



# NTTF 2.1 High Frequency Program Status Update

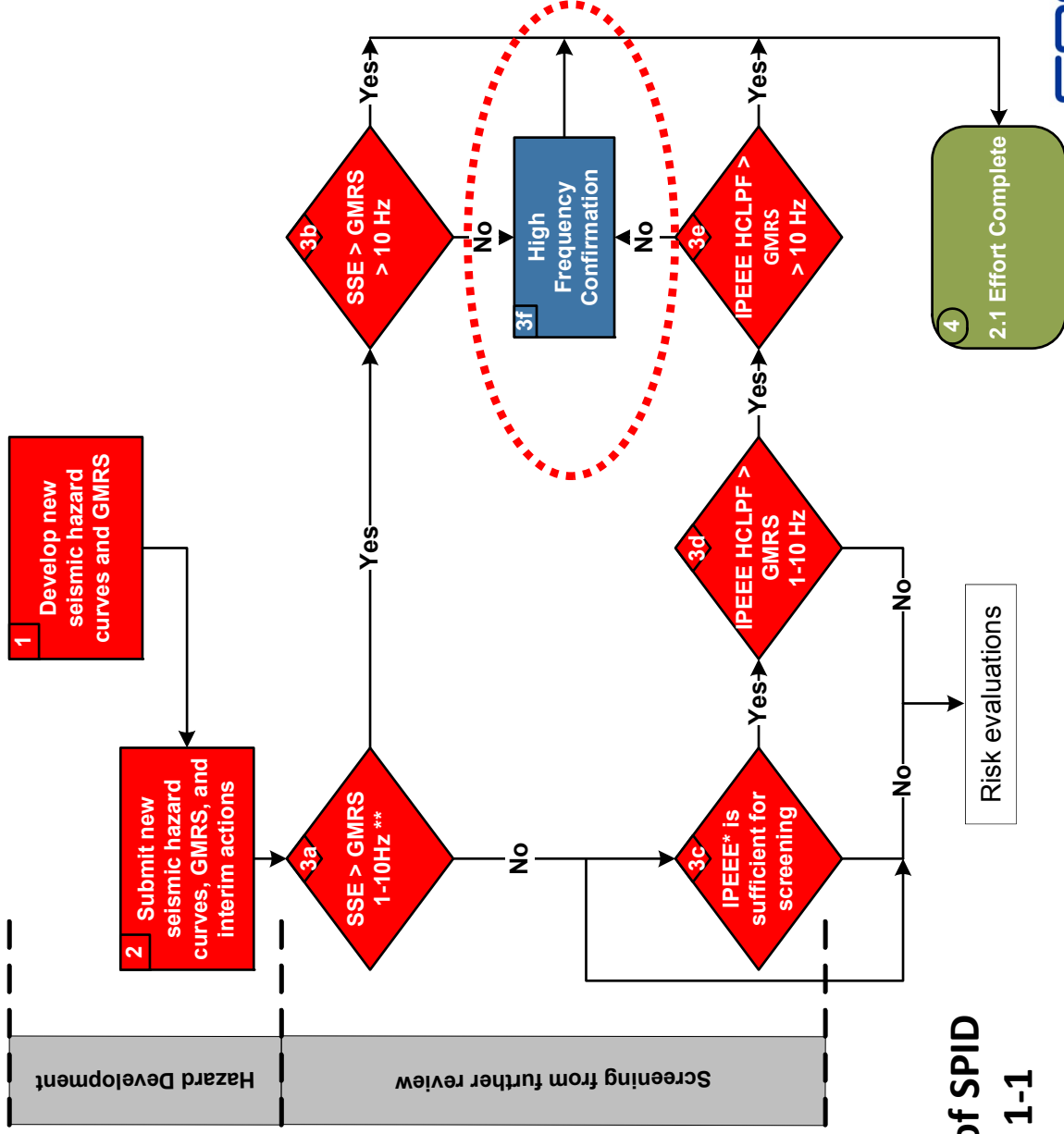
John Richards

EPRI

**NRC Meeting**

**October 27, 2014**

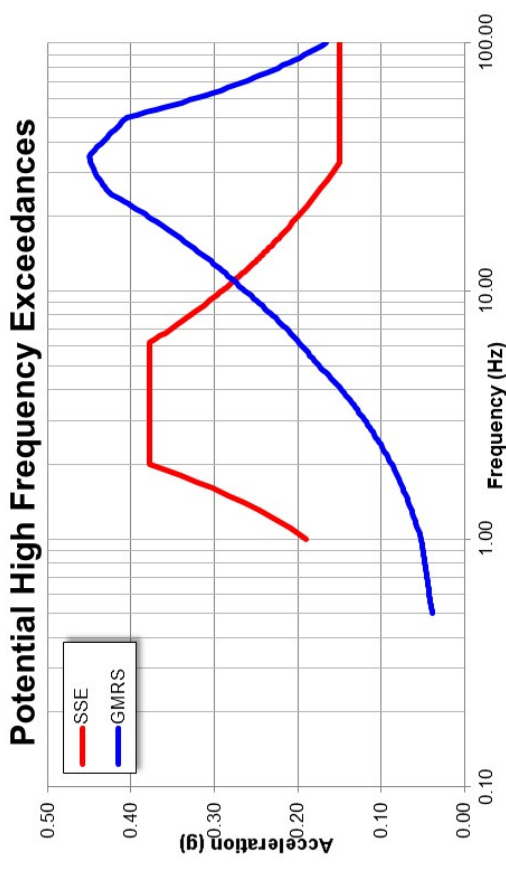
# High Frequency Program



Top half of SPID  
Figure 1-1

# High Frequency Program - Purpose

- Identify components potentially vulnerable to loss of function due to high frequency vibratory motion
  - Develop capacity data for potentially high-frequency sensitive components
  - Use accelerations that are high enough to address anticipated high frequency in-structure and in-cabinet responses of various plants
- Identify resolution strategies for components that prove to be sensitive to high frequency motion



