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FirstEnergy Nuclear Operating Company

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August 11, 2017
L-17-234

10 CFR 50.54(f)

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

SUBJECT:
Perry Nuclear Power Plant
Docket No. 50-440, License No. NPF-58
High Frequency Supplement to Seismic Hazard Screening Report, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident (CAC Nos. MF3729)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a Request for Information pursuant to 10 CFR 50.54(f) (Reference 1) to all power reactor licensees. The required response section of Enclosure 1 of Reference 1 indicated that licensees should provide a seismic hazard evaluation and screening report within 1.5 years from the date of the letter for central and eastern United States (CEUS) nuclear power plants. By letter dated May 7, 2013 (Reference 2), the NRC extended the date to submit the report to March 31, 2014.

By letter dated May 9, 2014 (Reference 3), the NRC transmitted the results of the screening and prioritization review of the seismic hazards reevaluation report for Perry Nuclear Power Plant (PNPP) submitted by letter dated March 31, 2014 (Reference 4). In accordance with the screening, prioritization, and implementation details report (SPID) (References 5, 6, and 7), and Augmented Approach guidance (Reference 2), the reevaluated seismic hazard is used to determine if additional seismic risk evaluations are warranted for a plant. Specifically, the reevaluated horizontal ground motion response spectrum (GMRS) at the control point elevation is compared to the existing safe shutdown earthquake (SSE) or Individual Plant Examination for External Events (IPEEE) High Confidence of Low Probability of Failure (HCLPF) Spectrum (HIS) to determine if a plant is required to perform a high frequency confirmation evaluation. As noted in Enclosure 2 of Reference 3, PNPP is to conduct a limited scope high frequency evaluation (confirmation).

Within Reference 3, the NRC acknowledged that these limited scope evaluations will require additional development of the assessment process. The Nuclear Energy Institute (NEI) submitted an Electric Power Research Institute (EPRI) report titled, *High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation (EPRI 3002004396)* for NRC review and endorsement (References 8 and 9). NRC endorsement was provided by Reference 10. Reference 11 provided the NRC final seismic hazard evaluation screening determination results and the associated schedules for submittal of the remaining seismic hazard evaluation activities.

The enclosure to this letter provides the High Frequency Evaluation Confirmation Report for PNPP that confirms that all high frequency susceptible equipment evaluated with the scoping requirements and criteria for seismic demand have adequate seismic capacity. Therefore, no additional modifications or evaluations are necessary. The enclosure provides the requested information in response to Reference 1 associated with NTTF Recommendation 2.1 Seismic evaluation criteria.

There are no new regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on August 11, 2017.

Respectfully,

David B. Hamilton

Enclosure
Near-Term Task Force (NTTF) 2.1 High-Frequency Confirmation Submittal
Perry Nuclear Power Plant

References:

1. NRC Letter, Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 12, 2012, Agencywide Documents Access and Management System (ADAMS) Accession Number ML12053A340.
2. NRC Letter, Electric Power Research Institute Report Final Draft Report XXXXXX, *Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic*, As An

Acceptable Alternative to the March 12, 2012, Information Request for Seismic Reevaluations, dated May 7, 2013, ADAMS Accession Number ML13106A331.
3. NRC Letter, Screening and Prioritization Results Regarding Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Seismic Hazard Re-evaluations for Recommendation 2.1 of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated May 9, 2014, ADAMS Accession Number ML14111A147.
4. FENOC Letter, FirstEnergy Nuclear Operating Company (FENOC) Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident, dated March 31, 2014, ADAMS Accession Number ML14092A203.
5. NEI Letter, Final Draft of Industry Seismic Evaluation Guidance (EPRI 1025287), dated November 27, 2012, ADAMS Accession Numbers ML12333A168.
6. EPRI Report 1025287, *Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details [SPID] for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic*, November 2012, ADAMS Accession Number ML12333A170.
7. NRC Letter, Endorsement of Electric Power Research Institute Final Draft Report 1025287, *Seismic Evaluation Guidance*, dated February 15, 2013, ADAMS Accession Number ML12319A074.
8. NEI Letter, Request for NRC Endorsement of *High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation (EPRI 3002004396)*, dated July 30, 2015, ADAMS Accession Numbers ML15223A100.
9. EPRI Report 3002004396, *High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation*, July 2015, ADAMS Accession Number ML15223A102.
10. NRC Letter, Endorsement of Electric Power Research Institute Final Draft Report 3002004396, *High Frequency Program: Application Guidance for Functional Confirmation and Fragility*, dated September 17, 2015, ADAMS Accession Number ML15218A569.
11. NRC Letter, Final Determination of Licensee Seismic Probabilistic Risk Assessments Under the Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendation 2.1 "Seismic" of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated October 27, 2015, ADAMS Accession Number ML15194A015.

cc: Director, Office of Nuclear Reactor Regulation (NRR)
NRC Region III Administrator
NRC Resident Inspector
NRR Project Manager

Enclosure
L-17-234

Near-Term Task Force (NTTF) 2.1
High-Frequency Confirmation Submittal
Perry Nuclear Power Plant

(77 pages follow)

FIRST ENERGY NUCLEAR OPERATING COMPANY

Near-Term Task Force (NTTF) 2.1 High-Frequency Confirmation Submittal

Perry Nuclear Power Plant

APPROVALS

Report Name: Near-Term Task Force (NTTF) 2.1
High Frequency Confirmation Supplemental Report
Perry Nuclear Power Plant

