



Western
Area Power
Administration

Transformer Risk Strategy

Roadshow: Oct. 5 to Nov. 9, 2017



Topics

- ◆ Transformer Spare Need
- ◆ Objectives
- ◆ Events and Quantities
- ◆ Strategies for short lead time spares
 - ◆ WAPA Inventory
 - ◆ WAPA System Robustness – In-Service “Spares”
 - ◆ Grid Assurance
- ◆ Customer Feedback



Why are Spare Transformers Needed?

- ◆ WAPA has a commitment to its customers and the bulk electric system to be prepared for the loss of transformers.
 - ◆ Operational failures.
 - ◆ Catastrophic event – high impact, low likelihood.
- ◆ The unanticipated loss of a transformer in the bulk electric system directly impacts the resiliency/reliability of the system.
- ◆ High Voltage Power Transformers typically have an acquisition lead time of 18-24 months.
 - Unique characteristics of transformers require custom build.
 - Transformer can weigh up to 100 tons and contain 25,000 gallons of oil. Transportation requires multiple specialized vehicles, road permits, and task specific crews.



Typical WAPA High Voltage Transformer



Specialized Transportation



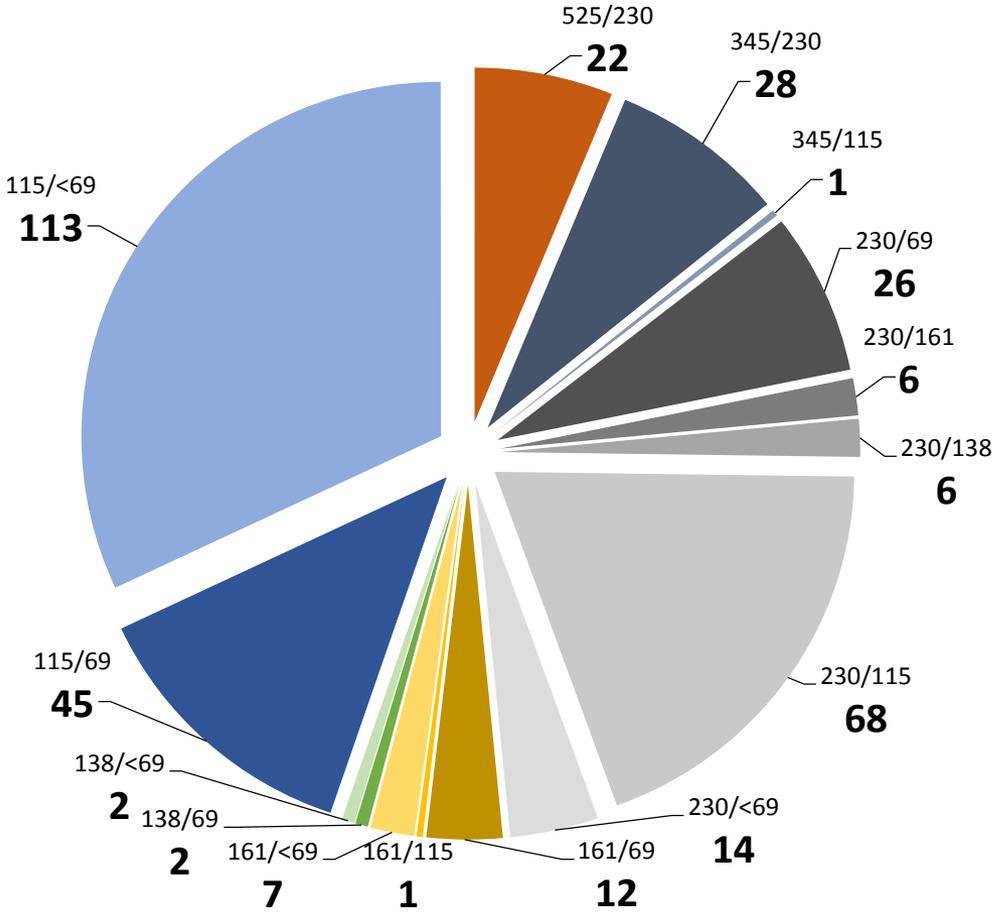
Analysis Objectives

- ◆ Develop and analyze alternatives for response to high impact events resulting in loss of multiple transformers.
 - ◆ Reduce/eliminate acquisition interval of transformers.
 - ◆ Complementary to existing sparing strategies.
- ◆ Solicit Feedback from WAPA SMEs and WAPA Customers.
- ◆ Develop recommendation incorporating customer feedback and regional expertise.
- ◆ Initiative is a WAPA-wide strategy intended to produce a recommendation that most efficiently uses WAPA's entire fleet of transformer options.