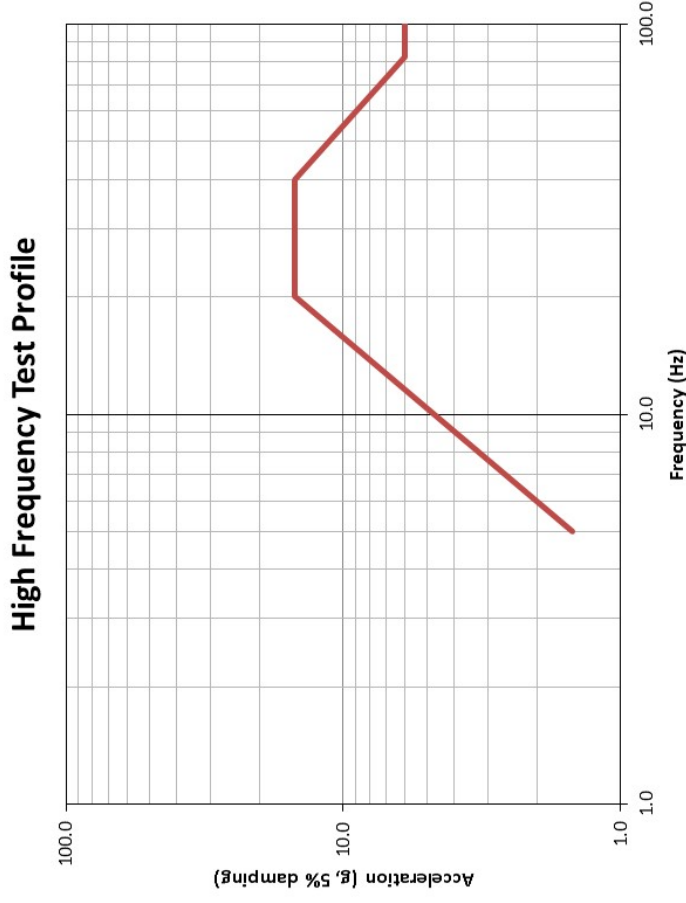
# High Frequency Program - Scope

## Component type list from SPID Table 3-3 (EPRI 1025287)

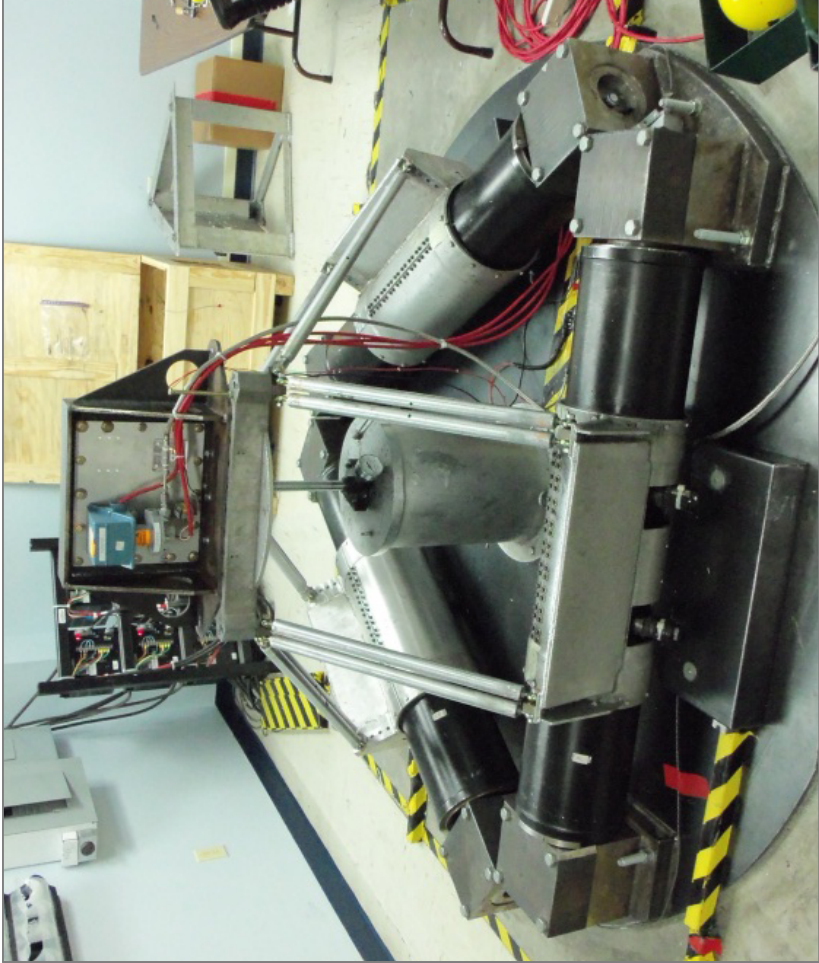
- Electro-mechanical relays (e.g., control relays, time delay relays, protective relays)
- Process switches and switches (e.g., pressure, temperature, flow, limit/position)
- Circuit breakers (e.g., molded case and power breakers – low and medium voltage)
- Auxiliary contacts (e.g., subcomponents of MCCBs, contactors / starters)
- Control switches (e.g., benchboard, panel, operator switches)
- Transfer switches (e.g., low and medium voltage switches with instrumentation)
- Electro-mechanical contactors (e.g., MCC starters)
- Potentiometers (without locking devices, and subcomponents of relays)

# High Frequency Test Protocol

- Testing conducted with a IEEE C37.98 shape spectra with a peak range from 20 Hz to 40 Hz
- Random-multi frequency input used in all three directions with independent input signals
- Component functional monitoring performed during the testing (e.g. 2ms chatter monitoring on relay contacts, continuity on circuit breakers and switches)
- Test acceleration levels increased until component malfunction or shake table limits
- Components tested in the energized and de-energized state

