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Slides for Oct 23, 2017, public meeting with NEI.

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50.69 Seismic Categorization Options

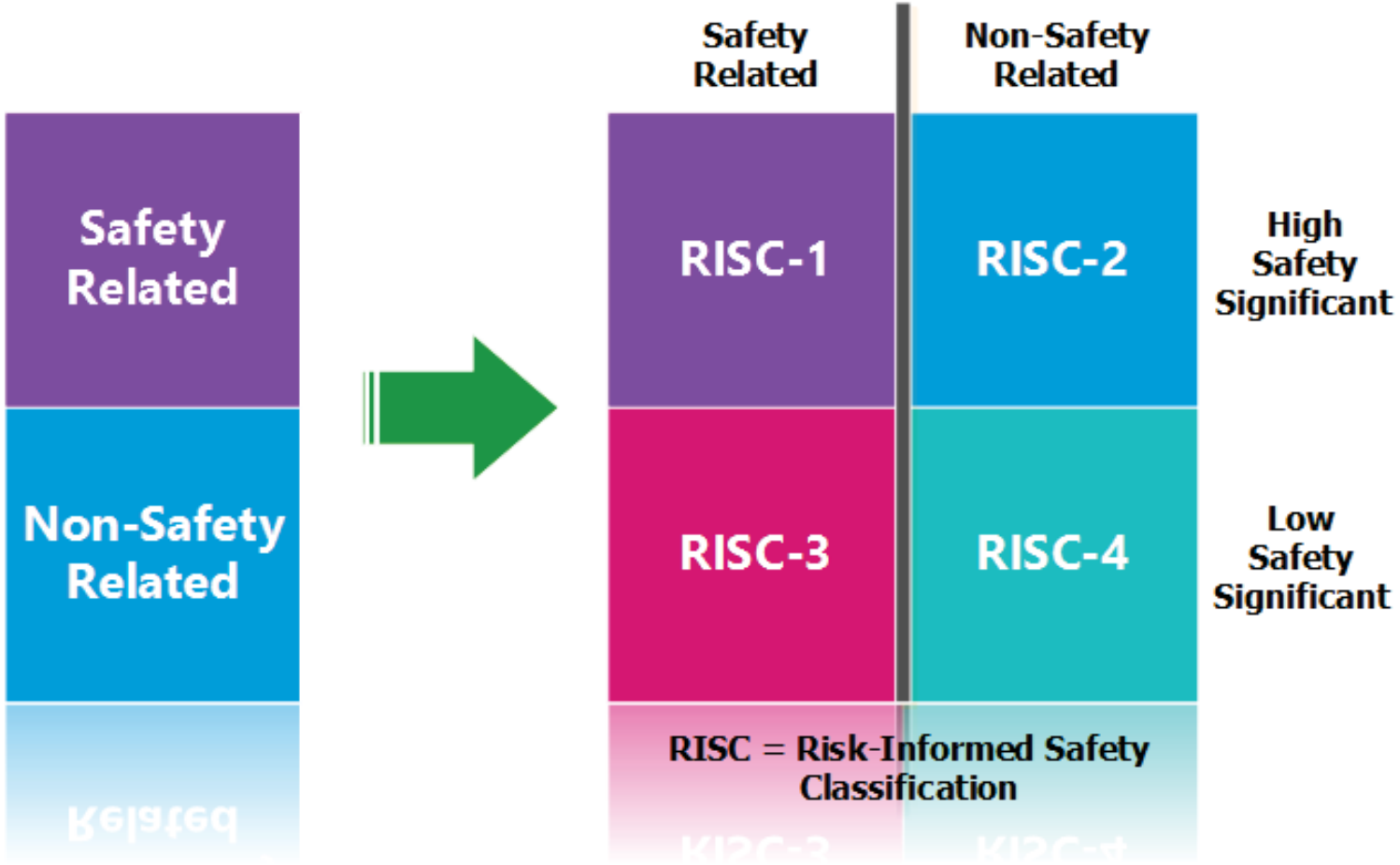
Phil Tarpinian, Exelon Nuclear
Bill Webster, Dominion Power
Greg Krueger, NEI
Greg Hardy, SGH
John Richards, EPRI

