not be acceptable environmentally. Even if modified to pass PSD modelling, it may be noted that this option would cumulatively contribute to the permitted emissions of the many other coal plants in the Tennessee Valley.*

Response: Comment noted.

Comment ID: 56

Name: Tom Eldredge

Affiliation: Lehigh University

DEIS Section: 2.2.2

Comments: *Mr. Eldredge wanted to know if we were planning "a flue gas scrubber system without reheat."*

He stated that without doing any calculations, he believed that the proper placement of a heat source inside the natural draft cooling tower would be beneficial. The draft is affected by the buoyancy of the air. The heat source would decrease the density of the air and increase the draft which would improve the cooling tower efficiency.

Response: The EIS has been prepared to cover likely scenarios involving use of coal and/or natural gas at Bellefonte, but detailed engineering has not been performed for any of the options. It is unlikely that this technology is considered commercially ready at this point.

Comment ID: 109

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 2.2.2

Comments: *The other thing is I am very confused as to how committed TVA would be to a natural gas combined cycle option. If you look at this document, all of the other options that are presented, there are time lines given when construction activity would begin. If you look at the natural gas combined cycle option, there are no time lines, none whatsoever.*

Response: A graphic depicting work force population for the NGCC option can be found in Section 2.2.3; Construction and Operation of Natural Gas Combined Cycle Units. The formatting and location of this graphic is consistent with the other 4 options.

Comment ID: 118

Name: Deon Smith

Affiliation:

DEIS Section: 2.2.2

Comments: *When you get it finished, you are going to burn a thousand tons of coal an hour. If you go to Huntsville in the morning, you see that train from Widows Creek. From a practical standpoint, I don't necessarily want to burn a thousand tons of coal an hour but I would sure like to see that plant operated.*

Response: Comment noted.

Comment ID: 14

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.2.3

Comments: *NGCC - The NGCC option appears to be the "cleanest" option in terms of emissions. Also, there would be no need for dredging since there would be no coal barges, considerable existing hardware would be utilized, the least amount of new hardware would be needed for conversion, and the least amount of operational noise would be generated. There also would be no storage of chemical by- or co-products on site, although a large volume of backup fuel oil would be stored on site. However, this option would require a natural gas pipeline source with pipeline connection to the site with access to the plant which could induce secondary development impacts (also see "Pipeline Corridors" below). This option appears to be the overall best environmentally.*

Response: Comment noted.

Comment ID: 48

Name: Allan Stewart

Affiliation: PIRA Energy Group

DEIS Section: 2.2.3

Comments: *After reviewing the DEIS statement, I frankly cannot understand why the NGCC option seems so inefficient. I found a reference in the report of new units having efficiencies eclipsing 55%. Is the gas option using convention natural gas (i.e., containing close to 1,000 Btu/scf)? Is the site at high elevation? All the analysis will unduly penalize the natural gas option unless you use a reasonable heat rate (~7,000 btu/kwh (ISO/HHV)). The new "H" series turbines are supposed to have heat rates under 6,000 btu/kwh, and lower installed costs than the "F" type or "G" type units.*

Response: The DEIS refers to a variety of types of combined cycle combustion turbine operations including conventional combustion turbines with 47-51% lower heating value (LHV) efficiencies and G/H technology combustion turbines with 56 - 60% LHV efficiencies. The DEIS states on page 11, and again on page 2-24, that advanced combined cycles yield plant efficiencies greater than

55%. The average combined cycle LHV efficiencies are shown on page 2-64 as 49%, 53.5%, and 58% for Conventional, "F," and "G/H" combustion turbine technologies, respectively. This data is consistent with published combustion turbine information and with engineering studies made on TVA's behalf.

The natural gas option does use conventional natural gas with a nominal heating value of 1,000 Btu/scf.

The design basis site elevation for Bellefonte is 192 meters (630 feet) above sea level which will derate the performance by less than 2% of the ISO performance, although this is not taken into consideration in the statement in question.

The analyses for the natural gas based combined cycle performance will use a reasonable heat rate. The use of the existing Bellefonte steam turbine(s) would derate the overall plant heat rate slightly because the existing steam turbine will be less efficient than a steam turbine designed specifically for the combined cycle operation. The LHV heat rates calculated from the data used in Table 2.3-9 on page 2-64 range from 5,900 to 7,000 Btu/kWh. These LHV values would be roughly equivalent to 6,500 to 7,700 Btu (HHV)/kWh.

We are aware that the "H" series turbines are reported to have LHV heat rates under 6,000 Btu/kWh and the lowest installed costs for combined cycle available. If the choice to use combined cycle technology at Bellefonte were made, then the ultimate selection of the combined cycle system would be greatly influenced by vendor proposals with price quotes, guaranteed performance, risk mitigation, and schedules for commercial delivery. The DEIS, however, is written to discuss the potential environmental consequences of each option, and must conservatively address the performance of each option.

Comment ID: 15

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.2.4

Comments: *IGCC - The IGCC, however, does have notable PM10 emissions compared to other options, requires large coal use (24,000 tons/day) and on-site storage, requires on-site storage of fuel oil for start-up, requires the greatest amount of intake water, results in wetland losses due to dredging for a coal barge terminal, involves flare stack operation, has considerable pollutants associated with its final waste water discharge, has a large discharge volume, has modeled selenium (selenite) discharges that exceed EPA's aquatic life criteria, and needs considerable new hardware (including a large gasifier) for conversion. Compared to the PC option, however, the IGCC option is considered a relatively "clean" form of coal combustion and therefore would be the preferred coal option. Nevertheless, in light of the NGCC option, the IGCC option would not be favored by EPA.*

Response: Comment noted.

Comment ID: 16

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.2.5

Comments: *IGCC/C - As an IGCC, the IGCC/C option has the same qualities and drawbacks of the IGCC discussed above. In addition, however, it also has various pollutants associated with chemical co-production and on-site storage. It would also involve considerable construction for conversion, but would produce comparatively little power (450 MW) relative to the other conversion options. As such, it could involve secondary impacts since other forms of power generation would presumably be needed to make up the almost 2,000 MW difference (between the Bellefonte nuclear vs. IGCC/C design capacities) to help provide the reported TVA-projected capacity needs of 16,600 MW by 2020. Overall, this option would not be favored by EPA because it would not seem to satisfy the stated power needs and therefore presumably require other additional power production (and their associated impacts) elsewhere.*

Response: In addition to plans to convert Bellefonte, other supply-side actions included in the short-term action plan are (1) purchase call options - up to 3000 MW, (2) hydro modernization projects - 150 MW, (3) use of renewables - no estimate of MW, and (4) planning for future consideration of advanced turbine systems and energy storage technologies.

The IGCC/C option would not fully convert the existing facilities at Bellefonte to electricity production. The purposes of converting Bellefonte are to make use of assets already constructed at the site, and to deliver power to its customers at the lowest cost commensurate with other corporate goals and obligations. As noted above, Energy Vision 2020 identified a mix of options for expanding capacity to a production level of 16,500 MW by 2020. Energy Vision 2020 commited to further evaluation and planning of each alternative to ensure they were economically attractive and involved low risk to TVA and its customers before implementation.

The IGCC/C option, because of the associated revenue stream provided by the marketing of chemicals produced from synthesis gas, appears to offer high potential for delivering electricity at a price much lower than many conventional fossil fuel powered systems. The IGCC/C option also meets the test of flexibility in its ability to adapt to uncertain load growth, future market conditions, and changes in environmental regulations. While this option does not fully utilize all of the current assets at Bellefonte, it does not preclude the future consideration of additional power production at the site (not under consideration at this time).

Comment ID: 17

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.2.6

Comments: *Combination - ...most flexible since various forms of energy could be used and both power and coproducts would be produced and would still satisfy the power production need. This option would involve the most conversion (coproduce chemicals) and associated construction impacts. Since natural gas is one of the fuels, secondary impacts of a gas pipeline connection would also be required. Since an IGCC/C is also one of the technologies of the options, the above impacts associated with this option would also be relevant. The Combination option would not be favored by EPA since it involves the greatest amount of conversion construction and generate both power plant and chemical co-production impacts. TVA power need projections suggest that power as opposed to coproduction would seem to be a facility priority.*

Response: The most recent projections do show a need for baseload power, although peak power is also needed. Coproduction would allow TVA to deliver this power to its customers at the lowest cost. Thus, while coproduction may not be a direct facility priority, the market demand for coproduct chemicals would allow TVA to deliver power at the lowest cost.

Comment ID: 97

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 2.3

Comments: *I don't think they have adequately addressed the environmental implications of potentially running a natural gas pipe line down. We would like to see some more development in that.*

Response: Given the early stages of planning a pipeline for supplying the needs of the conversion options requiring natural gas, precise routes were not yet developed. In order to assess the environmental impacts of this potentially connected action, three pipeline corridors were identified and impacts evaluated in Section 4.3. New information pertaining to the indirect effects of this action has been added to Section 4.4.

New supplies of natural gas would likely lead to secondary development. Language has been added to the EIS to acknowledge possible impacts due to secondary development induced by the expanded availability of natural gas. New information has been added to Section 4.4, Indirect and Cumulative Effects to qualitatively acknowledge such impacts. As discussed in Section 2.3.1, impacts would be addressed by a subsequent NEPA review by the Federal Energy Regulatory Commission once a conversion option involving natural gas has been selected and specific routes have been identified.

Comment ID: 20

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.3.1

Comments: *pg. 2-45. 4-160. ...potential natural gas pipeline corridors...EPA preliminarily prefers Corridor "C" (and possibly "B").*

Response: Comment noted.

Comment ID: 47

Name: Paul E. Pratt

Affiliation: Williams Energy Group

DEIS Section: 2.3.1

Comments: *TVA's position on the likely three corridors and subsequent statement that "more specific pipeline routes would be identified for environmental review" raises a question of clarification. Having identified "three likely corridors," would any subsequent, more specific pipeline route be required to be located within one of the "three likely corridors?" While, the DEIS implies that the routing of a potential pipeline would not necessarily be limited to the "three likely corridors" and that in any case further environmental review would be required for a specific pipeline routing, it would be short sighted for TVA to assume that all viable proposed routings would be located within "three likely routes," particularly in the absence of a pipeline proposal process or other significant input from the energy industry. Other economically and environmentally viable pipeline corridors may well exist to fuel the Bellefonte plant.*

Response: The natural gas supply analysis provided in the EIS was not intended to constrain future gas pipeline routes to the confines of the three corridors studied. It is TVA's policy to maintain flexibility with respect to the acquisition of any future of natural gas supplies for Bellefonte in seeking least-cost, long-term fuel supplies. EIS describes impacts and mitigation measures associated with the construction and operation of pipelines along three feasible routes on the basis of information currently available to TVA. A site specific environmental review would be conducted by any agency proposing to construct a new pipeline (also required by the Federal Energy Regulatory Commission (FERC) certification process) when and if a new pipeline is planned.

Comment ID: 121

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.3.1

Comments: *PIPELINE CORRIDORS - Interconnection with a nearby natural gas pipeline is apparently not available at this time and pipeline corridors for a new pipeline from potential nearby sources are undecided. However, we much appreciate that the DEIS considers three potential corridor routes (A, B, C) for a new pipeline to the site as well as some preliminary impacts of this potential action. Two of these originate from larger cities (Corridor "B" from Chattanooga, TN and Corridor "A" from Huntsville, AL), and the third (Corridor "C") from the east. EPA considers such a pipeline a connected action to the NGCC and the Combination options (the NGCC option could in fact not operate without a natural gas source). We agree, however, that such a new pipeline would be under the NEPA responsibility of the Federal Energy Regulatory Commission (FERC); however, there would also need to be a pipeline access interconnection from the potential new pipeline to the plant which would be under the NEPA responsibility of TVA.*

Construction of the potential pipeline would not only have direct impacts associated with its construction and operation, it could also potentially induce secondary impacts such as providing a natural gas supply for additional development in the area. Development is often associated with various forms of pollution such as air and water pollution, soil erosion, wetland loss, habitat loss, biodiversity loss, etc.