Date: June 30, 2017

Revision No.: Revision 0

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*See comment review sheets for applicable sections reviewed

ABS Consulting

RIZZO ASSOCIATES

2734298-R-015
Revision 0

Near-Term Task Force (NTTF) 2.1 High-Frequency Confirmation Submittal Perry Nuclear Power Plant

June 28, 2017

Prepared for:

FirstEnergy Nuclear Operating Company

ABSG Consulting Inc. • 300 Commerce Drive, Suite 200 • Irvine, California 92602

NEAR-TERM TASK FORCE (NTTF) 2.1 HIGH-FREQUENCY CONFIRMATION SUBMITTAL PERRY NUCLEAR POWER PLANT

ABSG CONSULTING INC. REPORT NO. 2734298-R-015
REVISION 0
RIZZO REPORT NO. R12 12-4734
JUNE 28, 2017

ABSG CONSULTING INC.
RIZZO ASSOCIATES

ABS Consulting
RIZZO

APPROVALS

Report Name: Near-Term Task Force (NTTF) 2.1
High-Frequency Confirmation Submittal
Perry Nuclear Power Plant

Date: June 28, 2017

Revision No.: 0

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CHANGE MANAGEMENT RECORD

REVISION No.	DATE	DESCRIPTIONS OF CHANGES/AFFECTED PAGES
0	June 28, 2017	Initial Submittal

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LIST OF ACRONYMS

ABS CONSULTING	ABSG CONSULTING INC.
AC	ALTERNATING CURRENT
ADS	AUTOMATIC DEPRESSURIZATION SYSTEM
AUX	AUXILIARY BUILDING
BWR	BOILING WATER REACTOR
CC	CONTROL COMPLEX
CEUS	CENTRAL AND EASTERN UNITED STATES
CST	CONDENSATE STORAGE TANK
DC	DIRECT CURRENT
DGB	DIESEL GENERATOR BUILDING
ECCS	EMERGENCY CORE COOLING SYSTEM
EDG	EMERGENCY DIESEL GENERATORS
EL	ELEVATION
EPRI	ELECTRIC POWER RESEARCH INSTITUTE
ESEP	EXPEDITED SEISMIC EVALUATION PROCESS
ESW	EMERGENCY SERVICE WATER
FENOC	FIRSTENERGY NUCLEAR OPERATING COMPANY
FHB	FUEL HANDLING BUILDING
FIRS	FOUNDATION INPUT RESPONSE SPECTRA
ft	FEET
ft/s	FEET PER SECOND
g	ACCELERATION OF GRAVITY
GMRS	GROUND MOTION RESPONSE SPECTRA
HFIRS	HORIZONTAL FIRS
HGMRS	HORIZONTAL GMRS
HPCS	HIGH PRESSURE CORE SPRAY
HX	HEAT EXCHANGER
Hz	HERTZ

LIST OF ACRONYMS (CONTINUED)

ISRS	IN-STRUCTURE RESPONSE SPECTRA
LOCA	LOSS OF COOLANT ACCIDENT
LOOP	LOSS OF OFFSITE POWER
LPCS	LOW PRESSURE CORE SPRAY
m	METER
m/s	METER PER SECOND
MCC	MOTOR CONTROL CENTER
MOV	MOTOR-OPERATED VALVE
MSIV	MAIN STEAM ISOLATION VALVES
NRC	UNITED STATES NUCLEAR REGULATORY COMMISSION
NSSS	NUCLEAR STEAM SUPPLY SHUTOFF
NTTF	NEAR-TERM TASK FORCE
PGA	PEAK GROUND ACCELERATION
PNPP	PERRY NUCLEAR POWER PLANT
RB	REACTOR BUILDING
RCIC	REACTOR CORE ISOLATION COOLING
RCS	REACTOR COOLANT SYSTEM
RHR	RESIDUAL HEAT REMOVAL
RIZZO	RIZZO ASSOCIATES
RPS	REACTOR PROTECTION SYSTEM
RPV	REACTOR PRESSURE VESSEL
RWCU	REACTOR WATER CLEAN-UP
SA	SPECTRAL ACCELERATION
SILO	SEAL-IN OR LOCK-OUT
SPRA	SEISMIC PROBABILISTIC RISK ASSESSMENT
SPID	SCREENING, PRIORITIZATION, AND IMPLEMENTATION DETAILS
SRV	SAFETY RELIEF VALVE
SSC	STRUCTURES, SYSTEMS, AND COMPONENTS

LIST OF ACRONYMS (CONTINUED)

SSE	SAFE SHUTDOWN EARTHQUAKE
UFSAR	UPDATED SAFETY ANALYSIS REPORT
WUS	WESTERN UNITED STATES
V/H	VERTICAL-TO-HORIZONTAL
V_S	SHEAR-WAVE VELOCITY
VAC	VOLTS AC
VFIRS	VERTICAL FIRS
VGMRS	VERTICAL GMRS

NEAR-TERM TASK FORCE (NTTF) 2.1 HIGH-FREQUENCY CONFIRMATION SUBMITTAL PERRY NUCLEAR POWER PLANT

EXECUTIVE SUMMARY

The purpose of this report is to provide information as requested by the Nuclear Regulatory Commission (NRC) in its March 12, 2012, letter issued to all power reactor licensees and holders of construction permits in active or deferred status (Reference 1). In particular, this report provides information requested to address the High-Frequency Confirmation requirements of Item (4), Enclosure 1, Recommendation 2.1: Seismic, of the March 12, 2012, letter (Reference 1).