NRC Meeting
October 23, 2016

50.69 Seismic Categorization Options

- Review 50.69 categorization
- Discuss seismic risk inputs to categorization
- Present results from 2 sensitivity studies at sites with new SPRAs
- Listen to NRC Staff feedback
- Discuss path forward

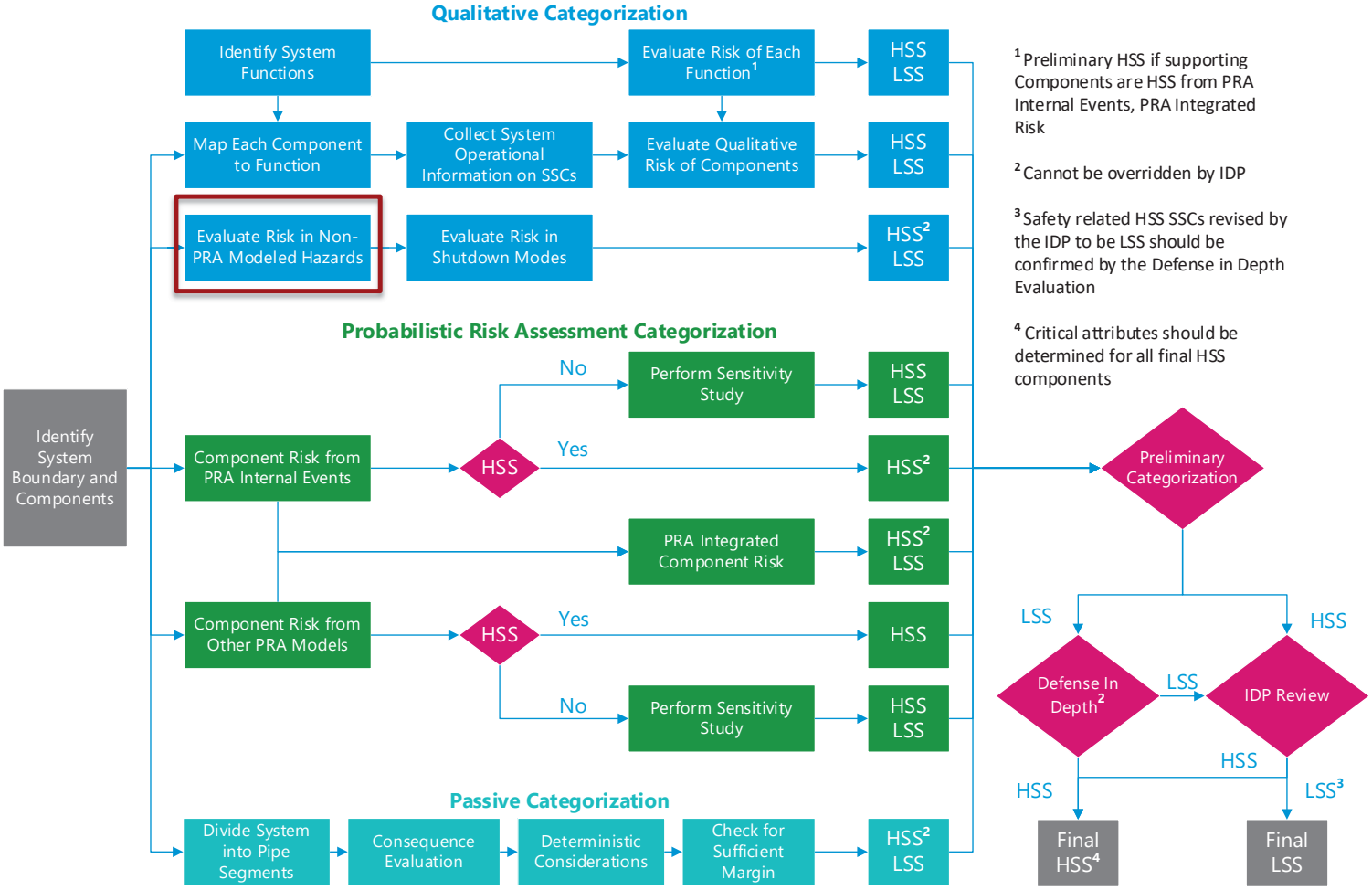
NEI 00-04 Risk Informed Categorization



NEI 00-04 Risk Informed Categorization

- Each of the elements below determines a separate categorization of the SSC used in the final categorization by the IDP
  - Qualitative risk assessment of supported system functions
  - Non-PRA modeled external hazard risk
  - Shutdown risk assessments
  - Probabilistic Risk Assessments
  - Passive categorization
  - Defense-in-depth assessments
- All components in a selected system must be categorized

NEI 00-04 Risk Informed Categorization



[1] Preliminary HSS if supporting Components are HSS from PRA Internal Events, PRA Integrated Risk

[2] Cannot be overridden by IDP

[3] Safety related HSS SSCs revised by the IDP to be LSS should be confirmed by the Defense in Depth Evaluation