We appreciate that additional information was provided for the connected pipeline action. We note that generic impacts and mitigative measures were documented and that actual preliminary impacts of the three potential corridors were included. Considering EPA's wetland mandate, we particularly note from Table 4.3.2-1 (pg. 4-167) that Corridor A would have *"high" wetland impacts, B with "medium" impacts, and C with "low" impacts. Based on this table, it appears that Corridor "B" might provide the least overall impact since it includes no high-rated impact potential categories and low-or-medium-rated impacts for wetlands, urban development, lack of common ROW, surface water, endangered species, etc. Corridor C also appears reasonable since it includes low-or-medium-rated impact potential for wetlands, surface water, endangered species, cultural resources, etc. but has high urban development and lack of common ROW and would cross steep terrain. Corridor A appears to have the highest overall impact potential. Should the need for a pipeline eventuate, FERC would need to further investigate these and/or other corridors and alignments within these corridors. Impact categories additional to those on Table 4.3.2-1 would include environmental justice considerations within the "urban areas" category.*

We note that Table 5 (pg. 23) assigns a temporary "light" negative impact level ("T-") to wetland impacts for the pipeline. It is unclear if this was intended for all three corridors since their impact potentials range from low to high. The FEIS should clarify. Since pipelines placed in forested wetlands would destroy the functional value of such wetlands and therefore be more significant than if placed in herbaceous wetlands, the FEIS should also preliminarily estimate the ratio (or approximate acreages) between forested versus herbaceous wetlands along each corridor.

Response: TVA agrees that clarification is required. The FEIS has been revised to emphasize that the Table 5 and Table 6 impact summaries are for comparisons between and among the various options relative to each other. These are not for purposes of determining impact significance under NEPA. This is treated in Section 4 of the EIS. As to the pipeline wetland impacts, it was assumed for purposes of developing these tables that a corridor and specific alignment would be developed so as to avoid forested wetlands and that wetland restoration techniques following construction would fully mitigate impacts to herbaceous wetlands. Actual impacts will be evaluated in the environmental analysis required by the Federal Energy Regulatory Commission (FERC) for any new pipeline that is proposed in the future.

Comment ID: 96

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 2.3.3

Comments: *...our organization would be interested in seeing more development and fleshing out of economics involved with possibly exploring some of the "G and H" type of high efficient combined cycles combustion turbines that could possibly be located at Bellefonte.*

If they were to adequately shave the peak and still found the need to look at peaking units, the only options that we think should be seriously considered are the "G and H" advanced combined cycle combustion turbines.

Response: Equipment specific decisions will be based on the most recent information about cost, performance, and technology risk.

Comment ID: 141

Name: Dolores Howard

Affiliation:

DEIS Section: 2.3.4

Comments: *We prepare for the future energy needs with a new vision, by searching for a perfecting alternative, safe, sustainable energy sources, efficiency technology, and rewarding customer conservation and efficiency. The present method is a dead end, creating ever more demand is unsustainable, and undesireable. The new vision solves old problems and tries to avoid the pitfalls of only considering the benefit of the short-term and the few. We can create as many jobs in research and development, and have more customers for the new technology, than we can ever create and sustain by increasing demand for power and supplying it with more and more of the same old dead end technology and spending debt dollars on pollution credits.*

Response: As identified in Energy Vision 2020, renewable technologies have not been developed for commercial use that would be available in time meeting the project power demands of TVA's customers. Further, the purpose of this project is to convert the Bellefonte assets to a fossil-based plant as a supply-side option.

Comment ID: 19

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 2.3.4

Comments: *In addition, fractional use of biomass fuel with any selected option would also be environmentally favorable since it would reduce landfill wastes, assuming air emissions can be controlled within standards. A consistent biomass source may be difficult to obtain, delivery of non-recyclable, combustible domestic trash from various nearby cities and agricultural wastes/harvests from nearby sites may in time become reliable with proper management. Biomass could perhaps also serve as a standby fuel source for peaking power.*

Response: Comment noted. TVA will continue to evaluate biomass fuels for power production in future projects. At this time, supplies of this fuel in the vicinity of Bellefonte are not sufficient to support its use in connection with a fossil conversion strategy.

Comment ID: 111

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 2.3.4

Comments: *There are technologies out there. Solar power is a very viable technology. In fact, a utility in Sacramento moth-balled one of their nuclear power plants and converted it to a solar power plant. There is no reason those type of activities cannot be drawn into economic development initiative not only for TVA but also for the individuals that live and reside here in Scottsboro. And again, TVA has done a very inadequate job at looking at those technologies.*

Response: As identified in Energy Vision 2020, renewable technologies have not been developed for commercial use that would be available in time for meeting the projected power demands of TVA's customers.

Comment ID: 135

Name: George G. Martin

Affiliation: U.S. Department of Agriculture

DEIS Section: 2.3.7

Comments: *One variation of the IG technology adds an integral chemical manufacturing plant with several potential product lines. The specific effects of each of these product lines was not described, however. In addition, there is the "no action" alternative which would maintain the current situation -- continuing facility maintenance with no forseeable product or revenue.*

Response: The EIS discusses and describes impacts for representative chemical products. In general, impacts analyses focused on the chemical presenting the greatest environmental or health threat under conservative but realistic conditions, thereby providing a bounding estimate of impacts for the other chemicals. For example, ammonia was chosen for the analysis of acute effects of storage tank rupture since ammonia's toxic endpoint was lowest and ammonia is most volatile of the candiate chemicals. To evaluate the effects of tank explosions, methyl tert butyl ether was chosen because its heat of combustion was highest of the candidate chemicals. It should be noted that chemical emissions from process vents during normal operation would be captured and either recycled or treated to prevent their release to the environment. Environmental impacts would therefore be negligible during normal operation.

Comment ID: 54

Name: Randy Eminger and John Paul

Affiliation: The Center for Energy & Economic Development

DEIS Section: 2.4.2.6

Comments: *Surface water quality impacts are over-rated. The surface water quality impact of the PC coal was rated as an important permanent negative. This rating was given based upon potential discharges from coal pile runoff and gypsum/fly ash disposal. These discharges are subject to strict permit limits on the types of controls which need to be installed and the effluent quality.*

These permit limits are designed to protect the surface water quality for all its uses and assure there are no adverse environmental impacts. Therefore placing an important negative rating disregards these important permit safeguards that will be imposed by the state and EPA. The rating infers a potential for an adverse impact that is highly unlikely.

Response: The five options are compared to the No-Action Alternative and the degree of impacts are expressed only relative to the No-Action Alternative. As stated in the write up under Surface Water: "Waste water generated as a result of power production and operations would be treated to the level needed to meet these limits before discharge. While no problems are expected in the removal of pollutants to the levels required to comply with regulations, the potential for threat to the environment is greater for the larger and more diverse solid and liquid waste streams, such as those commonly associated with PC plants."

Comment ID: 55

Name: Randy Eminger and John Paul

Affiliation: The Center for Energy & Economic Development

DEIS Section: 2.4.2.10

Comments: *Aquatic ecology impacts are over-rated: The aquatic ecology impacts for the coal-based alternatives were given a modest permanent negative rating based upon the potential impact of raw material spills and wastewater discharges. This rating disregards the safeguard controls that will be required to protect against these impacts. The rating infers a potential for an adverse impact that is highly unlikely.*

Response: The modest permanent negative ratings assigned to various coal-based alternatives are expressed only relative to the five options (See Table 2.4-2 and associated Note). These ratings differentiate degrees of impacts among the action alternatives as compared to the No-Action Alternative. TVA believes these ratings are appropriate because they include impacts associated with aquatic habitat disruption caused by barge activities in the area of the barge unloading facility and impacts caused by withdrawal of river water and associated entrainment and impingement of aquatic life, in addition to potential impacts of raw material spills and wastewater discharges, as is discussed in Section 2.4.2.10. The ratings reflect the safeguard controls that will be used to protect against spills and discharge-associated impacts.

Comment ID: 52

Name: Randy Eminger and John Paul

Affiliation: The Center for Energy & Economic Development

DEIS Section: 2.4.2.15

Comments: *Bellefonte project aesthetics and recreation impacts are over-rated: On the summary table 2.4-2 (pg. 2-101) of the operational impacts of the proposed resource alternatives, the aesthetics and recreational impacts of the coal-based alternatives were rated as an important permanent negative. This rating was given because of the additional barge and truck traffic associated with raw material transport. The rating overstates the project's true impact which should more likely be rated as neutral. Commercial barge traffic has always been an important part of river traffic throughout the US and provided the needed financial support to maintain the river system. The Tennessee River traffic is not running at or near its capacity. The recreational boaters will not be inconvenienced since they likely have several alternatives other than entering the lake through the locks. The EIS should identify the base traffic volume and measure the increased volume associated with the Bellefonte project as a percentage of base traffic and river capacity. It could also provide additional perspective by comparing traffic and congestion at the Guntersville Lock to other river lock operations.*

The visual impact of additional structures onsite are also neutral. A building or structure should not automatically be assumed as having a negative impact unless it impairs a unique vista that must be protected. The area does not have an unusual vista. Nor does the site have a historic vista of a battlefield or famous geological structure (e.g. Grand Canyon) that attracts visitors to the area. Have local residents complained that additional structures would create a negative impact?

Response: Your comments about the over-rating of aesthetics and recreation impacts are noted. The additional barging of fuel to this site will be noticeable to all lock users and place increased pressure on lock usage. These impacts were described in Section 4.2.13, along with estimates of current and projected lock usage at Guntersville and the four downstream locks. Recreational users wishing to pass through the locks will experience periodic delays (the length of delay varies by lock) as a result of the additional barge use. The measure of utilization capacity, i.e, the percentage of time which the lock is in use relative to the total time it is available for use, was used to estimate impacts for the five conversion options and to compare projected use with a typical year (1995).

While there are no unique vistas that would be affected by the construction of additional and in some cases, higher structures, TVA believes that the changes associated with the conversion options will be perceived negatively by residents who live nearby and by boaters or recreation users on the river and area roadways.

Comment ID: 148

Name: James H. Lee

Affiliation: United States Department of the Interior

DEIS Section: 3.1

Comments: *In the Affected Environment discussion, consideration should be given to selling or giving away the wood for residential burning as an alternative to open burning. Also, the use of low solvent paints and alternative cleaning solvents should be considered.*

Response: Comment noted. As stated in Section 4.2.5.2, TVA would adopt a hazardous waste minimization policy for the proposed facility which would provide for the substitution of nonhazardous for hazardous materials where feasible.

Comment ID: 137

Name: George G. Martin

Affiliation: U.S. Department of Agriculture

DEIS Section: 3.1.1

Comments: *ITEM 1 -*

Our interest in this proposal arises from its proximity to the Cohutta Wilderness and/or the likelihood that it may have negative impacts on its *wilderness values. Cohutta Wilderness is a Class I area under the PSD provisions of the Clean Air Act. The wilderness resource and aesthetic values of Cohutta that are related to air quality can be grouped into three categories: visibility, aquatic habitats and vegetation. In consideration of these values, we are submitting comments regarding some issues related to: mitigation of predicted adverse impacts, description of the affected environment, atmospheric dispersion modeling and development of alternatives.*

Mitigation of Predicted Adverse Impacts
The DEIS discusses several instances where computer modeling of dispersion of the atmospheric pollutants did predict adverse impacts on Cohutta Wilderness. All of the alternatives, except "no action," would impair visibility through creation of visible plumes from time to time. Several other alternatives would have trouble staying within the PSD sulfur increment, both for Class I Areas (Cohutta) and for Class II areas. In most of these cases, the problem was dismissed by assuming: a) The problem would shrink to insignificance when the predictions are redone via the more refined (and less conservative) models required in subsequent air permitting process; and/or b) The problem can be resolved by upgrading the pollution control/combustion technology associated with the alternative.