WAPA-Wide Transformers over 115kV Primary

Primary Voltage	Secondary Voltage	Number of Transformers
115000	12470	38
115000	13200	1
115000	13800	7
115000	14400	1
115000	2400	2
115000	24900	9
115000	34500	33
115000	4160	2
115000	41600	1
115000	41800	9
115000	57000	3
115000	60000	1
115000	69000	45
115000	6900	6
138000	12470	1
138000	2400	1
138000	69000	2
161000	115000	1
161000	13800	2
161000	34500	5
161000	69000	12
230000	115000	68
230000	12470	1
230000	138000	6
230000	161000	6
230000	20000	1
230000	21000	6
230000	280000	1
230000	34130	2
230000	4160	1
230000	41800	1
230000	60000	2
230000	69000	26
345000	115000	1
345000	230000	28
525000	230000	22
Total		354



Event Definition

- ◆ WAPA Analysis
 - ◆ Define three event types.
 - ◆ Assume loss of all assets within event zone.
- ◆ Local Event
 - ◆ Event center at WAPA facility.
 - ◆ Impacted sites are within 5 mile radius of center.
 - ◆ All WAPA facilities could be center of event.
- ◆ Seismic Event
 - ◆ Event center at Tracy or Mead facility.
 - ◆ Impacted sites are within 80 mile radius of center.
- ◆ Targeted Event
 - ◆ Event center at major population centers and military installations – 9 sites identified.
 - ◆ Impacted sites are within 50 mile radius of center.



Spares Needed

◆ Quantities

Primary Voltage	Secondary Voltage	Type	Number of Spares
525kV	230kV	Single Phase	3
345kV	230kV	Three Phase	2
230kV	161kV	Three Phase	1
230kV	115kV	Three Phase	3
230kV	115kV	Single Phase	3
230kV	69kV	Three Phase	3

◆ Why Now?

- ◆ Physical attacks on infrastructure have become more prevalent.
- ◆ Grid resiliency has garnered more interest in recent years as potential weaknesses in the utility industry have been identified.
- ◆ Power systems are being operated closer to their operating limits.



Alternatives Currently Under Evaluation

- ◆ WAPA Warehoused Alternative
- ◆ WAPA System Enhancement Alternative
- ◆ Grid Assurance Alternative
- ◆ Hybrid Alternative
- ◆ No Action – Status Quo



WAPA Warehoused Alternative

- ◆ WAPA Spare Transformers
 - ◆ Will warehouse in existing WAPA locations.
 - Event Impact zones must be considered.
 - Locations TBD.
 - ◆ May inventory more than one unit per voltage class.
 - Use multiple locations.
 - May use different specifications.
 - ◆ Will maintain and test on periodic basis.
 - ◆ Need to define refresh of inventory method.
- ◆ WAPA Responsibilities
 - ◆ Carry full cost of investment and maintenance.
 - ◆ Disassembly, assembly, installation and commissioning.
 - ◆ Logistics from warehouse to location.
- ◆ Method for funding and cost allocation will need to be defined.



WAPA System Enhancement Alternative

- ◆ WAPA Spare (Re-deployable) Transformers
 - ◆ Will be placed in-service in WAPA's system.
 - Event Impact zones must be considered.
 - Locations TBD.
 - Should bring operational benefit to system.
 - ◆ May inventory more than one unit per voltage class.
 - Use multiple locations.
 - May use different specifications.
 - ◆ Will maintain as an operational unit.
- ◆ WAPA Responsibilities
 - ◆ Carry full cost of investment and maintenance.
 - ◆ Disassembly, assembly, installation and commissioning.
 - ◆ Logistics from location to location.
- ◆ Method for funding and cost allocation will need to be defined.



Grid Assurance Alternative

- ◆ Grid Assurance Subscription Service.
- ◆ Method for funding and cost allocation will need to be defined....for all the options where assets may cross regional boundaries.



Feedback

- We want your feedback. We are in the beginning stages of assessing the various options and customer feedback is critical to our success.
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- A copy of this presentation can be found on The Source.

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