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New Plant Seismic Issues Resolution Program

High-Frequency Response Effects: Component Screening

May 31, 2007



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Recent EPRI Report

- EPRI White Paper Sent to the USNRC (March 16, 2007)
 - Considerations for nuclear power plant (NPP) equipment and structures subjected to response levels caused by high-frequency (HF) ground motions
 - Summarizes a significant amount of empirical and theoretical evidence, as well as regulatory precedents, which support the conclusion that such HF motions are non-damaging to virtually all types of nuclear power plant structures, systems, and components (SSCs)
- Key Further Actions Requested by the USNRC
 - Identify potentially high-frequency sensitive components
 - Establish screening criteria
 - Develop evaluation methods
 - Recommend additional testing procedures as appropriate

Existing HF Test Data

- NPP safety-related active components have been seismically qualified by IEEE 344 type tests for over 30 years with HF content present
 - Inadvertent HF, due to ball-joints and kinematic linkages of shake tables
 - Intentional HF, such as inclusion of concurrent BWR hydrodynamic response
- Existing qualification test data can be used to demonstrate that such exceedances do not affect component function

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Potentially HF Sensitive Components

- Electro-mechanical relays (e.g., control relays, time delay relays, protective relays)
- Electro-mechanical contactors (e.g., Motor Control Center (MCC) starters)
- Circuit breakers (e.g., molded case and power breakers – low and medium voltage)
- Auxiliary contacts (e.g., for Molded Case Circuit Breakers (MCCBs), fused disconnects, contactors/starters)
- Control switches (e.g., benchboard, panel, operator switches)
- Transfer switches (e.g., low and medium voltage switches with instrumentation)
- Process switches and sensors (e.g., pressure/diff. pressure, temperature, level, limit/position, and flow) (calibration stability)
- Potentiometers
- Digital/solid-state devices (Provisional; some have been used for years others may involve new technology)

Evaluation Methods

- Acceptable methods for resolving HF concerns not already addressed by certified design qualification include:
 - Review existing equipment qualification test data for adequate HF input motion
 - Review circuits containing potentially sensitive items for inappropriate system actions due to intermediacy or set point drifts
 - Screening test to identify any HF vulnerabilities
- Goal is to demonstrate that potential HF vulnerabilities are not present

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Screening Test Recommendations

- High-frequency motion between 25 and 50 Hz
 - Sine Sweep (log or linear rate)
 - Sine Beat at 1/3 octave spacing
 - Band-limited White Noise

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Screening Test Amplitude

- Screening level referenced to HF spectral acceleration
- Screening level to be proposed by Industry based on the type of test