While it's true that the predicted air pollution problems may be resolved via refined modeling, technological upgrades, purchase of emission offsets or other techniques, there is no guarantee. Some aspects of refined modeling protocols tend to uncover a more difficult situation than originally thought. Also, technological upgrades and emission offsets can be very expensive -- to the point of making mitigation of impacts financially unfeasible.

The Final EIS should discuss the unproven assumptions contained within each alternative and disclose the course of action in the event that the assumption does not hold up.

ITEM 2 -

Description of Affected Environment
The DEIS's conclusion that ambient air quality in the vicinity of the project "is generally good" is based on the fact that data from a nearby monitoring station shows no exceedance of, and very few encroachments on, the National Ambient Air Quality Standards (NAAQS). We don't dispute this conclusion. However, as most of the content of NAAQS is aimed at protecting human health, there is less assurance that they provide adequate protection regarding environmental and natural resource concerns. Indeed, there is evidence that natural resources in the project area are being impaired by air pollution.

The Southern Appalachian Assessment (SAA): Atmospheric Technical Report (SAMAB, 1996) documents that average visibility at Cohutta Wilderness is less than half of the natural value due to the impact of regional haze. The Bellefonte DEIS reports that the current median standard visual range (SVR) at Cohutta is 65 km. While this is true, it should be noted that the natural median SVR is estimated at 155 km. This situation is common throughout the southeast United States and is due, in large part, to nitrogen and sulfur emissions from a variety of sources including electric power generating plants.

That same Technical Report describes the impact of tropospheric ozone on forest and wildland vegetation in the southern Appalachian mountain area. Cohutta Wilderness, and much of the impact area east of the Bellefonte project, is in a zone showing the highest potential for vegetation damage from ozone. Ozone is a secondary air pollutant which derives, in part, from nitrogen emissions. The project would be a large source of nitrogen emissions. Further, ozone is the only one of the NAAQS parameters monitored near the proposed project that showed encroachment on the standard.

Last, information contained in the SAA Aquatic Technical Report and the SAA Atmospheric Technical Report identifies a concern regarding the impact that acid deposition (sulfur & nitrogen) is having on native trout populations in the Cohutta Wilderness and other parts of the SAA area. The Southern Appalachian Assessment compiled a wealth of information regarding the status and trends of natural resources in the Bellefonte project area. We recommend that the DEIS authors review this information and provide relevant summaries in the Final EIS to give a more complete picture of the affected environment in the project area.

ITEM 3 -

Atmospheric Dispersion Modeling
It is acknowledged that the ISC3 and RTDM models may be inappropriate for estimating impacts at distances beyond 50 km from the pollution source. It's further stated that the information gained from using these models to assess impacts at the distant Class I areas is not conclusive. We suggest that such modeling be done according to the Level 2 guidelines of the Interagency Workgroup on Air Quality Models (IWAQM). These protocols are more appropriate than the standard Gaussian dispersion models for work at these longer distances.

An interpretation of the charts provided in Figure 4.2.1-1, "Dispersion Modeling Results," suggests that the model runs were done with the *assumption that the Bellefonte alternatives were the sole source of emissions in/near the impact area. This assumption might be OK for assessment of project impact on NAAQS attainment and Class II area increment consumption, where the greatest impacts lie very close to the source. Such assumption is inappropriate, however, for assessment of increment consumption at the distant Class I areas. All major NOx, SOx and PM sources near the Class I Area are deemed to "consume" increment. These sources will have to be added in future model runs to fully assess how much of the Class I area increment will have been consumed. A review of the maps provided in the SAA Atmospheric Technical Report will show that there are many increment consuming sources of SOx, NOx and PM within the Bellefonte - Cohutta impact area. If increment consumption already appears to be a problem, inclusion of those additional sources can only further diminish hope that the problem will go away.*

We understand that running the dispersion models, for all the Bellefonte alternatives, with the appropriate refinements would be a costly proposition. It would be helpful if such analyses were done for the most onerous alternative. In absence of this, however, we recommend that the Final EIS acknowledge that these obstacles lie in the path of the project and disclose the course of action to be followed if these obstacles cannot be overcome.

Response: ITEM 1

The conservative screening models used to support the Bellefonte EIS were used to bound a set of conditions for each of the options that would allow TVA decisionmakers flexibility in selecting fuels, equipment, and BACT. Clearly, some options, as configured, are not as environmentally acceptable–from an air quality perspective–while others, such as the preferred NGCC option, appear considerably more benign. Nevertheless, the Class I air quality impacts of the selected alternative will be addressed in much greater detail as part of the PSD air permit application process.

ITEM 2

Supplementary information concerning the potential Bellefonte air quality impacts on the natural resources has been added in the Cumulative Impacts of Proposed Action on Air Quality (Section 4.4.2.1). Since each of the proposed Bellefonte alternatives will impact AQRVs, we have included an evaluation of the possible role of emissions on visibility impairment, as well as on soils and stream acidification and injury to vegetation.

This analysis includes information synthesized from the Southern Appalachian Assessment Technical Reports as well as other references. Nitrogen and sulfur emissions that impact AQRVs come from a number of different sources including power generation, mobile sources, residential wood burning, livestock waste management, etc. A discussion of cumulative source impacts of the proposed Bellefonte alternatives on AQRVs has been added in order to give a more complete picture of the affected environment.

ITEM 3

Standard Gaussian models such as ISC3 and RTDM are not well suited for estimating air quality impacts at distances beyond 50 km and that the modeling guideline recommendations developed by the Interagency Workgroup on Air Quality Models (IWAQM) for estimating air quality impacts on distant Class I areas represent a considerable improvement over the standard models for performing such analyses.

The modeling of the Bellefonte conversion options was performed on a limited set of configurations. However, since the purpose of the modeling was to provide a ranking of the relative air quality impacts, a very conservative approach was appropriate. More detailed analyses of Class I increment consumption will be performed as part of the PSD permit application if one of the options is selected for construction. If a PSD permit is prepared, the IWAQM modeling guidelines will be taken into consideration. However, the IWAQM recommendations were developed several years ago and improved models have become available since that time. Consequently, one or more of these newer models for some parts of the analyses may be proposed rather than relying exclusively on the IWAQM recommendations.

Comment ID: 6

Name: James H. Lee

Affiliation: U.S. Department of the Interior

DEIS Section: 3.1.2.3

Comments: *As mentioned in the text, permeability is an important factor in the screening of soils that will serve as a buffer for leachate migration; but soil thickness should also be considered. The text states that the soil thickness at Bellefonte ranges from 0.6 to 7 meters and thins northward. The proposed ash storage* *area would lie in the north-northeastern region of the Bellefonte plant (Figure 2.2-1, page 2-16), suggesting soil thicknesses of less than 1 meter. A preliminary investigation should be conducted to verify if the soils are of sufficient thickness to promote enhanced attenuation and prevent leachate migration for ash storage.*

Response: A detailed engineering study would be carried out during the final design phase of the project. Currently, there are no state requirements for the storage of fossil plant ash; nonetheless, storage areas will be designed in accordance with good engineering practices in order to protect the groundwater quality.

Comment ID: 122

Name: Joseph R. Castleman

Affiliation: Department of the Army

DEIS Section: 3.1.6

Comments: *Reference Chapter 3.0, page 3-27, Table 3.1.6-2, Plant Name - Fort Payne, Location. The existing location of the recently constructed water intake is at TRM 387.6L.*

Response: The FEIS has been revised to reflect these comments.

Comment ID: 123

Name: Joseph R. Castleman

Affiliation: Department of the Army

DEIS Section: 3.1.6

Comments: *Reference Chapter 3.0, pages 3-27 & 28, paragraph 3.1.6.2, Surface Water Supply and Demand. We recommend the last part of this paragraph be revised to read as follows: The Water Works Board of the City of Fort Payne, Alabama, has constructed a new raw water intake pumping station on the Tennessee River at Mile 387.6L with a capacity of 10 million gallons per day to supply additional drinking water.*

Response: The FEIS has been revised to reflect these comments.

Comment ID: 4

Name: James H. Lee

Affiliation: U.S. Department of the Interior

DEIS Section: 3.1.6.3

Comments: *This is a general comment. Specific comments are listed in Comments #5-9.*

The proposed project may adversely affect species listed by the U.S. Fish and Wildlife Service as endangered or threatened. Additional surveys should be carried out to determine the presence or absence of these species and to assist in the determination of potential impacts based on their occurrence.

Response: As indicated in Sections 3.1.10.2 and 3.1.10.3, TVA has been aware of the potential presence of endangered or threatened species in the Tennessee River adjacent to the Bellefonte site. To clarify this issue, TVA conducted a dive survey of potential impact sites in 1995. Results of that survey are presented in Section 3.1.10.2 and Appendix I. Specific comments about the potential and actual presence of listed species in this part of the river are presented in Section 3.1.10.3. As indicated, the sparse mussel community found during the survey does not suggest that any endangered or threatened aquatic mollusks persist adjacent to the Bellefonte site. Aquatic habitat conditions in the reach also are not suitable for the snail darter, the only other federal endangered or threatened aquatic species likely to occur in the general project area.

Comment ID: 5

Name: James H. Lee

Affiliation: U.S. Department of the Interior

DEIS Section: 3.1.6.3

Comments: *Page 3-34. Section 3.1.6.3. Table 3.1.6-6. The criteria established by the ADEM for public water supplies (ADEM, June 1996, Table A-3, page A-5) includes a MCL for asbestos of 7 million fibers (longer than 10 micrometers)/liter. Because of the probable occurrence of asbestos on the site (Section 3.1.5, Table 3.1.5-1, page 3-22), the surface water monitoring may need to include this constituent.*

Response: Table 3.1.6-4--Primary Drinking Water Regulations Versus Guntersville Lake Water Quality, and Table 3.1.6-8--Primary Drinking Water Regulations Versus Water Quality in the Bellefonte Vicinity have been revised to include the MCL for asbestos.

Comment ID: 250

Name: Anonymous

Affiliation:

DEIS Section: 3.1.9

Comments: *"I had an individual tell me that the following rare plant is found on the BLN reservation. I was told by the individual that the TVA botanists were aware of this plant. "Spiranthes Odorata: Occurs in damp low places in woodland overstory and on backwater shorelines of the Bellefonte reservation. This is a terrestrial orchid which is sensitive to pollutants particularly airborne."*

Response: TVA botanical staff have reviewed records of field investigations for the site and are not aware of this species occurring at the site. This species is not listed on the Federal or Alabama state list for rare species.

Comment ID: 7

Name: James H. Lee

Affiliation: U.S. Department of the Interior

DEIS Section: 3.1.10.3

Comments: *Endangered Species Comments. The document indicates that no listed species are found in terrestrial habitats on the site and we concur. The Anthony's river snail (Atheamia anthoyi) was recently found in the Tennessee River. Because a 1995 TVA survey found the snail 15 miles upstream of the plant site, we recommend a survey be conducted in the river area adjacent to the plant site to determine possible occurrence of the snail.*

Response: As indicated in Section 3.1.10.3, TVA was aware of the potential presence of Anthony's river snail when the mussel survey adjacent to the Bellefonte site was conducted in 1995. No specimens of this species were found at any of the stations examined during that survey, in spite of diver awareness that this snail was present further upstream. Neither TVA or the Alabama Department of Conservation and Natural Resources are aware of any recent records of Anthony's river snail in the Tennessee River downstream from Long Island (TRM 412). On that basis, none of the proposed actions at the Bellefonte site would have any impact on Anthony's river snail.