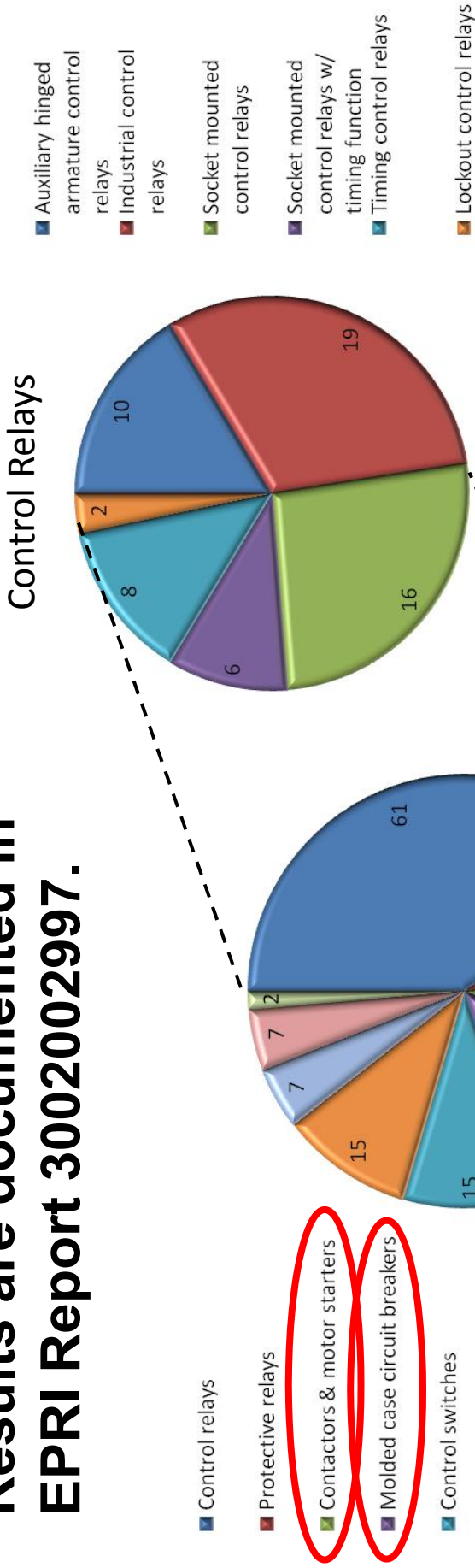


# Small and Large Test Samples



# High Frequency Program

Testing complete for 153 items.  
 Results are documented in  
 EPRI Report 3002002997.

