Electric Grid Resiliency
Real world Perspective

D.O.E - GMI Peer Review

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Agenda

• Resiliency
• Examples
• Future needs
• Summary
Resiliency

- Acceptance - Vulnerability
- Protect – Reasonable measures
- Respond – Innovative designs & practices
- Share – Knowledge, Equipment and Resources
Example – (1)

Challenge: Large Power Transformers (LPT) replacement
- Spares on hand
- Transport – size and weight
- Time to assemble & energize
- Impedance

Solution: Siemens single phase resiliency auto transformers
Example (1) Siemens single phase auto transformers

Salient features: 3 day restoration Vs 3 weeks

- Multi voltage:
  - 300 MVA – 345 to 138 kV
  - 150 MVA 138 to 69 kV
- Lightweight – each phase tank - 98 tons oil filled
- Load tap changer - +/- 12%
- 170% Overload capability 5 minutes
- Air transportable – C5A Galaxy
- Plug in solid resin core bushings – bullet resistant
- Flexible high voltage 230 kV cable with cable extender
- Modular relay & control cabinet with plug in wire & fiber connections
Example (2)

EMP proof - mobile Energy Control Center

Goals

• Storage
  – Sealed and protected
  – Receive periodic updates from production systems

• Transport
  – Pre-Planned routes
    • DOT Approved
  – Pre-determined deployment locations

• Deployment
  – Rapid mobilization
  – Quick connect into Verizon infrastructure
  – Utility Power or Generator
Example (2)

EMP proof - mobile Energy Control Center
Example (2)

EMP proof - mobile Energy Control Center – ESP Inc.
Example (3)

Loss of a distribution substation – Mobile 450 MW substation

Goals

• Mobile 100 MVA transformer
  – 138 kV to 13.8/27/33 kV with load tap changer.

• Mobile MV Switchgear
  – 4000 AMP – 24 circuit breaker total with cable bus connection – Double SYN bus configuration

• Transport
  – Pre-Planned routes
    • DOT Approved

• Deployment
  – Rapid mobilization
  – Energization at N-1 within a week
Examples

Loss of a substation – Siemens - mobile 450 MW substation
Near Future Needs

DOE & National Labs

- Cyber threat mitigation & recovery
- Adaptive relay protection and control systems
- Data conversion into actionable information
- Advanced material science
- Advanced HPI tools
- Efficient electrification
Summary

Leadership

– Culture shift – sharing & collaborating

– Engage - DOE & National Labs
  • We provide use cases & talent
  • Labs provide additional talent & workable solutions

– Engage - PUC for acceptance and approval