Comment ID: 8

Name: James H. Lee

Affiliation: U.S. Department of the Interior

DEIS Section: 3.2.7

Comments: *The natural gas pipeline corridors identified in the document may include habitats occupied by listed species. The following species should be added to the species listed in the table and be considered in further project review because data available in the Daphne Field Office indicates their probable occurrence in one or more of the corridor areas.*

Indiana bat (Myotis sodalis)
Green pitcher plant (Sarracenia oreophila)
Alabama hart's tongue fern (Asplenium scolopendrium var. Americana)
Morefield's leather flower (Clematis morefieldii)

Corridor A:

1. *Impacts to the gray bat are a possibility since caves are proximate to the corridor.*
2. *The pink mucket mussel (Rampsilis abrupta) is found in the Tennessee River and Shanty Creek.*
3. *The Alabama hart's tongue fern and Morefield's leather flower are likely to occur in the area.*

Corridor B:
1. *Bald eagles are found near the confluence of Crow Creek and the Tennessee River.*
2. *Gray bats may be present.*

Corridor C:
1. *The gray bat and the Indiana bat could be present.*
2. *The bald eagle is found on Coon Creek.*
3. *The green pitcher plant occurs in the area of the corridor.*

Surveys to document the presence/absence and distribution of these listed species are recommended. The results of these surveys should be provided to the Daphne Field Office for review. Should any of these listed species be found in the project area, then the Tennessee Valley Authority (TVA) should initiate Section 7 Endangered Species Act consultation.

Response: The Indiana bat, green pitcher plant, Alabama hart's tongue fern, and Morefield 's leather flower have been added to Table 3.2-1. We appreciate the additional information on listed species potentially occurring along the three pipeline corridors.

As described in Section 2.3.1.1, the three pipeline corridors evaluated in the EIS are speculative and were selected to evaluate the range of potential impacts from pipeline construction and operation. No field surveys have been conducted to document the occurrence of listed species along these corridors, and such field surveys are premature at this time. If TVA selects one of the two conversion options requiring a natural gas pipeline, field surveys will then be conducted along proposed pipeline corridors. Such a pipeline, regardless of whether it is constructed and/or operated by TVA, an existing natural gas supplier, or another entity, would be considered a federal action in that it would require TVA, U.S. Army Corps of Engineers, and/or Federal Energy Regulatory Commission (FERC) approval. Section 7 Endangered Species Act consultation, as appropriate, would be carried out at that time.

An environmental review would be conducted by the FERC before approving the construction of new natural gas pipeline and associated facilities.

Comment ID: 3

Name: James H. Lee

Affiliation: U.S. Department of the Interior

DEIS Section: 4.2.1

Comments: *We suggest that the proposed and the existing monitoring requirements for particulate material be used to verify the attainment of these standards in the modeling exercises.*

Response: Since the printing of the DEIS, EPA has promulgated new standards. The FEIS has been revised to address these new standards in Chapters 3 and 4.

Comment ID: 29

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.1

Comments: *AIR QUALITY AND HUMAN HEALTH - A best available control technology (BACT) analysis, air quality analysis, and additional impact analysis would be required as part of the PSD application process. Use of either of the five conversion alternatives would also require the Bellefonte facility to obtain a Title V operating permit. Depending on the alternative selected by TVA, applicability of New Source Performance Standards (NSPS) under 40 CFR Part 60 will be triggered. Also, maximum achievable control technology (MACT) requirements under 40 CFR Part 63 would need to be evaluated for applicability for those alternatives involving a chemical plant. Future MACT standards could also be applicable to electric steam generating units and combustion units.*

We note, however, that no thresholds apparently exist for certain listed pollutants (e.g., formaldehyde, acetaldehyde: Table 4.2.1-10b). The FEIS *should discuss these pollutants relative to modeled levels and potential impacts. Also, for future EIS reference, should a pollutant fail screening, additional analysis would be appropriate, i.e., risk assessment analysis for direct pathways (inhalation) and preferably indirect pathways (agricultural).*

Although mercury passed the screening models for toxic air pollutants, we suggest that any possible further limitation of mercury pollution in air emissions and water discharges to levels further below the threshold/standard should be seriously considered by TVA. Also relevant to mercury, the apparent data gap on Table 4.2.1-10a (pg. 4-27) for elemental mercury modeling for the one-hour concentration for the PC option should be discussed in the FEIS.

For the IGCC options (IGCC, IGCC/C, Combination), substantiated assurances should be provided that dioxins and furans would not be generated during combustion. The FEIS should clarify.

Response: Comments regarding BACT, Title V, NSPS, and possible MACT requirements are noted.

Tables 4.2.1-10a and 4.2.1-10b of the Bellefonte EIS have been revised to reflect updated hazardous air pollutant emissions estimates for the various Bellefonte repowering alternatives. The comment regarding possible future risk assessment analysis is noted.

Information has been included in Table 4.2.1-10a for elemental mercury, selenium, benzene, benzo (a) pyrene, formaldehyde, and acetaldehyde from the PC Option. A revised (higher) estimate for hydrogen fluoride has been included.

Although stationary fuel combustion sources are suspected of being a major source of dioxin and furan emissions, we are unaware of any reliable dioxin and furan emissions factors for IGCC. We suspect that the quantitative significance of stationary fuel combustion is due to the application of miniscule theoretical emission rates to large quantities of fuel.

Comment ID: 43

Name: John F. Ramey

Affiliation: U.S. Department of Agriculture

DEIS Section: 4.2.1

Comments: *We are concerned if any of the proposed alternatives which burns fossil fuels are implemented then there is a high likelihood that one or more air quality related values (AQRV) at the Joyce Kilmer/Slickrock Wilderness will have an adverse impact. We are requesting Joyce Kilmer/Slickrock be included in an AQRV analysis if your Agency desires to proceed with a Prevention of Significant Deterioration (PSD) application.*

We encourage your Agency to have a pre-application meeting with our Air Resource Specialist, as well as the Air Resource Specialist for the Cohutta and Sipsey Wilderness, and the air quality regulatory agency for Alabama. At the meeting our Air Resource Specialist will provide greater details on what pollutants are of concern, and which AQRVs are likely to be impacted by the proposed facility.

Nevertheless, we believe the emissions proposed are significant and could impact the AQRV's at the Wilderness. At this time, we would not recommend the use of Gaussian dispersion models. Instead, your agency should follow the Interagency Workgroup on Air Quality Models (IWAQM) Level 2 guidelines to evaluate oxides of nitrogen and sulfur dioxide emissions on visibility and acidic deposition impacts to terrestrial and aquatic AQRV's. Implementation of most of the alternatives could also lead to increases in ground-level ozone. Modeling of ozone increases can be a challenge, but we would recommend the use of the UMAV with the point source in grid (PIG) option. Another option in modeling would be to consider using the models and episode days selected by the Southern Appalachian Mountain Initiative (SAMI). The SAMI effort is proceeding and they may have a tool which could be used for PSD purposes.

Response: We agree that the impacts on AQRVs in Class I areas should be a part of the PSD permit if a decision is made to proceed with any of the fossil-fuel alternatives described in the Bellefonte repowering DEIS. We also agree that discussions about AQRV details should take place with the Federal Land Managers (FLM) prior to performing the PSD analyses.

We also agree that the IWAQM Level 2 guidance is a useful starting point for discussions on the details of evaluating AQRV impacts in Class I areas. Other models, however, have become available since the development of this guidance and may be more appropriate for some parts of the analyses. Similarly, we agree that the UAM-V model with the plume-in-grid (PIG) treatment may be useful for evaluating potential ozone impacts but other models should be considered as possible alternatives. These details will be discussed with the States and FLMs prior to initiating any PSD analyses for Bellefonte.

Comment ID: 50

Name: Randy Eminger and John Paul

Affiliation: The Center for Energy & Economic Development

DEIS Section: 4.2.1

Comments: *The draft EIS may underestimate the environmental emissions from resource alternative #2- 2,406 MW natural gas combined cycle plant. The environmental emissions calculations for the natural gas combined cycle plant alternative are based upon burning 472 mmscf/day of natural gas to reach the full unit output of 2,406 MW. This use is based upon use of a "F" class gas turbine with an assumed combined cycle heat rate efficiency of 53.5 percent (6,378 Btu/kWh) with supplemental duct firing to reach peak output which would reduce the efficiency to 8,419 Btu/kWh. The assumed combined cycle heat rate efficiency before the adjustment for supplemental duct firing is far better than the efficiencies experienced by existing combined cycle plants using the "F" class machines. Energy Ventures Analysis in its review of actual heat rate efficiencies of modern combined cycle plants found that the average energy efficiency for the most recent units was only 42.1 percent (8,090 Btu/kWh). This level showed technological improvements versus the average efficiency of 38.5 percent (8,856 Btu/kWh) average for all combined cycle plants.*

Response: The NGCC efficiency of 53.5% used to calculate fuel usage and estimate emissions was based on information for "F" class combustion turbine technology from several vendors. This reflects a fully developed and state-of-the-art steam cycle design. These higher efficiencies are projected due to recent combined cycle design improvements associated with "F" class and later technologies. TVA intends to utilize the most efficient systems commercially available. Recent literature reports efficiencies for "G" and "H" natural gas fired systems approaching 60 percent. A Best Available Control Technology evaluation is required for the Prevention of Significant Deterioration air permit for construction. That evaluation does not consider efficiency per se’ in control technology selection.

Comment ID: 79

Name: Stephen Smith and Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.2.1

Comments: *Smith -- Neither of the explored options truly adequately addresses the air impacts. Again as was mentioned earlier and I will expound a little bit more, it appears that EPA has proposed new standards for both particulate matter and ozone.*

The problem with this is that with these new standards, chances are the metropolitan area of Chattanooga is going to be non-attainment for the ozone and particulate matter. If they are, indeed, non-attainment and TVA plans to load the atmosphere with additional emissions from Bellefonte, they have not adequately addressed the impacts on the regional air shed and this would cause significant, both human health, environmental health, and economic hardship on the Chattanooga community.

TVA needs to take a step back and adequately address the impact of ozone and particulate matter from a fossil fuel conversion at Bellefonte both for the current regs. and for the potential regs. that may be promulgated and enacted in the near future.

Neal-Conlon -- None of these studies relative to air quality were conducted addressing proposed revisions in the Clean Air Act.

Response: Since the printing of the DEIS, EPA has promulgated new standards. Chapters 3 and 4 of the FEIS have been revised to address these new standards for ozone and particulate matter.