[4] Critical attributes should be determined for all final HSS components

NEI 00-04 Risk Informed Categorization – Seismic Inputs

- NEI 00-04 recommends three options for considering seismic
  - Plants with Seismic PRAs can use risk ranking and sensitivity studies to determine seismic-related high safety significant (HSS) SSCs
  - Plants with IPEEE Seismic Margin Assessments cannot perform risk informed categorization; SSCs on seismic equipment list declared HSS
  - Plants with very low seismic CDF (< 1% of the Internal Events CDF) do not need to consider seismic insights in the categorization process

NEI 00-04 Risk Informed Categorization – Seismic Inputs

- There is a gap in the information plants have available to implement NEI 00-04
- A number of plants do not reasonably fit within any of the three available options
- Plants that did not perform an SMA for IPEEE and were also not required to perform an SPRA in response to Fukushima, do not have the tools available to implement NEI 00-04

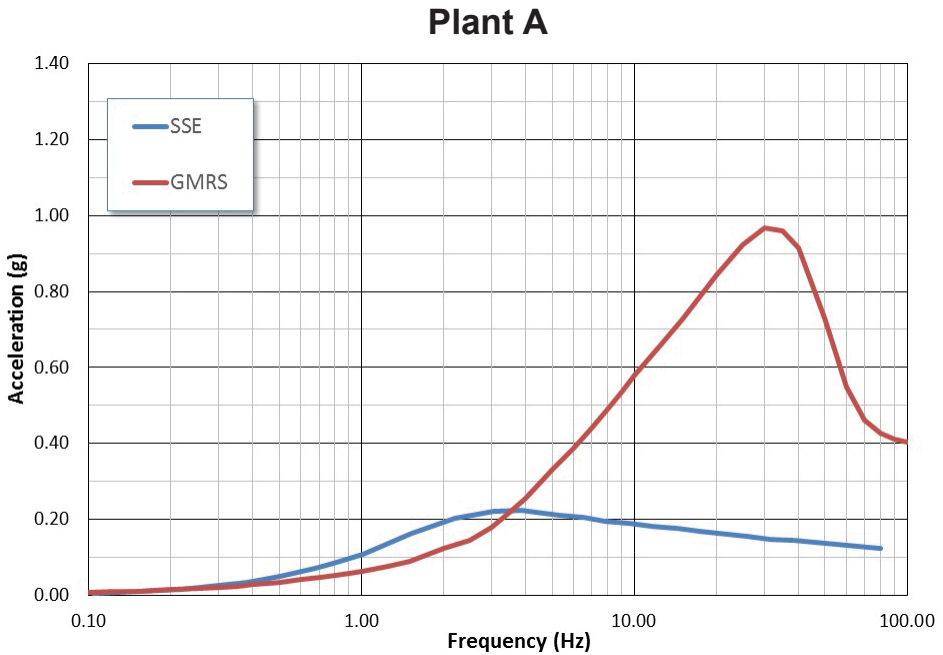
NEI 00-04 Risk Informed Categorization – Seismic Inputs