Following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the NRC established a Near-Term Task Force (NTTF) to conduct a systematic review of NRC processes and regulations and to determine if the agency should make additional improvements to its regulatory system. The NTTF developed a set of recommendations intended to clarify and strengthen the regulatory framework for protection against natural phenomena. Subsequently, the NRC issued a 50.54(f) letter on March 12, 2012 (Reference 1), requesting information to assure that these recommendations are addressed by all U.S. nuclear power plants. The 50.54(f) letter requests that licensees and holders of construction permits under 10 CFR Part 50 reevaluate the seismic hazards at their sites against present-day NRC requirements and guidance. Included in the 50.54(f) letter was a request that licensees perform a "confirmation, if necessary, that SSCs, which may be affected by high-frequency ground motion, will maintain their functions important to safety".

EPRI 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" (Reference 2) provided screening, prioritization, and implementation details to the U.S. nuclear utility industry for responding to the NRC 50.54(f) letter. This report was developed with NRC participation and was subsequently endorsed by the NRC. The SPID included guidance for determining which plants should perform a High-Frequency Confirmation and identified the types of components that should be evaluated in the evaluation.

Subsequent guidance for performing a High-Frequency Confirmation was provided in EPRI 3002004396, "High Frequency Program, Application Guidance for Functional Confirmation and Fragility Evaluation," (Reference 3) and was endorsed by the NRC in a letter dated September 17, 2015 (Reference 4). Final screening identifying plants needing to perform a High-Frequency Confirmation was provided by NRC in a letter dated October 27, 2015 (Reference 5).

This report describes the High-Frequency Confirmation evaluation undertaken for Perry Nuclear Power Plant (PNPP). The objective of this report is to provide summary information describing the High-Frequency Confirmation evaluations and results. The level of detail provided in the report is intended to enable NRC to understand the inputs used, the evaluations performed, and the decisions made as a result of the evaluations.

EPRI 3002004396 (Reference 3) is used for the PNPP engineering evaluations described in this report. In accordance with Reference 3, the following topics are addressed in the subsequent sections of this report:

- Process of Selecting Components and a List of Specific Components for High-Frequency Confirmation
- Estimation of a Vertical Ground Motion Response Spectrum (GMRS)
- Estimation of In-Cabinet Seismic Demand for Subject Components
- Estimation of In-Cabinet Seismic Capacity for Subject Components
- Summary of Subject Components' High-Frequency Evaluations

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to provide information as requested by the NRC in its March 12, 2012, 50.54(f) letter issued to all power reactor licensees and holders of construction permits in active or deferred status (Reference 1). In particular, this report provides requested information to address the High-Frequency Confirmation requirements of Item (4), Enclosure 1, Recommendation 2.1: Seismic, of the March 12, 2012, letter (Reference 1).

1.2 BACKGROUND

Following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the NRC established a NTTF to conduct a systematic review of NRC processes and regulations and to determine if the agency should make additional improvements to its regulatory system. The NTTF developed a set of recommendations intended to clarify and strengthen the regulatory framework for protection against natural phenomena. Subsequently, the NRC issued a 50.54(f) letter on March 12, 2012 (Reference 1), requesting information to assure that these recommendations are addressed by all U.S. nuclear power plants. The 50.54(f) letter requests that licensees and holders of construction permits under 10 CFR Part 50 reevaluate the seismic hazards at their sites against present-day NRC requirements and guidance. Included in the 50.54(f) letter was a request that licensees perform a "confirmation, if necessary, that SSCs, which may be affected by high-frequency ground motion, will maintain their functions important to safety."

EPRI 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" (Reference 2) provided screening, prioritization, and implementation details to the U.S. nuclear utility industry for responding to the NRC 50.54(f) letter. This report was developed with NRC participation and is endorsed by the NRC. The SPID included guidance for determining which plants should perform a High-Frequency Confirmation and identified the types of components that should be evaluated in the evaluation.

Subsequent guidance for performing a High-Frequency Confirmation was provided in EPRI 3002004396, "High Frequency Program, Application Guidance for Functional Confirmation and Fragility Evaluation," (Reference 3) and was endorsed by the NRC in a letter dated September 17, 2015 (Reference 4). Final screening identifying plants needing to perform a High-Frequency Confirmation was provided by NRC in a letter dated October 27, 2015 (Reference 5).

On March 31, 2014, PNPP submitted a reevaluated seismic hazard to the NRC as a part of the Seismic Hazard and Screening Report (Reference 6). By letter dated August 3, 2015, the NRC staff concluded that the GMRS that was submitted adequately characterizes the reevaluated seismic hazard for the PNPP site (Reference 8). The seismic hazard was later reevaluated under the Expedited Seismic Evaluation Process (ESEP) and submitted to the NRC on December 19, 2014 (Reference 7). The ESEP was accepted by the NRC by letter dated September 23, 2015 (Reference 19). By letter dated October 27, 2015 (Reference 5), the NRC transmitted the results of the screening and prioritization review of the seismic hazards reevaluation.

This report describes the High-Frequency Confirmation evaluation undertaken for PNPP using the methodologies in EPRI 3002004396, "High Frequency Program, Application Guidance for Functional Confirmation and Fragility Evaluation," as endorsed by the NRC in a letter dated September 17, 2015 (Reference 4).