Comment ID: 88

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.2.1

Comments:

** TVA has failed to adequately address the air impacts of both sulfur dioxide and nitrous oxide which is a precursor for ozone on impacts on the Great Smoky Mountain National Park in particular and other class one areas generally.*

** TVA has failed to admit that the significant sulfur dioxide emissions and nitrous oxide emissions, particularly from the coal options, would have what I consider an absolute unacceptable impact on the Great Smoky Mountain National Park. I have talked to air quality scientists at the national park within the Department of Interior and they expressed great concerns about the potential fossil fuel options, particularly the coal options, at Bellefonte and how it would bring additional loading of both sulfur and nitrogen.*

** The Great Smoky Mountain National Park right now, the soils in the Great Smoky National Park has experienced what's called nitrogen saturation. There is so much nitrogen raining out of the sky into the park that the soils are so filled with nitrogen that this nitrogen now runs off in the streams and causes the pH or the acidity of the streams in the Great Smoky Mountain National Park to drop.*

** There is also great concern about the sulfur loading that is happening because again in the presence of moisture, sulfur dioxide converts to sulfuric acid and then is an acid precipitation or acid rain that falls in the park. And this is a grave concern because there are significant impacts in the water quality, particularly in the higher elevations in the park and because the soils there cannot buffer the acidity.*

** TVA hasn't taken the time to really communicate with the Department of Interior and the people at the Great Smoky Mountain National Park about these impacts and has failed to adequately include in this particular document the impacts on that both environmentally and economically. I don't think there is any discussion of economic impact.*

** One additional negative impact from sulfur dioxide is the fact it is the precursor that leads to visibility problems and the Great Smoky Mountain National Park has significant visibility problems. When people come up to the higher elevations and take a look at the beautiful vistas and they are unable to do that because the visibility in the summer months can be down as low as 12 miles. That's all you can see is out all for 12 miles when the normal visibility in the Great Smoky Mountain National Park should be close to 90 to 100 miles. That is a significant deterioration and that is due to sulfur emissions,* *primarily from plants to the west and the southwest; and this particular plant would add additional loading to that.*

Response: Supplementary information concerning potential Bellefonte air quality impacts on natural resources has been added in the Cumulative Impacts of Proposed Action on Air Quality (Section 4.4.2.1). Since each of the proposed Bellefonte re-powering alternatives will emit regulatorily significant quantities of compounds that could impact AQRVs, an evaluation of the possible role of these emissions on visibility impairment, as well as soils and stream acidification and injury to vegetation has been included.

Other additions to Section 4.4.2.1 include a discussion on visual range in the southern Appalachians and consider the changes in visibility patterns and trends due to point source and mobile emissions, regional population increases, and meteorological conditions. Since particulate sulfate, nitrogen dioxide, and to a lesser extent, particulate nitrate contribute to regional haze, projected SO2 and NOx emissions from the selected Bellefonte conversion alternative will contribute to regional haze. If the construction and operation of the selected Bellefonte alternative results in the retirement of older, less-controlled facilities, an improvement in visibility conditions could be expected.

The section now includes a discussion on the effects of the sulfate and acid deposition to sensitive watersheds, including soil acidification, cation leaching, and surface water acidification, as well as a discussion of evidence of episodic acidification by nitrogen saturation. This section also addresses the combined role of ozone and moisture on foliar injury symptoms reported for ozone-sensitive forest species.

Nitrogen and sulfur emissions that impact AQRVs come from a number of different sources including electric power generation, mobile sources, residential wood burning, livestock waste management, etc., and we have added a discussion of cumulative source impacts and a consideration of the proposed Bellefonte conversion alternatives on AQRVs in order to give a more comprehensive picture of the affected environment.

In regards to the potential impacts of the various Bellefonte conversion options on Class I areas including the Great Smoky Mountains National Park, modeling assessments suggest that the proposed Bellefonte PC and PFBC options, as configured, will have difficulty meeting the Class I sulfur dioxide (SO2) increment for the Great Smoky Mountains National Park and Cohutta Wilderness Class I areas. If relevant to the selected conversion alternative, this issue will be addressed as part of the PSD air permit application process.

Comment ID: 100

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.2.1

Comments: *TVA does a woefully inadequate job of addressing concerns about CO2.*

Response: The discussion of these potential impacts is contained in Cumulative Impacts on Global Warming (Section 4.4.2.3).

Comment ID: 130

Name: Stephen Smith and Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.2.1

Comments: *Emissions (Air Quality)*

There are concerns that emissions (especially SO2 and NOX) from the plant would cause non-compliance with air pollution standards. This is especially true with Chattanooga, Tennessee which is fairly close to the Bellefonte plant.

Additionally, the Environmental Protection Agency (EPA) is promulgating new standards for ozone and particulate matter emissions. The draft EIS does not address the impacts of the proposed options on these new standards. The environmental, economic, and human health impacts of these emissions need to be better studied.

Finally, there are concerns about the impact of more emissions on The Great Smoky Mountain National Park. There is already evidence of nitrogen *saturation into the soils and high stream acidification. Many of the Bellefonte proposals could exacerbate this problem. Relative to the IGCC option, it is indicated the sulfur removal of 99.5% if possible; TVA should indicate regarding "utilization of 24,800 tons per day of Illinois No. 6 coal," what the impact of the 0.5 % is.*

Because of the potential to exceed the standards for Class 1 SO2 increments in the Great Smoky Mountains National Park, TVA should abandon PC and PFBC options. Although there is discussion on how long it would take a plume to travel to this area, any continued additional air impact to the National Park is undesirable.

Nitrogen Oxides continue to be a concern as well. Emissions relative to the PC option are almost double of any other option and would have a significant impact on the production of O3. Ozone-like damage has been observed on 90 different species of plants, and the Smokies has the highest monitored levels of nitrogen deposition of anywhere in the United States and one of the highest levels of sulfur.

During the public hearing TVA dismissed the likelihood of revisions to the Clean Air Act relevant to ozone and PM. With the discussion of these revisions in the document, TVA should explore the economic and environmental repercussions of these revisions.

The document concludes that from an emissions minimization perspective, the most desirable option is NGCC and the least desirable is PC. Also, in terms of acidifying emissions per megawatt of production, the most desirable option is NGCC and the least desirable is PC.

Response: The intentionally conservative screening models used to support the Bellefonte EIS suggest that the proposed PC and PFBC options, as configured, may have trouble meeting the Class I sulfur dioxide increment. In each case, however, where difficulty was noted, strategies were identified which would reduce impacts to maintain attainment of NAAQS or to avoid exceeding PSD increments. The modeling of the Bellefonte conversion options was performed on a limited set of configurations. The purpose of this modeling was to provide a ranking of the relative air quality impacts and to allow the TVA decisionmakers flexibility in selecting, fuels, equipment, and BACT. This issue, if relevant to the selected option, will be addressed as part of the PSD air permit application process.

Supplementary information concerning the potential Bellefonte air quality impacts on natural resources has been added in the Cumulative Impacts of

Proposed Action on Air Quality (Section 4.4.2.1). Since each of the proposed Bellefonte options and variants will impact AQRVs, an evaluation of the possible role of emissions on visibility impairment, as well as on soils and stream acidification and injury to vegetation has been included. This section now includes a discussion on the effects of the sulfate and acid deposition to sensitive watersheds, including soil acidification, cation leaching, and surface water acidification, as well as a discussion of evidence of episodic acidification by nitrogen saturation and the possible combined role of ozone and moisture on foliar injury symptoms for ozone-sensitive species.

Since the printing of the DEIS, EPA has promulgated new standards. Chapters 3 and 4 of the FEIS have been revised to address these new standards for ozone and particulate matter. In addition, the NGCC conversion option has been selected as the preferred conversion alternative for the FEIS.

Comment ID: 134

Name: John H. Yancy

Affiliation: United States Department of Agriculture

DEIS Section: 4.2.1

Comments: *We noted that the analysis considered the effect the proposal's air emissions would have on visibility and consumption of Class I area PSD increments at Sipsey Wilderness.*

There are two other Class I areas, managed by the USDA Forest Service, located within the potential impact area of the Bellefonte project. I have reviewed the comments of the Forest Supervisors responsible for those Class I areas and share their concerns.

My only request is that you continue to consider the impacts this project will have on the Sipsey Class I area as you complete the environmental analysis and the PSD air permit application processes.

Response: Comment noted.

Comment ID: 136

Name: George G. Martin

Affiliation: U.S. Department of Agriculture

DEIS Section: 4.2.1

Comments: *We did not find estimates of total annual emissions for the various alternatives described in the DEIS. Therefore, we calculated estimates based on the limited information available and assuming that each alternative would operate at full capacity 365 days per year. We found that the PC (pulverized coal) option would emit SOx, NOx and PM Pollutants at rates (tons per year) of 26,000 tpy, 39,000 tpy and 2900 tpy; respectively. For the NG option, SOx, NOx and PM emissions would be 85 tpy, 10,000 tpy and 1200 tpy; respectively. For the IG option, SOx, NOx and PM emissions would be 6,300 tpy, 21,000 tpy and 1350 tpy; respectively. These are some very large numbers and we ask you to let us know if you find them in error.*

Response: The estimated SO2, NOx and PM10 emission rates (in grams per second) for the various alternatives are provided in Table 4.2.1-2. To convert these to tons per year, multiply grams per second by 34.762.

Comment ID: 145

Name: James H. Lee

Affiliation: United States Department of the Interior

DEIS Section: 4.2.1

Comments: *The DEIS does not state the magnitude of impact the emissions from the different alternatives would have at several DOI units, including Great Smoky Mountains National Park and Russell Cave National Monument (a Class II area), both administered by the NPS and three Class II National Wildlife Refuges, Blowing Wind Cave, Fern Cave, and Wheeler, which are administered by the Fish and Wildlife Service (FWS). The final EIS should state the impacts to the sulfur dioxide (SO2), PM-10, and nitrogen dioxide (NO2) Class I and Class II increments at those areas. The final EIS also needs to quantify the impacts to the AQRVs, including acid deposition of sulfates and nitrates, impacts to visibility in the form of uniform haze, and formation of ozone (O3) at the park and the monument, and the three refuges.*

Response: Modeling assessments suggest that the proposed Bellefonte PC and PFBC options, as configured, will have difficulty meeting the Class I SO2 increment for the Cohutta Wilderness and the Great Smoky Mountains National Park. If relevant, this issue will be addressed as part of the PSD air permit application process.

Analyses indicated that the PFBC variant of the PC option and the IGCC option would exceed the 24-hour SO2 PSD Class II increment and the distillate oil variant of the Combination option would exceed the PM Class II increment near the plant. Although the extent of the maximally impacted area varies somewhat due to differing source configurations, it is limited to a small area–on the order of one square kilometers or less–on elevated terrain (250 meters above the plant site) 3.3 kilometers east of the proposed plant site. The predicted impacts decline quickly beyond this area. Therefore, although not specifically estimated, the impact of the proposed Bellefonte conversion options on the Russell Cave National Monument, the Blowing Wind Cave National Gray Bat Sanctuary, Fern Cave Potential National Natural Landmark, or the Wheeler National Wildlife Refuge, would be substantially less than the Class II increments.

Additional information about AQRVs have been added concerning the potential impact of the proposed Bellefonte conversion alternatives in the Cumulative Impacts of Proposed Action on Air Quality (Section 4.4.2.1).

Comment ID: 146

Name: James H. Lee

Affiliation: United States Department of the Interior

DEIS Section: 4.2.1

Comments: *The air quality modeling analysis in the DEIS indicates SO2 and NO2 PSD Class II increment exceedances near the Bellefonte site, which is indicative of the impacts expected at the wildlife refuges and the national monument. Under certain conditions, Class I increments could be exceeded at both the Cohutta Wilderness and Great Smoky Mountains National Park Class I areas, as well. In addition, visibility impacts, including plume blight, are predicted at the Cohutta Wilderness.*

Response: Modeling analyses indicated that the PFBC variant of the PC option and the IGCC option would exceed the 24-hour SO2 PSD Class II increment and the distillate oil variant of the Combination option would exceed the PM Class II increment near the plant. The maximally impacted area varies somewhat because of source configuration differences but is limited to a very small area–one square kilometer or less–on elevated terrain (250 meters above the plant site) 3.3 kilometers east of the proposed plant site. The predicted maximum concentration falls off quickly beyond this area and therefore these maximum impacts are not indicative of the impacts predicted at the more distant wildlife refuges or the national monument.