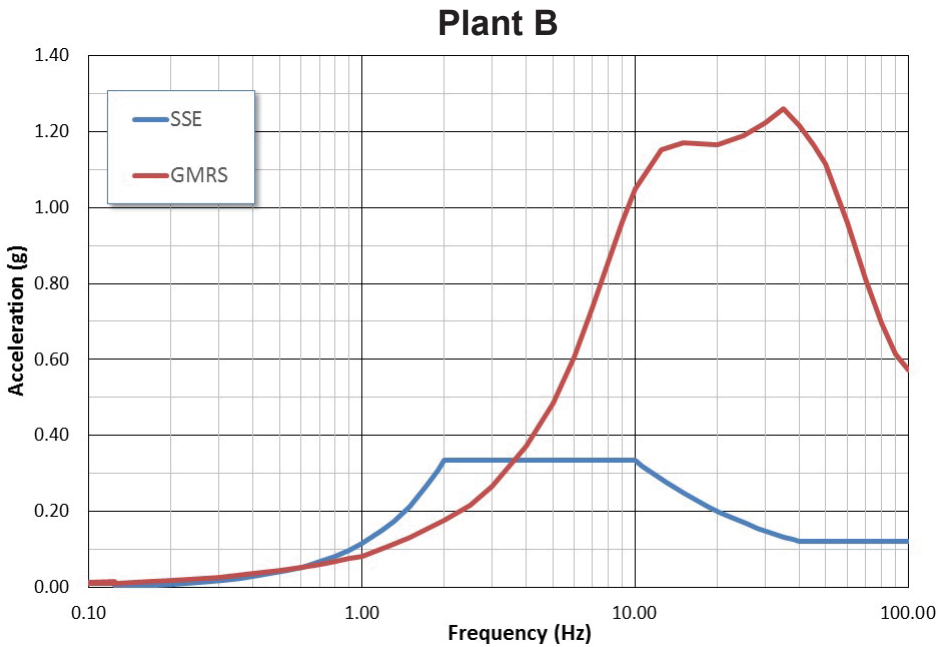
- For plants that do not have new SPRAs, the key question is whether or not seismic considerations provide unique risk insights in the 50.69 categorization process that would lead SSCs to be HSS?
  - Through the NTTF 2.1 50.59(f) letter response process, licensees submitted updated seismic hazard estimates and the NRC has identified the plants where SPRAs are appropriate to evaluate seismic safety
  - Other plants are generally not performing SPRAs and are less likely to identify unique seismic categorization issues

50.69 Seismic Categorization Sensitivity Studies

- Using high seismic ground motion plants with new SPRAs as test cases, determine how many and what kinds of SSCs would be categorized as HSS due to different hazard PRAs
  - Using Full Power Internal Events (FPIE), Fire, and Seismic PRA models, identify HSS components based on importance measures for the PRA model types
  - Compare risk-significant (HSS) seismic components to those derived from internal events and/or fire models
- Performed studies for two plants with high seismic hazards and new Seismic PRAs
- Results portrayed on the following slides

50.69 Seismic Categorization Sensitivity Studies





Sensitivity Study – Plant A

- Sensitivity study performed following risk evaluation criteria in NEI 00-04
  - Using the Full Power Internal Events (FPIE) PRA, items with Fussell-Vesely ≥ 0.005 or RAW > 2 are identified as High Safety Significant (HSS)
  - Similarly, items with Fussell-Vesely ≥ 0.005 or RAW > 2 in the Fire PRA and Seismic PRA are identified as HSS