The objective of this report is to provide summary information describing the High-Frequency Confirmation evaluations and results. The level of detail provided in the report is intended to enable NRC to understand the inputs used, the evaluations performed, and the decisions made as a result of the evaluations.

1.3 APPROACH

EPRI 3002004396 (Reference 3) is used for the PNPP engineering evaluations described in this report. Section 4.1 of Reference 3 provided general steps to follow for the High-Frequency Confirmation component evaluation. Accordingly, the following topics are addressed in the subsequent sections of this report:

- PNPP's SSE and GMRS Information
- Selection of Components and a List of Specific Components for High-Frequency Confirmation
- Estimation of Seismic Demand for Subject Components
- Estimation of Seismic Capacity for Subject Components
- Summary of Subject Components' High-Frequency Evaluations
- Summary of Results

1.4 PLANT SCREENING

PNPP submitted the seismic hazard and screening report in response to the NRC request for information Pursuant to 10 CFR 50.54(f) on March 31, 2014 (Reference 6). By letter dated August 3, 2015, the NRC staff concluded that the GMRS that was submitted adequately characterizes the reevaluated seismic hazard for the PNPP site (Reference 8).

The NRC final screening determination letter concluded (Reference 5) that the GMRS to SSE comparison at the PNPP resulted in a need to perform a High-Frequency Confirmation in accordance with the screening criteria in the SPID (Reference 2).

Subsequent to the March 31, 2014 submittal, the seismic hazard was updated considering site specific damping in rock. The updated seismic hazard is the basis for the ESEP Reports submitted by FirstEnergy Nuclear Operating Company (FENOC) on December 19, 2014 (Reference 7), and also used in the SPRA. The ESEP was accepted by the NRC by letter dated September 23, 2015 (Reference 19).

Table 1-1, ***Table 1-2,*** and ***Figure 1-1*** present the spectral accelerations characterizing the updated GMRSs and SSE at the PNPP. ***Figure 1-1*** presents the comparison of SSE, ESEP GMRS (Reference 7) and the GMRS reported in the PNPP March 2014 submittal (Reference 6). The difference in the GMRS results is attributed to the material damping used for the rock material over the upper 500 feet (ft). While the GMRS reported in the March 2014 submittal is based on the low strain damping of approximately 3.2 percent over a depth of 500 ft below the Reactor Building (RB) foundation, the GMRS used in the ESEP limits this damping value to the upper 100 ft where the rock is considered as weathered or fractured. Below this depth, a low strain damping of 1.0 percent is used based on the unweathered shale dynamic properties from Stokoe et al. (Reference 9).

TABLE 1-1
GMRS AT THE PNPP, EL 561 FT

FREQUENCY (Hz)	GMRS (g) (ESEP, DECEMBER 2014 SUBMITTAL)	GMRS (g) (MARCH 2014 SUBMITTAL)
0.10	0.0030	0.003
0.13	0.0045	0.0044
0.16	0.0065	0.0065
0.20	0.0095	0.0095
0.26	0.0139	0.0139
0.33	0.0208	0.0209
0.42	0.0322	0.0323
0.50	0.0458	0.0458
0.53	0.0489	0.0488
0.67	0.0626	0.062
0.85	0.0784	0.0778
1.00	0.0895	0.0886
1.08	0.0991	0.0978
1.37	0.1228	0.1206
1.74	0.1277	0.1262
2.21	0.1489	0.1453
2.50	0.1769	0.1656
2.81	0.2103	0.1944
3.56	0.2721	0.2484
4.52	0.3287	0.3011
5.00	0.3618	0.3247
5.74	0.4020	0.3554
7.28	0.4664	0.4036
9.24	0.5424	0.4514
10.00	0.5663	0.4681
11.72	0.5773	0.4726
14.87	0.5851	0.4648
18.87	0.5976	0.4593
23.95	0.5788	0.4282
25.00	0.5722	0.4207
30.39	0.5389	0.3854
38.57	0.4868	0.3476
48.94	0.4233	0.3183
62.10	0.3443	0.2661
78.80	0.2672	0.2048
100.00	0.2426	0.1883