Comment ID: 147

Name: James H. Lee

Affiliation: United States Department of the Interior

DEIS Section: 4.2.1

Comments: *Other than the "no action" alternative, the remaining five alternatives could result in impacts to the park, monument and refuges. One alternative not discussed in the DEIS is offsets. SAMI is investigating offsets as one of the adverse conditions experienced at Great Smoky Mountains National Park caused by emissions from older existing sources. Ozone Transport Assessment Group (OTAG) modeling has also demonstrated that ozone formation in this region of the country is nitrogen oxides (NOx) limited, and the NOx emissions from this project will exacerbate the formation of ozone. By obtaining offsets from existing TVA power plants near the park (either by shutting down old inefficient units or adding controls to them), the Bellefonte conversion project would greatly reduce its impacts to the park and mitigate some of the impacts to the refuges and monument.*

Response: Comment noted.

Comment ID: 31

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.4

Comments: *HAZARDOUS AND SOLID WASTES - It should be emphasized, however, that on-site storage drums must be properly labelled (date, type, etc.) pursuant to appropriate EPA and state laws, regulations and requirements. Additionally, any storage beyond 90 days would require a State of Alabama (with EPA oversight) RCRA storage permit. Consideration should be given to direct transport to an appropriate off-site disposal site to minimize the transportation and handling of hazardous wastes and the attendant possibility of accidents.*

Response: As stated in the DEIS, the TVA Hazardous Waste Storage Facility (HWSF) in Muscle Shoals would be responsible for arranging for disposal at a permitted disposal facility off site. Hazardous wastes will be stored onsite temporarily, prior to shipment to the TVA permitted HWSF, which has a storage capacity of 720 55-gallon equivalent containers. In addition, Bellefonte would be classified as a small quantity generator, and 40 CFR 262.34(d) states, "a generator who generates greater than 100 kilograms and less than 1000 kilograms of hazardous waste in a calendar month may accumulate hazardous waste onsite for 180 days or less without a permit or without having interim status..." Consideration will be given to the direct transport to an appropriate off-site disposal facility when environmentally and economically feasible. TVA will often directly ship hazardous waste to an ERAL-approved (Environmental Restricted Awards List) disposal site when the sites can combine loads or one site has a full load to ship. Per TVA environmental policy, the disposal of all TVA hazardous waste shall be coordinated through the HWSF in Muscle Shoals. The off-site disposal sites used by Bellefonte shall be listed on TVA's ERAL.

Comment ID: 34

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.5

Comments: *Page 3-20 addresses asbestos solid wastes. Continued coordination is recommended with the state regarding appropriate disposal of asbestos-containing waste products (insulation board, gaskets, etc.). Will any asbestos insulation be removed during proposed conversion? Appropriate removal and* *disposal methods would need to be followed and addressed in the FEIS.*

Response: There is a small possibility that asbestos removal may be required during conversion. As stated in section 4.2.18, TVA has an industrial hygene program included in its Site Safety and Health Plan a comprehensive health and safety document required of all work projects. Asbestos removal procedures would be followed for any asbestos removal work conducted in the course of conversion.

Comment ID: 35

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.5

Comments: *We strongly support the concept of the statement on page 4-51 that "TVA would adopt a hazardous waste minimization policy for the proposed facility, among other things substituting nonhazardous for hazardous materials whenever feasible."*

Response: Comment noted.

Comment ID: 26

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.6

Comments: *Plant surface water withdrawal requirements should continue to be coordinated with the COE and State of Alabama (pg. 5-2).*

Response: Comment noted. TVA would coordinate with State and Federal agencies as appropriate.

Comment ID: 24

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.6

Comments: *SURFACE WATER - For all options, it appears that a temperature 316(a) variance to the National Pollutant Discharge Elimination System (NPDES) permit would be needed. The current Alabama (ADEM) NPDES permit allows a maximum in-stream temperature of 30C, which is exceeded by ambient upstream temperatures for an average of 8.5 days per year in July-August (recorded max. of 32.2C). The FEIS should discuss the preliminary or final comments that have been received from ADEM regarding the need for such a variance or permit modification. We note that the maximum allowable ADEM temperature rise of +2.8C is not predicted to be exceeded (Table 4.2.6-8).*

Response: TVA has requested a 316(a) temperature variance from the Alabama Department of Environmental Management. No comments on the DEIS were received from ADEM.

Comment ID: 25

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.6

Comments: *Table 4.2.10-4b (pg. 4-91) depicts estimated discharge volumes by contaminant, by option. We note an apparent data gap for mercury under the PC option. The FEIS should clarify.*

Response: This comment is noted and the referenced table has been revised to include the estimated discharge mercury concentration for the PC option.

Comment ID: 28

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.6

Comments: *The new or modified stormwater NPDES permit administered under the authority of the State of Alabama (with EPA oversight) should address stormwater runoff from such storage for all sources and all outfalls. However, if on-site karstic areas do exist or are created, site runoff should not be routed to any karstic features such as sinkholes. We recommend that such on-site features be filled with soils that will allow slow infiltration of any incidental drainage.*

Response: A detailed engineering study would be conducted in the design phase of the project. These issues would be appropriately addressed in that study.

Comment ID: 32

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.6

Comments: *On-site fuel storage is planned for all alternatives, including large quantities (25 million gallons). Incidental spills should be minimized through monitoring and employee training and supplier assurances. Appropriate leak detection systems for above-ground and any underground storage tanks should be instituted. In the event leaks are detected, appropriate regulatory agencies must be notified within the required timeframe and appropriate remedial measures implemented. We note that a spill prevention control and countermeasure (SPCC) plan is currently in place.*

Response: On-site fuel storage is planned for all alternatives except PC. Once the decision is made as to alternative fuel(s), the plant will be designed to incorporate the appropriate spill protection system. This system will meet the requirements of 40 CFR 112. The existing SPCC Plan will be amended to incorporate these changes as required by the regulations. Appropriate agencies will be notified within the required time frame in the event of leaks and remedial measures implemented.

Comment ID: 33

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.6

Comments: *On-site storage of coal, petroleum coke and chemical co- and by-products may need to include liners and monitoring of leachate. The state (with EPA oversight) NPDES permit would need to address various point-source runoff such as coal pile runoff. The existing NPDES permit would need, at the discretion of the state, to be modified or a new one applied for if the converted plant would be considered a new facility. Impacts to water and air quality should also be minimized through, for example, source reduction methods such as the use of silos for coal storage.*

Response: The existing NPDES permit would be modified or a new one applied for if the converted plant would be considered a new or modified facility. Storage areas were evaluated to determine the need of liners. These areas were identified in sections 4.2.4.2 and 4.2.6.2. Preliminary designs do not include the use of silos for coal storage. TVA may consider their use later.

Comment ID: 77

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.2.7

Comments: *Relative to impacts on floodplains and floodways, I am very concerned about -- I believe it is probably at least option one and maybe option three and four that could potentially place some beds that would house fly ash and gypsum in a floodplain area...there is an extensive amount of flooding in this area.*

Response: In accordance with the requirements of Executive Order 11988, an evaluation of the impacts of locating facilities or other use areas in the 100-year floodplain was conducted (see Section 4.2.7). Only one option (pulverized coal) involved the use of land at an elevation below the 500-year floodplain. The selection of areas identified for gypsum and ash storage was based on an evaluation of alternatives (Appendix M) which concluded that the areas were the only practicable alternatives on the Bellefonte site. There is no record of extensive or frequent flooding in the areas identified. The water elevation in Guntersville Lake (and Town Creek which borders the proposed storage areas) is well controlled by TVA in accordance with multi-use reservoir objectives and rarely encroaches into areas above the 100-year flood elevation.

Gypsum and ash storage areas would be constructed with dykes higher than the 500-year elevation and would not be subject to innundation even if flooding on the river were to occur. The flood storage capacity removed by isolating the two areas from the river through dyking is extremely small (270 acre feet).

Comment ID: 27

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.8.1

Comments: *GROUNDWATER - The potential for groundwater contamination, however, exists from several sources during construction and operation. These include general construction activities, coal pile storage, chemical by- and co-product storage, fuel oil storage, various incidental spills during operation, etc. As such, appropriate liners (double plastic, clay or as required or approved) should be used and monitored as appropriate to protect against groundwater contamination.*

Response: Groundwater protection measures will be implemented in accordance with ADEM regulations during construction and operation of the plant.

Comment ID: 38

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.9

Comments: *TERRESTRIAL ECOLOGY - We note that 900 acres of the 1,600 acre site are currently developed and would be additionally developed to various degrees with the proposed project. What are the long-range plans for the site in terms of potential development? Is any portion of the site dedicated to mitigation or preserved in perpetuity (via the original 1974 EIS or otherwise)?*

Response: The site is currently classified as an industrial site and TVA plans to utilize this asset. No portion of the site is dedicated to mitigation or preservation in perpetuity.

Comment ID: 21

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.11

Comments: *WETLANDS - page 4-94 indicates that TVA expects a total of 12 acres of wetlands to be lost - four acres of forested wetlands and eight acres of rooted aquatic vegetation. EPA considers such wetlands valuable with losses difficult to compensate. Unavoidable wetland losses should be mitigated in the same watershed as the project with proper in-kind compensation such as wetland restoration, enhancement and/or creation. Coordination with the U.S. Army Corps of Engineers (COE) and EPA should be continued. The FEIS should update progress in this regard.*

Response: At the printing of this FEIS, further coordination with the U. S. Army Corps of Engineers has not been required. Prior to construction, TVA would coordinate with the U. S. Army Corps of Engineers as appropriate to ensure compliance with Section 404 of the CWA.

Comment ID: 23

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.11

Comments: *pg. 4-83. As such, it would appear that the predicted 12- or 20-acre wetland losses are avoidable consistent with 404(b)(1) guidelines because NGCC Option would not impact wetlands.*

Response: The preferred alternative for the FEIS is the NGCC Option, which avoids impacts to wetlands. However, regardless of the conversion option chosen, TVA would meet requirements of the CWA, which offer mitigation options to offset wetland impacts of a project for which there is no practicable alternative. Pursuant to EPA's regulations, an alternative is practicable when it is available and capable of being done after taking into account the cost, existing technology and logistics in light of overall project purposes.

Comment ID: 62

Name: Cliff Griggs

Affiliation:

DEIS Section: 4.2.12

Comments: *What is it going to do to the people of this area and to the tourism in this area?*

Response: As discussed in Section 4.2.12.1, under any of the action alternatives, there would be some temporary increase in population in the area during construction, largely in Jackson County. Numbers of persons and expected residential locations are discussed in this section. The size of the increase varies widely among the alternatives. As a result of this population increase, there may be some important impacts on the housing market, including increases in mobile homes in the area and increased demand for apartments and sleeping rooms. Community services, especially fire protection and schools, may experience some temporary strain. As discussed in Section 4.2.12.2, the long-term impacts on population, housing, and community services due to operations will be smaller.

Some strains on the local transportation network (Section 4.2.13) may occur, both during construction and during operation. No important impacts are expected as a result of changes in land use (Section 4.2.14). However, there would be some visual/aesthetic and recreational impacts, as discussed in Section 4.2.15. Visual/aesthetic impacts would be related largely to the addition of some new stacks and the vapor plumes associated with these stacks and to flaring. Recreational impacts would primarily affect lake recreationists, due to increased barge traffic. Increased noise may also impact some residents (Section 4.2.17). In addition, various impacts, generally light to moderate, on the natural environment will be felt as impacts by some residents (Sections 4.2.1 through 4.2.11). There is also some risk to health and safety due to potential for accidents at the plant site (Section 4.2.18).

As noted throughout the FEIS, TVA will adhere to all regulations and laws pertaining to this project and will take all reasonable steps to avoid, minimize, or mitigate these impacts.