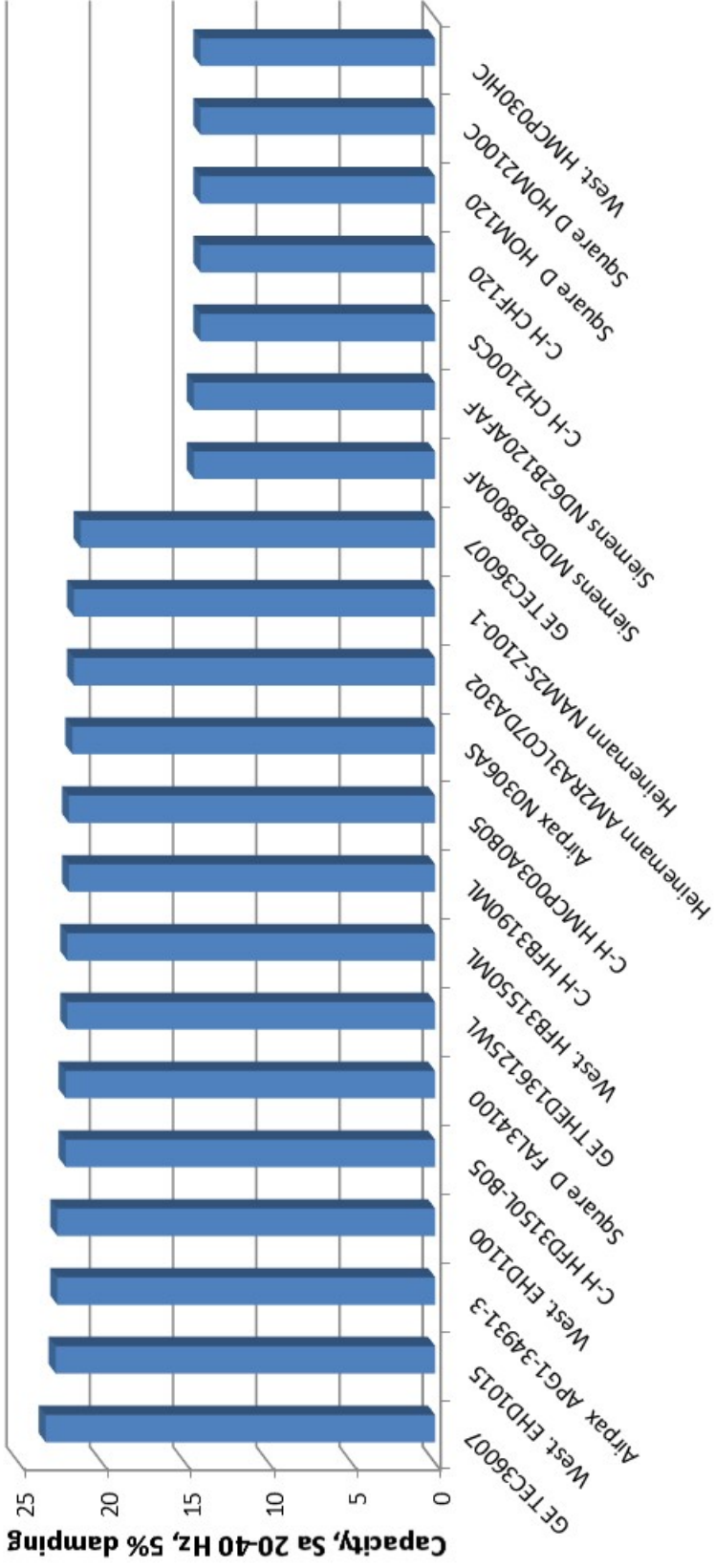


# Sample Results – MCCBs

All capacities at shake table limits.

All capacities > 10g spectral acceleration and many > 20g.