TABLE 1-2
SSE AT THE PNPP

FREQUENCY (Hz)	SSE [g]
0.10	0.013
0.25	0.07
2.50	0.47
9.00	0.39
33.00	0.15
100.00	0.15

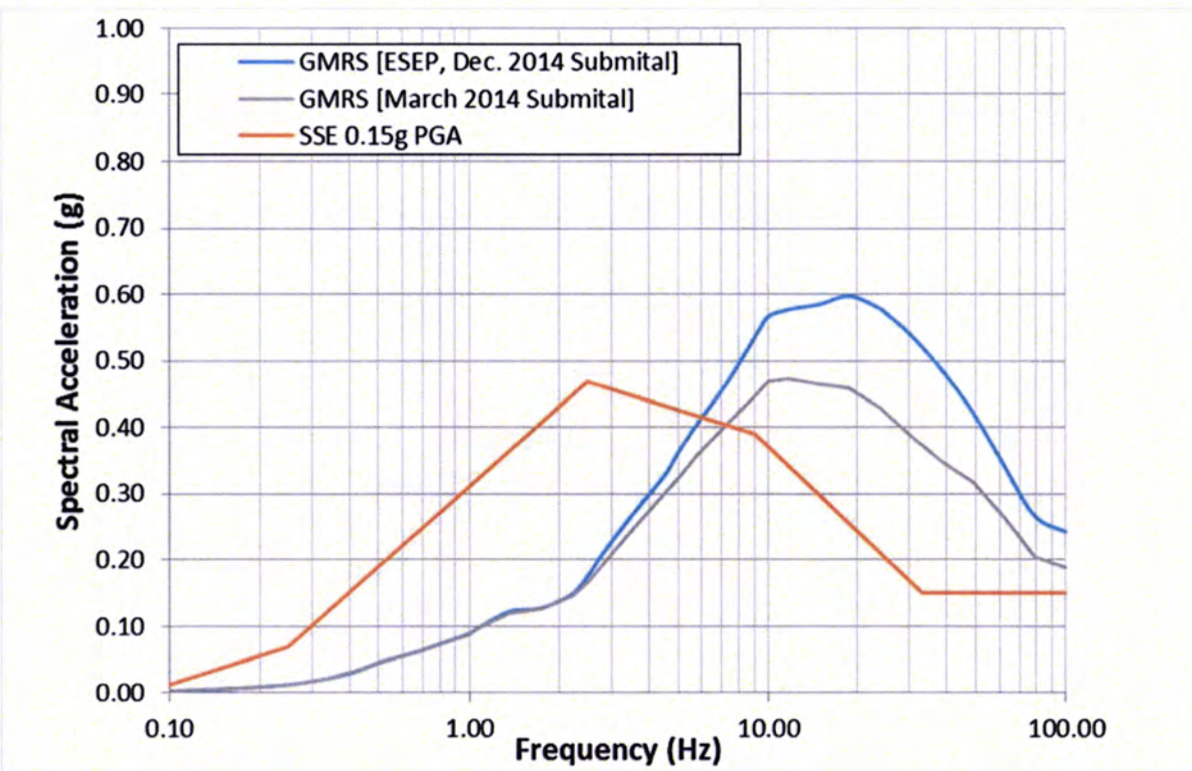


FIGURE 1-1
COMPARISON OF GMRS AND SSE AT THE PNPP CONTROL POINT (EL 561 FT)

2.0 SELECTION OF COMPONENTS FOR HIGH-FREQUENCY SCREENING

The fundamental objective of the High-Frequency Confirmation review is to determine whether the occurrence of a seismic event could cause credited equipment to fail to perform as necessary. An optimized evaluation process is applied that focuses on achieving a safe and stable plant state following a seismic event. As described in Reference 3, this state is achieved by confirming that key plant safety functions critical to immediate plant safety are preserved (reactor trip, reactor vessel inventory and pressure control, and core cooling) and that the plant operators have the necessary power available to achieve and maintain this state immediately following the seismic event (AD/DC power support systems).

Within the applicable functions, the components that would need a High-Frequency Confirmation are contact control devices subject to intermittent states in seal-in or lockout circuits. Accordingly, the objective of the review as stated in Section 4.2.1 of Reference 3 is to determine if seismic induced high-frequency relay chatter would prevent the completion of the following key functions.

2.1 REACTOR/TRIP/SCRAM

The reactor trip/SCRAM function is identified as a key function in Reference 3 to be considered in the High-Frequency Confirmation. The same report also states that "the design requirements preclude the application of seal-in or lockout circuits that prevent reactor trip/SCRAM functions" and that "No high-frequency review of the reactor trip/SCRAM systems is necessary".

2.2 REACTOR VESSEL INVENTORY CONTROL

The reactor coolant system/reactor vessel inventory control systems were reviewed for contact control devices in seal-in and lock-out (SILO) circuits that would create a Loss of Coolant Accident (LOCA). The focus of the review was contact control devices that could lead to a significant leak path. Check valves in series with active valves would prevent significant leaks due to misoperation of the active valve; therefore, SILO circuit reviews were not required for those active valves.

Reactor coolant system/reactor vessel inventory control system reviews were performed for valves associated with the following functions:

- Nuclear Steam Supply Shutoff
- Reactor Water Clean-Up
- Reactor Core Isolation Cooling
- Residual Heat Removal
- High Pressure Core Spray
- Low Pressure Core Spray

Nuclear Steam Supply Shutoff (NSSS) Valves

Reactor Head Vent Valves

The two reactor head vent valves (1B21F0001 and 1B21F0002) are normally closed and in series with one another. Electrical control for these motor-operated valves is via a rugged hand switch. The motor contactors for these valves do not contain a seal-in and there are no other chatter sensitive contact devices involved in the control logic of these valves.

Automatic Depressurization System (ADS) Valves

The ADS valves include 1B21F0041A, 1B21F0041B, 1B21F0041E, 1B21F0041F, 1B21F0047D, 1B21F0047H, 1B21F0051C, and 1B21F0051G. These Safety Relief Valves (SRV) are operated via the solenoid valves SOVs 1B21F0410A, 1B21F0410B, B21F0411A, 1B21F0411B, 1B21F0414A, 1B21F0414B, 1B21F0415A, 1B21F0415B, 1B21F0422A, 1B21F0422B, 1B21F0425A, 1B21F0425B, 1B21F0442A, 1B21F0442B, 1B21F0444A, and 1B21F0444B. Electrical control for the solenoid-operated pilot valves is via relays, which are controlled by the Reactor Pressure Vessel (RPV) Low Level Logic and the low pressure Emergency Core Cooling System (ECCS) pump pressure relays. This relay logic contains seal-ins and it is possible for the ADS valves to open following a seismic event. These relays are listed in ***Table B-1***, below.