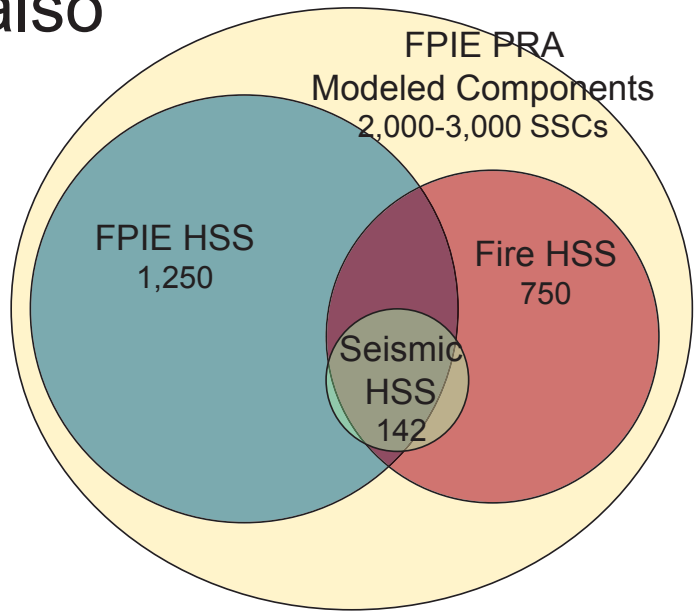
Sensitivity Study – Plant A Seismic Fragility Groups

Fragility Group ID	Fragility Group Description	HSS for Internal Events or Fire PRAs
OSP	Offsite Power	Yes
S-DCBT1-	DC Batteries 2(A-D)D01, 3(A-D)D01	Yes
S-CNWG1-	Conowingo Hydroelectric Plant (UHS)	Yes
S-CEPA1-	Panel 20C003, 20C004C, 30C003, 30C004C, 00C29(A-D)	Yes
S-CC014-	Correlated Relay Group 14 (All 4KV Buses-Unrecoverable)	Yes
S-DGTK2	E1-E4 EDG Fuel Oil Tank 0(A-D)T40	Yes
S-ECST1-	Emergency Cooling Tower Structure	Yes
S-DCBS2-	125 VDC Busses/MCCs 0(A-D)D13	Yes
S-DCBS8-	DC Panel 2BD306, 3DD306	Yes
S-ACBS10	4.16 KV EMERGENCY AUX SEGREGATED BUS 00A19, 00A20	Yes
S-CNWG2-	Conowingo Hydroelectric Plant (OSP)	Yes
S-CC023-	Correlated Relay Group 23 (All EDGs-Recoverable)	Yes
S-ACBS1--	4160V Buses 20A(15-18), 30A(15-18)	Yes
S-DCBS6	DC Panel 2(A-D)D17, 3AD17, 3CD17, 3DD17	Yes

NOTE: *The 14 correlated fragility groups encompass the 142 seismic HSS components*