## Molded Case Circuit Breakers



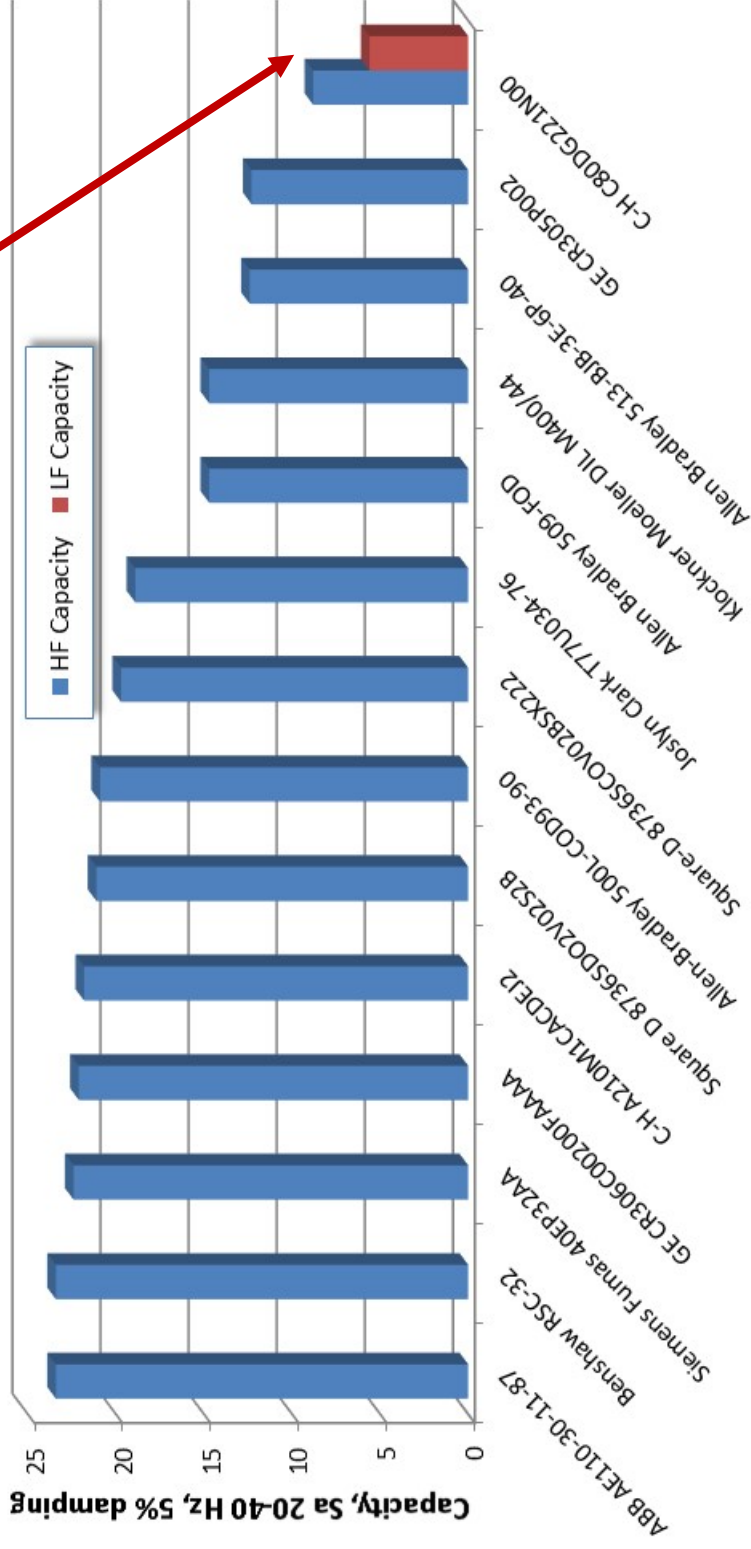


# Sample Results – Contactors & Motor Starters

More variation in capacity but most capacities > 10g spectral acceleration.

The 1 item with Sa <10g has a HF capacity greater than the 4.5-16 Hz frequency range capacity

