U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

RIC 2011

Adequacy of Station Electric Distribution System Voltages—Degraded Voltage Protection

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AN INDUSTRY PERSPECTIVE OF Adequacy of Station Electric Distribution System Voltages— Degraded Voltage Protection

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Historical DVR Milestones

- July 1976 – Millstone Unit 2
- September 1978 – Arkansas Nuclear One
  - Licensees received SERs on DVR design
- Early 1990's - EDSFI Reviews begin
- Mid 2000's to present - CDBIs

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INDUSTRY PERSPECTIVE

- Degraded voltage protection has been implemented at nuclear plants using various methodologies with regulatory approval
- Degraded voltage protection design has increased the potential for unnecessary separation from the offsite transmission system.

DVR Regulatory Guidance

- NRC issued "Statement of Staff Positions Relative to Emergency Power Systems for Operating Reactors" - June 1977
- Generic Letter 79-36, August 8, 1979, "Adequacy of Station Electric Distribution Systems voltages"
- Branch Technical Position (BTP) of the Standard Review Plan (SRP/NUREG-0800), PSB-1, Revision 0, "Adequacy of Station Electric Distribution System Voltages," dated July 1981

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Draft RIS 2011-XX – "Adequacy of Station Electric Distribution System Voltage"

- RIS provides new interpretation of existing regulatory documents
  - DVR setting's based on both starting and running voltage requirements
- Implies analysis that leads to a delayed LOOP
  - "The staff considers degraded voltage conditions coincident with a postulated design basis accident to be a credible event"
- New requirements for time delays
- Inconsistent interpretation by some licensees (i.e. sustained, protect)
- Does not consider lessons learned since 1976 events

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Addressing DVR Concerns

- J. D. Kueck, G. H. Nicely, J. Chiloyan, H. C. Leake, T. R. Sims, N. Trehan, G. Attarian, and F. Baxter. "A discussion of degraded voltage relaying for nuclear generating stations." *IEEE Transactions on Nuclear Science*, vol. 45, August 1998.
- J. D. Kueck, G. E. Attarian, H. C. Leake, and T. R. Sims. "Risk factors regarding the application of degraded voltage relaying at Nuclear Generating Stations." *IEEE Transactions on Energy Conversion*, vol. 16, no. 4, December 2001.

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An Industry Evolved

- Analytical methods have improved
  - computer based with detailed modeling
  - Involvement with transmission organizations analysis
- Interface Agreements with Transmission Organizations
  - NERC NUC-001
- Managing and Prediction of Post-Trip Offsite Voltage
  - Use of state estimators & analysis
  - Coordination of work activities and outages
- IEEE 741 – Annex A issued, not endorsed by NRC

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Concerns with Current Regulatory Environment

- PSB-1 design incapable of protecting against LOCA with degraded voltage events
- Original NRC regulatory documents not in agreement (ex. 1977 Letter & PSB-1)
- Plants regulatory commitments not consistent
- Current guidance allows for an "Interpretation" by inspectors
- Key technical points not adequately explained
  - Consideration of starting versus running voltage
  - Time delay setting requirements

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Concerns with Current Regulatory Environment –Cont.

- Risk Factors Not Fully Addressed
  - Performing analysis that results in a delayed LOOP without considering failure mechanisms
  - Impact of CDBI inspections
  - Changes in DVR settings
    - Increasing the probability of premature separation and delayed LOOP events

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Summary of Concern

- Current CDBI inspections have resulted in inconsistent interpretations of original NRC DVR positions
  - Recent RIS does not change this direction
  - Previous approved designs will not meet today's interpretation (backfit, possible increase in reducing defense in-depth)
- Risk of current DVR design
  - Protection versus preventative strategy

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Recommend Actions Going Forward

- Forming an industry work shop to address degraded voltage protection
- NRC Endorsement of IEEE 741-Annex A -"**IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations**"

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