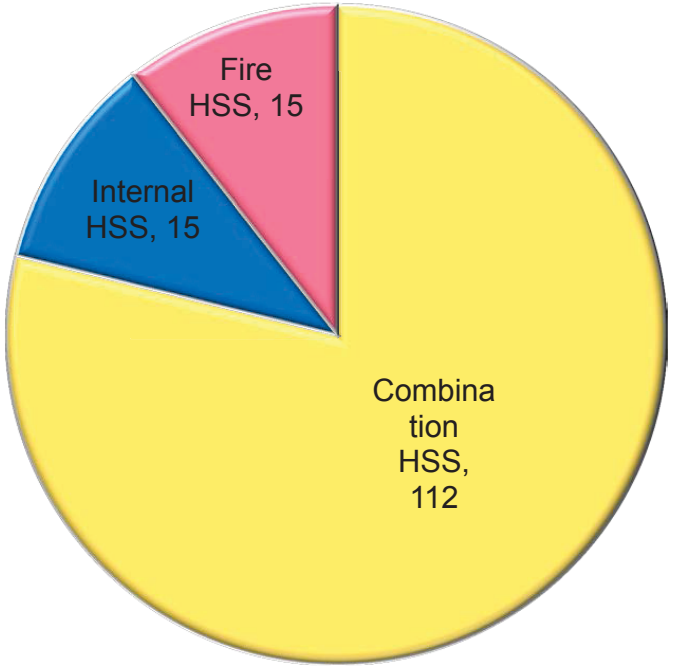
Sensitivity Study – Plant A

- Some components HSS exclusively from the FPIE or Fire PRA model
- 142 HSS components from SPRA
- All risk-significant seismic SSCs were also HSS from either the FPIE model, the Fire model (or both)
- No components are exclusively HSS from SPRA model (i.e. no unique HSS seismic components)



Sensitivity Study – Plant A HSS Components by Model

- Total of 142 HSS SSCs from SPRA
  - Vast majority (112 components) are HSS from *both* the Internal Events and Fire PRA models
  - 15 also HSS from FPIE only
  - 15 also HSS from Fire PRA only
  - None uniquely HSS from Seismic
- Data on per-unit basis



Sensitivity Study – Plant B

- Sensitivity study performed following risk evaluation criteria in NEI 00-04
  - Using the Full Power Internal Events (FPIE) PRA, items with Fussell-Vesely ≥ 0.005 are identified as High Safety Significant (HSS)
  - Similarly, items with Fussell-Vesely ≥ 0.005 in the Seismic PRA are identified as HSS

Sensitivity Study – Plant B, Fragility Groups F-V ≥ 0.005

Fragility Group ID	Fragility Group Description	HSS for Internal Events
SEIS-BDB-DB-123	BEYOND DESIGN BASIS DISTRIBUTION PANELS	Yes
SEIS-BLDG-AFW	AUXILIARY FEEDWATER PUMPHOUSE	Yes
SEIS-BLDG-RC	REACTOR CONTAINMENT BUILDING	Yes
SEIS-BLDG-SWVH	SERVICE WATER VALVE HOUSE	Yes
SEIS-BY-B-1-24	STATION BATTERIES 1-II AND 1-IV	Yes
SEIS-CC-E-1AB	COMPONENT COOLING HEAT EXCHANGERS - Aux Bldg SW Flood	Yes
SEIS-CH-P-1ABC-RLY	CHARGING PUMPS - RELAY CHATTER	Yes
SEIS-CN-TK-1	EMERGENCY CONDENSATE STORAGE TANK	Yes
SEIS-EDG-HJ-NR-RLY	3A Relay in 1H EDG circuit	Yes
SEIS-EDG-HJ-RLY	EMERGENCY DIESEL GENERATORS - RELAY CHATTER	Yes
SEIS-EE-BKR-HJ2-RLY	15H2 AND 15J2 BREAKERS - RELAY	Yes
SEIS-EE-BKR-HJ8-RLY	4160V TO 480V LCC BREAKERS - RELAY CHATTER	Yes
SEIS-EG-B-1234	EDG Batteries	Yes
SEIS-EG-P-HAB-JAB	EDG FUEL OIL PUMPS	Yes
SEIS-EI-CB-MCR-PNL	SEISMIC FAILURE OF MCR BOARDS AND PANELS	Yes
SEIS-EP-CB-12ABCD	125 VDC DISTRIBUTION PANELS	Yes
SEIS-EP-CB-4ABCD	120 VAC VITAL BUS DISTRIBUTION PANELS	Yes
SEIS-EP-SS-1H-1J	480V LOAD CONTROL CENTERS 1H AND 1J	Yes
SEIS-EP-SW-1H-1J	4160V EMERGENCY BUSES	Yes
SEIS-FW-P-2	TURBINE-DRIVEN AUXILIARY FEEDWATER PUMP	Yes
SEIS-FW-P-3AB-RLY	MOTOR-DRIVEN AFW PUMPS - RELAY CHATTER	Yes
SEIS-LOOP	SEISMIC-INDUCED LOSS OF OFFSITE POWER	Yes
SEIS-MLOCA	MEDIUM RCS PIPE BREAK	Yes
SEIS-MS-PCV-101ABC	STEAM GENERATOR ATMOSPHERIC DUMP VALVES	Yes
SEIS-QS-TK-1	REFUELING WATER STORAGE TANK	Yes
SEIS-RC-CNTRL-RODS	REACTOR CONTROL RODS	Yes
SEIS-RS-P-1AB-RLY	INSIDE RS PUMP - RELAY CHATTER	Yes
SEIS-RS-P-2AB-RLYSS	Outside RS Pumps Spuriously Start due to Relay Chatter	Yes
SEIS-SI-P-1AB-RLY	LOW HEAD SI PUMP - RELAY CHATTER	Yes
SEIS-SLOCA	SEISMIC-INDUCED SMALL LOCA	Yes
SEIS-SSLOCA	SEISMIC-INDUCED SMALL-SMALL LOCA	Yes
SEIS-SW-P-1AB-RLY	SERVICE WATER PUMPS - RELAY CHATTE	Yes
SEIS-VB-INV-1234	120 VAC VITAL BUS INVERTERS	Yes