Safety Relief Valves

In addition to the eight ADS SRVs listed above, PNPP has an additional 11 SRVs: 1B21F0041C, 1B21F0041D, 1B21F0041G, 1B21F0041K, 1B21F0047B, 1B21F0047C, 1B21F0047F, 1B21F0047G, 1B21F0051A, 1B21F0051B, and 1B21F0051D, operated via the solenoid valves 1B21F0412A, 1B21F0412B, 1B21F0413A, 1B21F0413B, 1B21F0416A, 1B21F0416B, 1B21F0417A, 1B21F0417B, 1B21F0420A, 1B21F0420B, 1B21F0421A, 1B21F0421B, 1B21F0423A, 1B21F0423B, 1B21F0424A, 1B21F0424B, 1B21F0440A, 1B21F0440B, 1B21F0441A, 1B21F0441B, 1B21F0443A, and 1B21F0443B.

The control logic which governs the Safety mode of the 19 SRVs contains seal-ins and it is possible for SRVs to open due to a seismic event. These relays are listed in ***Table B-1***, below.

Main Steam Isolation Valves (MSIV)

The MSIVs include 1B21F0022A, B, C, D, and 1B21F0028A, B, C, D. The MSIVs are controlled via solenoid valves. The solenoid-operated pilot valves are electrically controlled via relays, which are slaves to isolation logic relays. The later relays are energized for at-power operation and de-energized to close the valves. In the energized state the isolation logic relays are sealed in and any chatter in the control logic would break the seal-in and close the valves. This action is a desired response to the seismic event and for this reason chatter is acceptable and no contact devices in this circuit meet the selection criteria.

Main Steam Stop Valves

The Main Steam Stop Valves (1N11F0020A, B, C, D) are not required to be shut automatically upon isolation of the system, but provide a means of back-up isolation if necessary. The control logic for these normally open motor-operated valves contains no seal-in logic beyond the limit switch contactors. While it is possible for chatter of the contactors to close the Main Steam Shutoff Valves, this is the desired response to the seismic event and for this reason chatter is acceptable and no contact devices in this circuit meet the selection criteria.

Main Steam Line Drain Valves

The control logic for the normally-open Motor-Operated Valves 1B21F0016 and 1B21F0019 contains motor contactors which could chatter and seal-in, causing the valves to close. However, the closed position is the desired response to the seismic event and for this reason chatter is acceptable and no contact devices in this circuit meet the selection criteria.

<u>Reactor Water Clean-Up (RWCU) Valves</u>

Reactor Water Clean-Up Flow Control Valve and Bottom Head Drain Flow Control Valves

The RWCU Flow Control Valve 1G33F0102 is a normally-open motor-operated valve controlled by a hand switch. The relays, including the motor contactors for this valve, do not contain a seal-in and there are no other chatter sensitive contact devices involved in the control logic for this valve. The Bottom Head Drain Bypass Valve 1G33F0103 is a normally-open manual valve and is not susceptible to chatter. The Bottom Head Drain Valve 1G33F0101 is a normally closed motor-operated valve (MOV). This valve contains a motor contactor with a seal-in through which chatter could result in the valve opening. However, these valves are upstream of the RWCU Containment Isolation Valves 1G33F0001 and 1G33F0004 (see below) and are not relied upon for isolation of the system. No contact devices in this circuit meet the selection criteria.

Reactor Water Clean-Up Isolation Valves

The RWCU Containment Isolation Valves 1G33F0001 and 1G33F0004 are normally-open MOVs which close upon an isolation signal. Open limit switches in the opening circuit prevent seal-in of the opening contactor auxiliary contact and no contacts prevent valve closure via the control switch or isolation relay. These relays are energized for at-power operation and de-energized to close the valves. In the energized state the relays are sealed in and any chatter in the control logic would break the seal-in and close the valves. This action is a desired response to the seismic event and for this reason chatter is acceptable and no contact devices in this circuit meet the selection criteria.

Reactor Core Isolation Cooling (RCIC) Valves

Reactor Core Isolation Cooling Steam Supply Line Isolation Valves

The RCIC Steam Supply Line Isolation Valves 1E51F0063 and 1E51F0064 are normally-open MOVs and are required to remain open to supply steam to the RCIC turbine. The control logic contains seal-ins through the motor contactors and it is possible for the valves to close due to chatter following a seismic event. There is no seal-in that would prevent the automatic closure of these valves on a valid isolation signal.

Residual Heat Removal (RHR) Valves

Testable Check Valves

The RHR Testable Check Valves 1E12F0041A, B, C are operated by the solenoid-operated valves 1E12F0597A, B, C which are controlled by rugged control switches. The control logic for these valves contains no SILO devices that would prevent the normal operation of these check valves.

RHR Injection Valves

The RHR Injection MOV (1E12F0042A, B, C) control logic contains relays and motor contactors which may chatter and result in the valves opening following a seismic event. However, the RHR testable check valves are between the injection MOVs and the RPV; an undesired opening of the RHR Injection MOVs would not result in a loss of reactor inventory and piping would not be exposed to reactor pressure.

