Reliability and Resiliency

What is Reliability?

We say we are reliable, but what does that really mean?

- Electricity delivered in the right amounts precisely when and where it is needed
 - Three Components:
 - Power Supply
 - Transmission
 - Regional Coordination
- Maintain area reliability, meet regulatory requirements, and support regional growth
- TVA measures Reliability by:
 - Load Not Served (LNS)
 - Connection Point Interruptions (CPI)



System reliability is maintained through continual work to repair/ replace/ upgrade system elements

TVA Transmission at a Glance



- 16,000+ circuit miles of line operated at 115-kV to 500-kV
- 500+ substations and switchyards (100-kV and above)
- 103,000+ transmission structures on
 237,000 right-of-way acres
- 1,200+ customer connection points
- 2 fully-operational Control Centers



1. second se	<u>Plants/Units</u>	First/Last in Service	<u>Capacity*</u> (MW)	<u>Capacity/Energy**</u> (percent)	
Hydro	30/113	1912/1978	5,433	15/12	
Coal	10/46	1951/1973	12,901	35/40	
Nuclear	3/6	1974/1996	6,724	19/33	
Gas CT/CC	13/98	1971/2012	9,242	25/10	
	 Contractual/ PPAs 	• Diesels • Renewa	ble 2,294	6/4	
Other			* Summer Net Cap ** Based on FY13	* Summer Net Capability as of 09/30/2013 ** Based on FY13 Energy Totals	

M System Operations: Keeping the Lights On

- System Operations Center: Nerve center of TVA
- 24 x 7 operations
- Real-Time monitoring of the TVA Transmission System
- System Operations Center fully backed up by the Regional Operations Center
- Critical systems can be executed independently
- Continuous balancing of load and generation



TVA Reliability: Duration of Outages

- TVA's current performance is within first quartile industry performance
- 99.999% reliability = 7.8 system minutes of Load Not Served (LNS)
- Issues putting 99.999% at risk:
 - Aging Assets
 - Tightening Regulations
 - Changing System Conditions



M TVA Reliability: Frequency of Outages

- TVA's current performance is within first quartile industry performance for Connection Point Interruption Frequency (CPIf)
- Includes sustained and momentary interruptions
- Top impacts to frequency of customer interruptions:
 - Weather (Lightning and Wind)
 - Aging Assets
 - Foreign Objects (Birds, Animals, and Debris)

Since 2004*, TVA has been a Top Quartile performer or better

*2004 was the first year of an Industry Benchmarking being available with all voltage classes



M TVA Reliability: Consistency of Voltage

- Voltage sags can shut down sensitive production systems
 - Downtime costs for 50MW sensitive industry >\$100k in production losses
- TVA's PQ Program goal is reducing voltage sags associated with transmission system faults
- Program targeted at top 100 largest industries in the Valley:
 - Food Production
 Plastics
 - Textiles
 Glass
 - Paper
- Primary Metals
 Electronics
- Printing
- Transportation
- Chemicals
- Rubber

Power Quality program is focused on keeping the industry in the TN Valley running smoothly



TVA Reliability: Matching Generation to Load



M Transmission: Connecting Generation to Load

- Real-Time balancing of generation (supply) and load (demand)
 - Generation includes native sources and purchases
 - Diverse plant types ramp at different rates
 - Changing generation mix can significantly impact ability to meet load requirements





 Sufficient Reserves must be maintained at all times to recover from unexpected large generation losses

M Planning for System Resiliency

- Generation decisions cannot be made without Transmission support
 - Projects must be in place to ensure power can still be delivered where needed

- Robust Transmission system is needed to provide flexibility and respond to system events
 - Localized storm damage does not impact the entire system
 - Single generator loss can be balanced with power from another source





M Big Picture Reliability: Eastern Interconnection



- TVA is one of 23 Planning Authorities in the Eastern Interconnection
- TVA has 68 interconnections with 12 neighboring systems
- Partner with other industry participants to,
 - Prevent cascade of instabilities across neighboring systems (NE Blackout)
 - Plan robust and flexible systems
 - Guarantee resource adequacy

TVA partners with others to ensure the reliability of the Eastern Interconnection and the U.S.