Contactors & Motor Starters



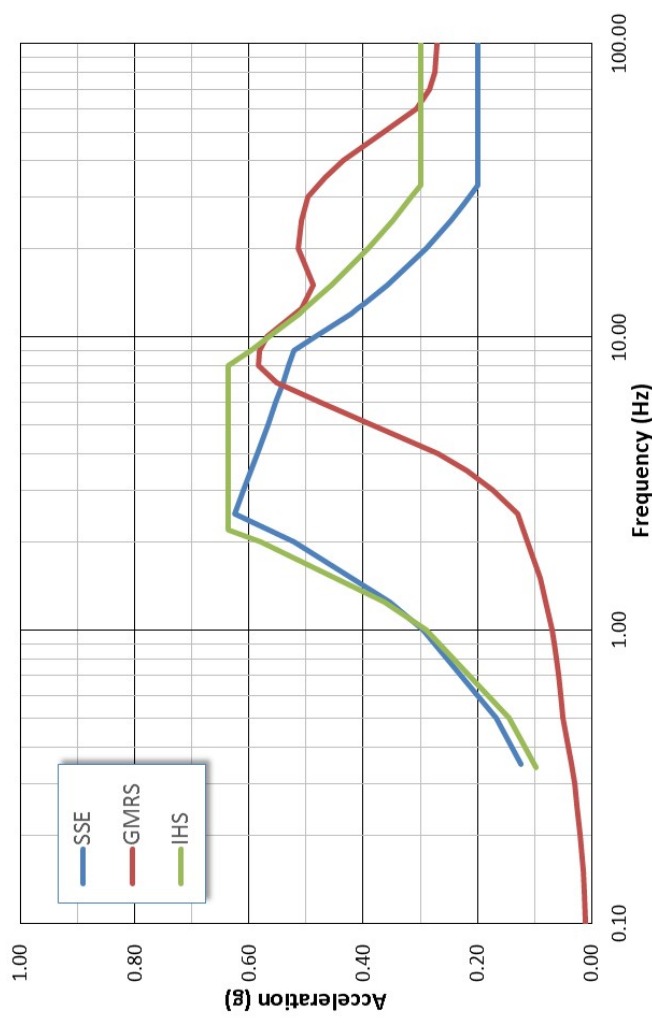
# Key Test Program Conclusions

- Most components are very rugged in the high-frequency range, passing the tests without contact chatter or malfunction at shake table limits.
- Components that showed contact chatter at high frequency accelerations less than 10g were compared with previous results from 4.5Hz to 16 Hz frequency range.
  - In all cases, the high-frequency capacity was equal to or great than the low-frequency capacity

**No unique high-frequency sensitivities were identified**

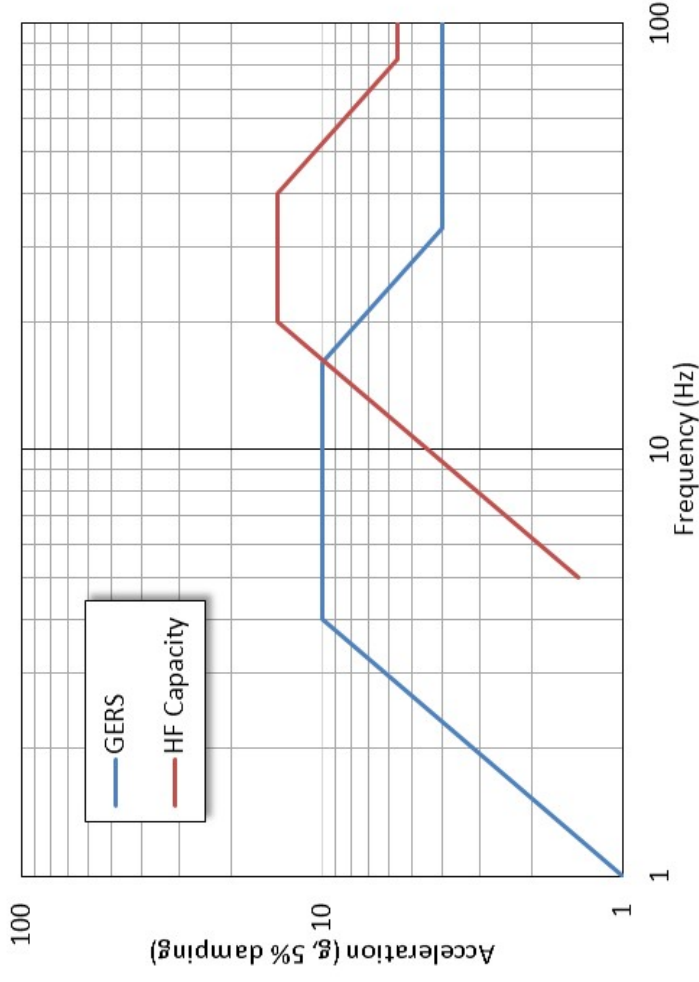
# High Frequency Confirmation Criteria

- Review site-specific HF exceedances
  - Some HF exceedances are modest and may be eligible for generic screening based on the lack of unique HF sensitivities
  - Some HF exceedances may warrant some limited level of plant-specific review to confirm a lack of high-frequency concern



# High Frequency Considerations in SPRAs

- Anticipate HF issues to be integrated with fragility calculations
- Considering an envelope of the 4-16 Hz capacity and the HF capacity



# High Frequency Confirmation Schedule

Task	Schedule
Develop proposed evaluation criteria	Oct – Dec 2014
Review with NRC	Jan – Feb 2015
Publish report	March 2015



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