RHR Shutdown Cooling Injection Valves

The RHR Shutdown Cooling Injection MOV (1E12F0053A, B) control logic relays, including the motor contactors for these valves, do not contain a seal-in and there are no other chatter sensitive contact devices involved in the control logic for this valve. Additionally, there is a check valve in series with these valves. No contact devices in this circuit meet the selection criteria.

RHR Shutdown Cooling Isolation Valves

The RHR Shutdown Cooling Isolation Valves 1E12F0008 and 1E12F0009 are normally-closed MOVs are opened via a control switch and relay permissive. While the plant is at power, the 1E12F0008 valve is de-energized by opening its disconnect; thereby preventing this valve from opening.

If open, the valves will close automatically via an isolation signal. During a seismic event, chatter on the controlling relays or motor contactors could cause the 1E12F0009 valve to open, however the low reactor pressure permissive in control logic would prevent seal-in of the relays. After the period of strong shaking the normally-closed contact of the relays (isolation signal) would command the valve to reclose. Because there is no seal-in and the valves reclose without operator intervention, chatter is acceptable and no contact devices in this circuit meet the selection criteria.

RHR Shutdown Cooling Suction Valves

The RHR Shutdown Cooling Suction MOV (1E12F0006A, B) control logic relays, including the motor contactors for these valves, do not contain a seal-in and there are no other chatter sensitive contact devices involved in the control logic for this valve.

High Pressure Core Spray Valves

Testable Check Valve

The High Pressure Core Spray (HPCS) Testable Check Valve, 1E22F0005, is operated by a solenoid-operated valve, 1E22F0526, which is controlled by a rugged control switch. There are no SILO devices that would prevent the normal operation of this check valve.

HPCS Injection Valve

The HPCS Injection MOV (1E22F0004) control logic contains relays and motor contactors which may chatter and result in the valves opening following a seismic event. However, the

HPCS testable check valve is between the injection MOVs and the RPV; an undesired opening of the HPCS Injection MOV would not result in a loss of reactor inventory and piping would not be exposed to Reactor pressure.

Low Pressure Core Spray Valves

Testable Check Valve

The Low Pressure Core Spray Valves (LPCS) Testable Check Valve, 1E21F0006, is operated by a solenoid-operated valve, 1E21F0524, which is controlled by a rugged control switch. There are no SILO devices that would prevent the normal operation of this check valve.

LPCS Injection Valve

The LPCS Injection MOV (1E21F0005) control logic contains relays and motor contactors which may chatter and result in the valves opening following a seismic event. However, the LPCS testable check valve is between the injection MOVs and the RPV; an undesired opening of the LPCS Injection MOV would not result in a loss of reactor inventory and piping would not be exposed to Reactor pressure.

2.3 Reactor Vessel Pressure Control

The reactor vessel pressure control function is identified as a key function in Reference 3 to be considered in the High-Frequency Confirmation. The same report also states that "required post event pressure control is typically provided by passive devices" and that "no specific high frequency component chatter review is required for this function."

2.4 Core Cooling

The core cooling systems were reviewed for contact control devices in SILO circuits that would prevent at least a single train of non-AC power driven decay heat removal from functioning.

The initial need for decay heat removal and the related scope of consideration varies based on the plant's NSSS system. The relay chatter impacts that could affect this function would be those that would cause the flow control valves to close and remain closed.

For BWR plants, the decay heat removal mechanism involves the transfer of mass and energy from the reactor vessel to the suppression pool. This requires the replacement of that mass to the reactor vessel via some core cooling system; e.g., RCIC. Therefore, for this evaluation the following functions need to be checked. (1) Steam from the RPV to the RCIC turbine and exhausted to the suppression pool, (2) coolant from the suppression pool to the reactor via the RCIC pump, and (3) steam from the RPV vented to the suppression pool via the SRVs. The selection of contact devices for the SRVs overlaps with the Reactor Coolant System (RCS)/Reactor Vessel Inventory Control Category. In addition to RCIC, the HPCS system was also assessed, as this system is powered by an independent AC source. The cooling of the suppression pool, while ultimately required, is not an immediate need, so assessment of component chatter effects on systems supporting suppression pool cooling or other core cooling systems is not required.

Reactor Core Isolation Cooling

The selection of contact devices for RCIC was based on the premise that RCIC operation is desired, thus any SILO which would lead to RCIC operation is beneficial and thus does not meet the criteria for selection. Only contact devices which could render the RCIC system unavailable were considered.

RCIC Pump and Control Logic

A vulnerability to RCIC operation following a seismic event is contact chatter leading to a false RCIC Isolation Signal or false turbine trip. A false steam line break trip has the potential to delay RCIC operation while confirmatory inspections are being made. Chatter in the contacts of RCIC Isolation Signal Relay or Steam Line High Differential Pressure Time Delay Relay may lead to a RCIC Isolation Signal and seal-in of the signal relay resulting in an Isolation of the RCIC system. Similar chatter in the contact devices that drive those relays could also lead to seal-in.

An additional vulnerability was identified involving contact chatter in the RCIC turbine trip logic and close the valve linkage arrangement for the RCIC Trip and Throttle Valve, 1E51F0510. Closure of this linkage will require operator action to reopen the valve.

These relays resulting in an undesired RCIC Isolation are listed in ***Table B-1***, below.

