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Risk Insights on Grid Reliability Issues

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ENCLOSURE 4

Overview

- EPRI has been working with NRC and industry for over 20 years on grid reliability, EDG reliability & related matters
  - Divergence in earlier years in reliability data resolved
  - Over 50 reports published since early 1980s
  - Significant ongoing work at EPRI
  - Good cooperation with NRC, e.g., via MOU with RES
  - Some divergence re-emerging after Aug. 14 2003 event
- Goals of SBO Rule have been met or exceeded
- Industry already evaluating LOOP as part of Configuration Risk Management (CRM) and Maintenance Rule programs

Post 8/14 Event Divergence re: LOOP data

- No nuclear plant caused or contributed to the 8/14 event
- All affected plants performed as designed
- Arguments that problems now worse in summer are not supported statistically by closer review of the data:
  - Conclusion driven largely by one event -- which could have occurred during any month (e.g., typical small summer voltage sag not relevant to actual 8/14 event)
  - Root cause of LOOP events not correlated to season
  - Emergence of longer duration grid-related events as higher percentage of total LOOP events is driven by reducing # of shorter duration plant-centered events
  - Total number of LOOP events actually going down

Post 8/14 Event Divergence re: LOOP data

- Grid weakness can occur any time -- not a summer-related phenomena
  - Longest recent sustained grid weakness: CA, winter of 2001; “stage 3 conditions” for 776 hours in Jan/Feb
  - Major Northeast Blackout occurred in Nov. (1965)
- Grid weakness can occur whenever high demand (e.g., unexpected warm weather) and/or low supply (e.g., plants out for maintenance) exists; e.g., April 2005 in CA
- Primary causes of the LOOP events over last ten years:
  - random equipment failures
  - adverse weather conditions
  - August 14, 2003 event
  - random human errors

Other Observations

- EPRI agrees with the conclusions in NUREG-1776 that the SBO was effective in meeting NRC's risk expectations:
  - The plants with the greatest numbers of LOOP events due to extreme weather made the most improvements in alternate AC power supply
  - EDG reliability has been high, resulting in higher risk reduction than expected from the SBO rule
- Likelihood of grid-induced LOOP is function of plant location
  - End of transmission lines
  - Weather vulnerable regions
- Industry capabilities against LOOP events have greatly improved since days of SBO Rule implementation

Configuration Risk Management (CRM) Practices Concerning Grid Reliability

- EPRI Configuration Risk Management Forum (CRMF) is a focal point for assessing current CRM practices
- CRM focused on managing risk due to planned and unplanned conditions, including consideration of grid issues
- Based on a CRM Survey, grid reliability is addressed in the majority of CRM models
  - Goal of survey was to examine the methods of assessing the impacts of grid disturbances on plant risk (Maintenance Rule (a)(4))
  - ~ 85% of plant sites (86 units) responded

More Details on CRM Survey

- Survey examined three specific types of grid disturbances
  - Severe weather
  - Switchyard maintenance activities
  - Other external events that could affect the grid (e.g., grid instability, regional flooding, forest fires)
- Conditions affecting risk may or may not be under the control of plant staff (e.g., switchyard maintenance vs. severe weather)
- Quantitative and qualitative means are being used
- CRM requires increased controls when conditions indicate

EPRI Transmission Grid Action Plan

- Establishing industry guidance:
  - Relay coordination between generator and the grid
  - Method to estimate probability of cascading grid events
  - Zone of Vulnerability for the nuclear plants for grid faults
  - Switchyard maintenance – role of human error
- Addressing equipment issues
  - Equipment Configuration Risk Management Program
  - Transformer and Switchyard Users Group:
    - Transformers, switchyard equipment, grid interfaces
  - TG torsional problems due to grid oscillations
  - FACTS (‘Electronic VARs’) devices for voltage support

Recent EPRI Reports and Studies

- Frequency Determination Method for Cascading Grid Events (1011759, December 2005)
- Losses of Off-Site Power at U.S. Nuclear Power Plants – Through 2003 (1009889, April 2004)
- Analysis of the Causes of Loss of Offsite Power at Nuclear Power Plants (1009890, August 2004)
- Losses of Off-site Power at U.S. Nuclear Power Plants, Technical Update for 2004 (1011764, May 2005)

EPRI POCs on Grid Reliability

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