Sensitivity Study – Plant B

- There are 166 fragility groups modeled in the SPRA representing 785 SSCs in the Unit 1 SPRA and 706 SSCs in the Unit 2 SPRA
- There are 33 fragility groups that have FV ≥ 0.005 representing 179 SSCs in Unit 1 and 173 in Unit 2
- All of the SPRA HSS SSCs are also HSS in the FPIE model

50.69 Seismic Categorization Sensitivity Studies

- Sensitivity studies show that seismic considerations do not provide unique insights
  - HSS SSCs identified in the seismic PRAs are also identified in the FPIE PRA and/or Fire PRA
- Insights from these two cases demonstrate that even for high seismic hazard plants, seismic insights do not identify unique HSS components

Relay Considerations

- Relays can be important components in SPRAs
  - Key relays of potential seismic concern would be in backup power systems (D/G control cabinets, chargers and inverters, 4kV switchgear)
- These relays are not explicitly modeled in FPIE PRAs but their contributions are implicitly modeled
  - While the individual relays are not modeled, the backup power system functions are modeled
- For 50.69 categorization, the cabinets housing important seismic relays would be identified HSS in the FPIE PRA, and by default subcomponents in those cabinets would also be considered HSS
- Subsequent categorization of subcomponents in enclosures would need to consider the functions of the subcomponents

50.69 Seismic Categorization Conclusions

- Results of the two case studies show that even for high seismic hazard plants, seismic risk insights do not identify unique HSS components
- An explicit seismic risk evaluation is unlikely to identify HSS SCCs that would not already be categorized as HSS from the FPIE and/or Fire PRA risk insights
  - Explicit consideration of seismic risks in the 50.69 categorization process is not necessary
  - Insights from the FPIE and/or Fire PRAs provide the necessary risk information to identify the appropriate HSS SSCs
- As shown in slide 5, the full 50.69 Categorization Process checks and balances appropriately identify HSS SSCs

Summary

- The industry has embarked on a research task for plants with limited seismic analyses to understand the impact of applying seismic information in support of 50.69 categorization
  - The focus was initially on Low Seismic Hazard (Fukushima Screened out and Seismic Risk Prioritization Group 3) plants
  - Comparison of High Seismic Hazard PRA categorization results to those obtained using the NEI 00-04 categorization process reveal that development of a detailed SMA list or SPRA in support of 50.69 may not be needed for Moderate Seismic Hazard (Fukushima Seismic Risk Prioritization Group 2) Plants
- The insights from the sensitivity studies are qualitatively consistent with the concept in NEI 00-04 which states that plants with low seismic risk (1% of FPIE risk) do not require a SPRA for 50.69
- Insights from the research performed thus far indicate that HSS SSC scope is not changed by explicit consideration of seismic information

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