Comment ID: 124

Name: Joseph R. Castleman

Affiliation: Department of the Army

DEIS Section: 4.2.13

Comments: *Reference Chapter 4.0, page 4-113, Figure 4.2.13-1. The legend on this chart has the shading of the Tennessee River Valley and the TVA Service area reversed. Also, the Pride Terminal is presently operating under the name Black Eagle Minerals, L. C.*

Response: The FEIS has been revised to reflect these comments.

Comment ID: 44

Name: F. Lawerence Oaks

Affiliation: State of Alabama

DEIS Section: 4.2.16

Comments: *We agree with the archaeological portion of the document that no significant sites will be impacted with the possible exception of 1 Ja 302 and that if impact is scheduled for this site, consultation with our office will take place. Regarding the historic structures within the community of Bellefonte, our earlier approval was some time ago and for this reason we request an update on the conditions of the structures associated with Bellefonte. Please forward photographs and written descriptions for each structure identified.*

Response: Further investigation was conducted and it was determined that no structures remain at the old town of Bellefonte; they have been removed by the owner in the intervening years. The FEIS has been revised to state that no structures will be impacted that are eligible for the National Register of Historic Places.

Comment ID: 36

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.2.17

Comments: *NOISE - We note that both the Ldn (=DNL) and Leq metrics were used. Since it was assumed (pg. 4-131) that construction noise would not occur at night, the use of Leq would be appropriate for construction noise assessments.*

* *The averaged time period should have been assigned to the Leq metric (e.g., 1 hr (Leq1); 12 hr (Leq12), other).*

* *Use of DNL for operational noise is appropriate since the power plant would be operating continuously and would affect residences.*

* *The TVA use of 75 dB Leq as a threshold for a startle-effect may be reasonable; however, this is dependent upon the individual receptor and the*

ambient noise level (i.e., the threshold could be considerably less for some and more for others).

**   An "assumed" ambient level of 50-55 dB DNL and use of 50 dB DNL for comparisons against plant noise contributions should be substantiated (i.e., were any ambient measurements made at the four ambient noise stations selected?). Given that 50 dB DNL was used as the ambient and +3 dB DNL and greater was used to determine significant increases, the accuracy of the ambient is important in determining if predicted increases are significant.*

** A conversion from 50-55 dB DNL to an Leq value should also have been provided to establish a baseline (ambient) for presented Leq data. We assume it would be less than 50 dB Leq due to the DNL 10 dB nighttime penalty.*

** The use of Leq for the flare stack noise may be inappropriate since we assume that such noise is a short-term single event. Such measurements should be instantaneous measurements (dB) rather than an average (Leq or Ldn), since averaging tends to level out the peak noise levels of interest. However, if flare stack noise is of a one-hour duration or more, use of Leq(1) would be appropriate.*

** The use of 65 dB DNL threshold for traffic noise results is somewhat unusual. Typically, the Federal Highway Administration (FHWA) predicts traffic noise levels in the form of Leq (formerly also L10) as opposed to DNL. The noise abatement criteria levels considered important for potential mitigation are those approaching or exceeding 67 dB Leq(1) for residences and 72 dB Leq(1) for businesses.*

** We assume that presented modeling results are resultant noise levels attributable to the plant at a given ambient level, i.e., are not only plant contributions that would still need to be added to ambient to obtain resultant levels. The FEIS should clarify.*

** We note the discussion (pg. 4-127) regarding the above-mentioned FICON conclusion to consider +1.5 db DNL as a significant noise increase in areas of 65 db DNL or greater and +3 db DNL for areas less than 65 db DNL. We believe this to be an accurate interpretation. We also note the DEIS reference to a previous EPA comment letter on an unrelated TVA EIS in which EPA cited a +2.5 db DNL increase as being significant. Our reference in that letter should have been +1.5 db DNL as opposed to the cited +2.5 db DNL increase.*

The DEIS suggests that TVA provide warning before these events to reduce startle effects for residents. However, no commitment was made in the noise *section (pg. 4-131) or the mitigation section (pg. 4-194); therefore, the FEIS should commit to such mitigation and the proposed method(s) of notification. In addition, approximate frequencies of occurrence per a given timeframe (week, month or year) should also be estimated. What startle-effects are expected for the heron rookery at 76-77 dB Leq? Are there any relevant studies in the literature? Also in regard to construction, the FEIS should indicate the expected lengths of time for construction by option.*

However, as suggested above, no commitments for implementation of such construction or operation measures are included. While we understand that some of these measures would only apply for certain options and that no preferred option has been identified, we believe the FEIS should conceptually commit to the implementation of project noise mitigation and, to the extent feasible, to specific mitigative measures (e.g., no nighttime construction, advance public notification of intrusive single-event noises, source reduction technologies, etc.).

We also note that no mitigative measures were listed for certain predicted impacts, specifically noise impacts to residences along the highways expected to be used for truck delivery/return traffic. Such traffic should be limited to daytime hours, be enumerated (number of trips in and out per day, week or month), possible alternate routes to distribute the impacts, comparison of predicted noise levels against FHWA noise abatement criteria (see above), and possible mitigation for residences affected. However, traffic increases would be due to project activities. Coordination with the FHWA/ALDOT is suggested. Possibilities include earthen vegetated berms and installation of central air conditioning for low-income housing (if relevant) so that windows could be closed during the summertime. Residences located within the designated impact radius of the plant (e.g., 5 miles) should be so considered. It should be noted that selection of options with low delivery traffic and a smaller workforce (e.g., NGCC option) would reduce noise impacts at the source.

Response: As described in Section 3.1.17 of the DEIS, ambient sound levels were measured by TVA at Bellefonte in the fall of 1995, the winter of 1995-1996, and the summer of 1996 at four locations. The Ldn values of these four locations ranged from 50 to 55 Ldn, which are typical of an idled plant in a semi-rural area. These four locations were inside the fence line of Bellefonte. These are not the four locations used in the impact analyses to estimate off-site impacts. No measured data are available for these off-site impact receptor sites. However, TVA believes that an assumed 50 Ldn value for these off-site areas is reasonable because off-site and on-site noise conditions appear to be consistent across the area. Moreover, the use of a 50 Ldn value provides a conservatively low baseline estimate which would tend to overstate plant construction and operational impacts rather than understate them.

As to the conversion from Ldn to Leq, this was done on page 4-131 of the DEIS where a parenthetical phrase stated that the 50 to 55 Ldn values would approximate 50 dBA during daylight hours. To more accurately communicate this, the FEIS will state that the assumed daytime baseline noise level is 50 dBA Leq (8).

The flare noises typically last one hour or less. For modeling purposes, it was assumed that they would last one hour and therefore the Leq metric was used. The Ldn metric was used for traffic noise because car and truck traffic will be spread out over long periods of time given the long construction schedules and the overlap with the operational activities which usually tends to have traffic peaks associated with shift changes.

EPA's assumption is correct although the data presented in Table 4.2.17-4 show only incremental impacts. The FEIS will clarify this by stating that all data are resultant and Table 4.2.17-4 will be changed from incremental to resultant estimates.

TVA has revised the FEIS to reflect the 1.5 dBA change. This, in turn, will affect what TVA has defined as substantive increase, namely a 2.0 dBA increase (which we now define as detectable but not significantly adverse). This threshold change was made throughout the section.

The construction periods are listed in Section 2.2 in various charts for each option. The text has been revised in the noise impact section to show the duration for each option (which ranges from 5 years for the IGCC/C to 10 years for the Combination). Mitigation will be conducted as described below.

To meet the need to both (1) maintain flexibility for the plant design and operation and to provide sufficient latitude for the construction contractor and (2) to make a commitment to avoid (or reduce to the extent practicable) adverse noise impacts, TVA will commit to the following actions, which have been included in greater detail in Section 4.5 of the Final EIS.

1. Once plans for construction have been developed, a noise assessment will be conducted to determine measures for mitigating any offsite noise impacts that exceed the 65 Ldn level (the threshold of significance used in the impacts evaluation).

2. All residents near the plant will be notified of steam cleanouts to reduce the

"startle effect" of such events.

3. TVA will periodically conduct noise monitoring to assess impacts and to help design any additional mitigation measures needed.

Comment ID: 51

Name: Randy Eminger and John Paul

Affiliation: The Center for Energy & Economic Development

DEIS Section: 4.3

Comments: *Compressor station emissions should be included in evaluations of the environmental impact of resource alternative #2: The proposed Bellefonte project alternative #2 requires additional gas pipelines to be built. Since these pipelines would not be constructed unless the Bellefonte project is built as a gas fired station, its environmental emissions should be included in the evaluation and modeling of the environmental impacts for alternative #2. Most environmental emissions associated with the pipeline are from the operation of a compressor station. The estimated emissions for the gas turbine compressor are quantified on pg. 4-161 and show that it would qualify as a major source. However, the location, permitting and potential impact of those emissions are not modeled or discussed in the document.*

Response: Due to the preliminary nature of pipeline and compressor station design, the locations and types of compressors are unknown. The emission data listed in the EIS are typical for natural gas pipeline compressor stations for pipelines of this magnitude. When, and if, a new natural gas pipeline is required to supply Bellefonte, ambient air quality impacts will be evaluated based on more precise emission estimates and the location of any new gas fired compressor stations. This work will be required as part of an EA or EIS that would be required to comply with Federal Energy Regulatory Commission (FERC) pipeline certification. Regardless of compressor station location, size, and type, such sources are subject to permitting reviews by the applicable state agency(s) which ensure ambient air quality standards are not exceeded.

Comment ID: 41

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.4

Comments: *Induced impacts of the proposed plant conversion should be addressed in the FEIS. Induced impacts are primarily associated with the fact that additional power would be available which in turn may expedite or induce development, which often will result in additional pollution. Conversion to the NGCC or Combination option would result in construction and operation of a natural gas pipeline which might also result in secondary development impacts due to gas availability. The FEIS should acknowledge such induced impacts.*

Response: It is not likely that the production of electrical power in or near Bellefonte, given prices remain stable, would induce secondary development since development in that area is not currently constrained by the availability of electrical power. A fully adequate supply is now available to users in the Scottsboro area from TVA's transmission system. Consequently, it would not be expected that induced growth would result from the Bellefonte's conversion to fossil fuel.

New supplies of natural gas, on the other hand, could likely lead to secondary development. The EIS has been revised to acknowledge possible impacts due to secondary development induced by the expanded availability of natural gas. New information has been added to Section 4.4, Indirect and Cumulative Effects to qualitatively acknowledge such impacts. As discussed in Section 2.3.1, impacts would be addressed by a subsequent NEPA review once a conversion option involving natural gas had been selected and specific routes had been identified.

Comment ID: 131

Name: Stephen Smith and Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.4

Comments: *Global Climate Change*
In addition to the impact on regional air quality, the issue of global climate change (GCC) has been completely ignored in the EIS. TVA is the largest single emitter of CO2 in the country. I would like to see TVA become more aggressive about reducing its emissions - not bringing more on-line. Investing in Bellefonte as a fossil fuel alternative can only continue to add to the impacts of GCC. TVA's commitment to be a Climate Change Partner is suspect with this endeavor.

Response: Global climate change was addressed in Section 4.4.2.3.

Comment ID: 39

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.4.2

Comments: *CUMULATIVE IMPACTS - All impacts (direct, indirect, secondary, induced, etc.) should be addressed in a CIA.*

We suggest that the FEIS document the major kinds of impacts that can be expected from these facilities and relate them to Bellefonte impacts. Any qualitative/quantitative information regarding the impacts of these nearby facilities (air quality, noise, discharges, etc.) would also be useful to the CIA.

The FEIS should also document existing area facilities in the same manner as discussed above. Special emphasis should be placed on any other power plants located in the area or region and their fuel source.

Response: Comment noted. Additional information has been included in the FEIS to address the cumulative effects on surface water.

Comment ID: 40

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.4.2

Comments: *It is unclear from Table 4.4.2-2a and 4.4.2-2b as to why the IGCC option would generate more SO2 emissions than the PC option. Specifically, we note that the percent of the SO2 standard generated by the IGCC option is 51.8% for a 24-hour period (vs. 47.3% for PC) and 61.9% for a 3-hour period (vs. 60.5% for PC). This appears inconsistent with the statement on page 4-174 in this section stating that "[q]uantitatively, SO2 emissions from the PC Option and PFBC variant emit more than four times as much SO2 as any other option or variant and, consequently, would have the greatest potential environmental impact on SO2 ambient air quality and secondary pollution related to SO2." The table values should therefore be verified. We would expect that the coal gasification technology would produce less SO2 than the PC technology (unless the above values are possibly due to the greater proposed capacity of the IGCC option (2,720 MW for IGCC vs. 2,400 MW for PC) or possibly the relative stack heights). The FEIS should clarify.*

Response: We believe you may have inadvertently misinterpreted Tables 4.4.2-2a and 4.4.2-2b. In order to assess the potential "worst-case" impacts of the proposed Bellefonte repowering alternatives on cumulative air quality impacts we added the "worst-case" modeled maximum concentration to the "worst-case" observations from 1990-1991 PSD monitoring. Since the maximum modeled concentrations of various pollutants are dependent, to a large degree, on plant configuration (e.g. stack height, plume rise) the differences you note are due to differences in configuration and not to emission rates.

Comment ID: 76

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.4.2

Comments: *Relative to the water quality impacts that these conversion options provide us, I am very, very concerned about TVA's complicit activity to file for permits to continue to degrade water quality not only relative to options that we have here but from other options that are considered throughout the TVA service area.*

It doesn't bother TVA one bit to consider going after a permit that would allow for them to increase the thermal pollution that would occur with some of the conversion options that we have here as well as potential wetland impacts that could occur within the construction process.

Response: Section 4.4.2 has been revised to include an evaluation of cumulative effects of discharges on water quality downstream of the proposed discharges.

Section 4.2.6 of the EIS evaluates the impacts of construction and operation of each option on surface water quality. The Cornell Mixing Zone Expert System (CORMIX) was used to evaluate the thermal impact of the proposed options. In the summary section of Surface Water Temperature, the conclusion was reached that "regardless of which option is chosen, the impact on maximum surface water temperature is very slight. The maximum temperature rise would be well below the Alabama limit of 2.8°C.

The Clean Water Act has provisions for the mitigation of wetlands that would be lost in the construction process of 4 of the 5 options. TVA would comply with appropriate State and Federal regulations and mitigate to offset impacts to wetlands as necessary. However, please note that the Preferred Option, NGCC would not impact wetlands.

Comment ID: 114

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.4.2

Comments: *Again I'll mention that TVA emits more than 110 million tons of carbon dioxide, one hundred million tons per year. That's more than any other utility in the United States. They are continuing to look at options to emit more CO2 into the atmosphere. Again, I think there is a responsibility on we as American's part to show and to at least show by example on how we need to proceed into a more global economy; and when we are out there burning more CO2 than any other country in the world, I think it's setting a very bad precedence for our very existence on this planet.*

Response: Global climate change was addressed in Section 4.4.2.3.

Comment ID: 113

Name: Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.4.2

Comments: *"This is TVA's statement on cumulative impacts on global warming and global climate change. This is how much credibility TVA has given this issue. Let me read this. The limited understanding of global climate change suggests that in order to protect human health and welfare in the environment, the emission of green house gases should be stabilized "at a level that would prevent dangerous interference with the climate system." Now there has been some reference made to some of the weather activities that have happened recently and I just want people to see, This is how serious TVA is about environmental stewardship. They give one sentence and one page and maybe two other sentences to this issue and it's just inadequate.*

Response: Section 4.2.1 assesses the impacts of each conversion option on the environment. The reader is referred to section 4.4.2.1, Cumulative Impacts of Proposed Action on Air Quality for further analyses and evaluation of these options on global warming.

Comment ID: 30

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.4.2.3

Comments: *GLOBAL CLIMATE CHANGE - A discussion on climate change impacts was not noticed in the air quality section (pg. 4-6) or as a separate section of the DEIS. The FEIS should address this topic and include information such as the tons per year (TPY) contributions of greenhouse gases for each option, particularly the selected preferred alternative. Source reduction methods should also be explored and commitments made as feasible. The 1994 EPA EIS on the Polk Power Station (Tampa Electric Company) near Tampa,* *Florida may be useful in developing this FEIS section. Additional EPA guidance is also available.*

Response: Global climate change was addressed in Section 4.4.2.3. Some of the Bellefonte conversion options emit considerably less carbon dioxide than others and these differences will be considered, along with other factors, in making the conversion selection. The preferred NGCC alternative emits considerably less carbon dioxide per MW than the all but one of the other fossil-fuel alternatives. The Polk Power Station EIS was considered in developing this section.

Comment ID: 101

Name: Stephen Smith

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.4.2.3

Comments: *The United States is going into global climate change negotiations here in a few months in Japan and yet TVA, the federal government's largest utility, is now proposing to burn more fossil fuels in light of a global climate change environment and doesn't even address that in the draft of your environmental impact statement.*

Response: Section 4.2.1 assesses the impacts of each conversion option on the environment. Some of the Bellefonte conversion options emit considerably less carbon dioxide than others and these differences will be considered, along with other factors, in making the conversion selection. The preferred NGCC alternative emits considerably less carbon dioxide per MW than all but one of the other fossil-fuel alternatives. The reader is referred to section 4.4.2.1, Cumulative Impacts of Proposed Action on Air Quality for further analyses and evaluation of these options on global warming.

Comment ID: 102

Name: Stephen Smith and Michelle Neal-Conlon

Affiliation: Tennessee Valley Energy Reform Coalition

DEIS Section: 4.4.2.3

Comments: *Smith -- TVA is going to be asked to be more pro-active on global climate change and converting Bellefonte to a fossil fuel plant makes no sense.*

Neal-Conlon -- Pulling out this document again, I want to tell you how again how inadequate it is relative to some of the issues that we are facing in our environment today. This is TVA's statement on cumulative impacts on global warming and global climate change. This is how much credibility TVA has given this issue.

Response: Global climate change was addressed in Section 4.4.2.3. Additional information about global climate change and greenhouse gas emissions is contained in Energy Vision 2020 Chapter 9, page 9.24 and Volume Two, Technical Document 1, page T1.70.

Comment ID: 37

Name: Heinz J. Mueller

Affiliation: U.S. Environmental Protection Agency

DEIS Section: 4.9

Comments: *ENVIRONMENTAL JUSTICE (EJ) - Tables 4.9-1 and 4.9-2 provide U.S. Census data (percent non-whites vs. whites) and population percentages below the poverty line. Although the text provides general demographic comparisons of non-whites in nearby cities versus the county, the actual percentage of non-whites for Jackson County and the State of Alabama were apparently not stated in this section. The FEIS should provide the Jackson County and State of Alabama percentages of non-white populations and compare them against local census data percentages.*

Tables 4.9-1 and 4.9-2 present census "division" data and city data. While these are important and helpful to the EJ analysis, are any census data more specific to the plant site and a reasonable radius thereof (e.g., 5-mile radius) available? The FEIS should clarify. If not, the most specific census section(s) should be used and compared to the larger section(s) in which it is (they are) located, and then compared to the county and state. If percentages are similar, disproportionate impacts may not be a concern, unless pockets of *minority and/or low-income populations are noted within the block group. If minorities and/or low-income groups are substantively more represented than whites, EJ impacts may exist and should be further reviewed and mitigated.*

In this case, there appear to be concentrations of non-whites ("larger than the county average;" pg. 4-202) in the nearby cities of Hollywood, Scottsboro and Pisgah as well as more distant cities (Stevenson). We also note that 39% of the minority population of Jackson County resides in the Scottsboro census division, suggesting that this is a minority area.

Table 4.9-2 presents poverty line percentages by selected cities within Jackson County. Again, a comparison of more site-specific census data (if available) against state percentages should be pursued in the FEIS. It may be noted that based on a draft EPA Region 4 document entitled "Draft Environmental justice Protocol," low income is defined as earnings of $15,000 or less for a family of four.

Given that there at least are pockets of minorities in the vicinity of the site at higher percentages than the county (state?), TVA project coordination with these populations is advised. If not already initiated, we suggest thorough discussions with community leaders for the affected populations (non-white as well as white) to honestly discuss the expected project impacts (which should be minimized through commitments or implementation of mitigative measures) and to respond to public concerns. Such dialogue should occur in the affected neighborhood to facilitate access and attendance. The number of affected population and minority/low-income population should be determined. It should also be determined if the affected public, after full understanding of the proposed project, consider themselves as impacted or disproportionately impacted. Employment of affected inhabitants and TVA sponsoring of coursework leading toward possible employment for plant construction or operation may also be important (we note from page 4-204 that "[m]inorities would have equal access to all jobs"). Dialogue should continue with these groups to further inform them of TVA's selection of a preferred option and the associated predicted impacts, changes in project design, monitoring results during proposed operation, and health effects.

Response: State of Alabama data have been added to Table 4.9-1 so that state demographic comparisons can be made. A new table, 4.9-3, has been added to provide data on minority and low-income populations near the plant site at the smallest available geographic level (block groups). In addition, a discussion of these data has been added to Section 4.9. No disproportionate impacts have been identified. Concentrations of low-income and minority populations in such areas as Scottsboro are far enough away from the site that they would experience no disproportionate impacts. If actions are taken to implement any of the action alternatives, we will work with the local communities to mitigate negative impacts. This would include establishment of local communications channels and would involve all segments of the community, including low-income and minority residents.

Comment ID: 125

Name: Joseph R. Castleman

Affiliation: Department of the Army

DEIS Section: Appendix O

Comments: *Reference Appendix O, page 0-10, paragraph 4.1, Relevant Statutes and Regulations. The proper cite for Section 10 is 33 USC 403.*

Reference Appendix O, page O-10, paragraph 4.2, Required Permits. We recommend that the following parenthetical statement be added: (In the past TVA has not been required to obtain Section 10 permits for water use facilities constructed in the Tennessee River Basin. However, TVA remains subject to obtaining Section 404 permits when such activities require the discharge of dredged or fill material in waters of the U. S.)

Reference Appendix O, page O-10 & 11, paragraph 4.3, Applicability. We recommend that portions of this paragraph be rewritten as follows: Alabama does not...However, permits are required from the U. S. Army Corps of Engineers under authority of Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act for the construction of water use facilities such as water intake and outfall structures and barge terminal facilities.

The following analyses...
** Application and supporting documentation should be combined with Section 404 permit, if required.*
** COE would issue public...(obstructions to navigation) application are processed together.*

Reference Appendix O, page O-12, 13, paragraph 6.3, Applicability. We recommend that portions of this paragraph be rewritten as follows: Construction activities that result in the discharge of dredged or fill material in waters of the U. S. including wetlands are subject to regulations. A permit would be required only if construction affected these waters. A wetlands...is more than 3 acres, an individual...between 1 and 3 acres.

Generally, applicants...cannot practically avoid waters of the U. S., that the project minimized impacts to these waters, and that...to offset losses. Typical compensatory mitigation for wetland losses requires...disturbed.

The following analyses...
** COE would issue...(obstructions to navigation) application are processed together.*

Response: The FEIS has been revised to reflect these comments. However, TVA would not be required to obtain a permit under Section 10 of the Rivers and Harbor Act.