RCIC Injection MOV

The RCIC injection MOV (1E51F0013) is normally closed, and is desired to open to permit RCIC injection. The control logic contains relays and motor contactors which include seal-ins, so chatter due to a seismic event may result in the valve opening. Opening of the injection valve without the pump running will not result in a potential RPV drain path due to the presence of the testable check valve, 1E51F0066, between the injection valve and the RPV. There are no seal-ins which would prevent the valve from opening when required. No contact devices were identified that met the criteria for selection.

RCIC Steam Supply MOVs

The normally closed RCIC Steam Supply MOV (1E51F0045) control logic was reviewed. Relay chatter may result in opening of this MOV; however, this is the desired state. No contact devices were identified that would prevent the proper operation of this valve on a valid RCIC initiation signal.

The normally-open RCIC Steam Supply Isolation Valves (1E51F0063, 1E51F0064) were initially reviewed in Section 2.1, above, from the NSSS perspective. The control logic for these MOVs contains motor contactors that could seal-in and close these valves. There is no signal to automatically reopen these two AC-powered valves on a valid RCIC initiation signal. Therefore, chatter of these motor contactors could prevent the RCIC system from supply injection to the RPV. These motor contactors are listed in ***Table B-1***, below. In addition, relays identified above that are associated with the RCIC Isolation Signal can also close 1E51F0064. These relays are listed in ***Table B-1***, below.

In addition, the control logic for the RCIC turbine exhaust to suppression pool valve (1E51F0068) was reviewed. This normally-open valve contains a motor contactor with a seal-in, and it is possible for chatter during a seismic event to result in closure of this valve. However, valid RCIC initiation conditions will automatically restore this valve to its desired open position. There are no seal-ins which would prevent this automatic restoration. No contact devices were identified that met the criteria for selection.

Finally, the control logic for the turbine trip and throttling valve (1E51F0510) was reviewed. The control logic for this normally-open valve does not contain any seal-in devices. No contact devices were identified that met the criteria for selection.

RCIC Suction Supply MOVs

The RCIC pump suction supply from Suppression Pool MOV (1E51F0031) and the suction supply from the Condensate Storage Tank MOV (1E51F0010) were reviewed for chatter impacts. Typically, the suction from the Condensate Storage Tank (CST) valve (1E51F0010) is open while the suction from the suppression pool valve (1E51F0031) is closed, as RCIC is always aligned to one suction supply or the other. The control logic for the normally-open 1E51F0010 includes motor contactors with seal-ins, and it is possible for chatter of the motor contactor or additional relays to result in closure of the normally-open valve. However, valid RCIC initiation conditions will automatically restore this valve to its desired open position. There are no seal-ins which would prevent this automatic restoration.

The control logic for the normally closed 1E51F0031 includes motor contactors with seal-ins, and it is possible for chatter of the motor contactor or additional relays to result in opening of this normally closed valve. However, if both RCIC suction supply valves are open, 1E51F0010 will receive an automatic closure signal. Relays identified above that are associated with the RCIC Isolation Signal can close 1E51F0031 and inhibit the automatic signals to restore it. These relays are already listed in ***Table B-1***, below. There are no other seal-ins which would prevent this automatic action.

It is possible for the RCIC system to be in an alternate alignment with the suction supply from the suppression pool valve open and the suction supply from the CST closed. Again, it is possible for relay chatter to alter the states of these valves. As before, if both suction supply valves are closed, the 1E51F0010 valve will automatically open on a RCIC initiation signal. If both valves are open, the 1E51F0010 valve automatically closes. There are no other seal-ins which would prevent this automatic action, beyond the already identified relays associated with the RCIC Isolation Signal.

RCIC Minimum Flow Valve

During operation of the RCIC system, the injection valve will cycle open and shut as the RPV level cycles between Level 2 and Level 8. During the times that the injection valve is shut, the minimum flow valve (1E51F0019) is required to be open to protect the RCIC pump from a deadhead condition. This valve is normally closed. The motor contactors contain seal-ins, however, no other control logic contains seal-ins. It is possible for chatter to cause the motor contactor to seal-in and open the valve, however, the control logic will then automatically restore the valve to its desired state, based on RCIC pump and RPV conditions. No contact devices were identified that met the criteria for selection.

RCIC Test Return MOVs

Potential diversion pathways through the RCIC test return to CST MOVs (1E51F0059, 1E51F0022) were reviewed. These valves are normally closed. The control logic for 1E51F0022 does not contain any devices that seal-in. The control logic for 1E51F0059 does contain a motor contactor with a seal-in as well as relays that may impact this motor contactor, however this logic is only tied to the valve closure, which is the expected and desired state. It is possible for chatter of the motor contactor itself in the open portion of the circuitry to result in the valve opening. However, if either valve is open it will automatically close on a RCIC initiation signal. This automatic action is not inhibited by any seal-in. No contact devices were identified that met the criteria for selection.

High Pressure Core Spray

The HPCS system is powered by an independent diesel generator. The selection of contact devices was based on the premise that HPCS operation is desired, thus any SILO which would lead to HPCS operation is beneficial and thus does not meet the criteria for selection. Only contact devices which could render the HPCS system unavailable were considered. Furthermore, component mispositions that would be automatically restored to their desired state on a Loss of Offsite Power (LOOP) or LOCA signal were screened from inclusion, unless the SILO inhibited the LOOP/LOCA signal from restoring the component to its desired state.

HPCS Pump and Control Logic

The HPCS motor driven pump (1E22C0001) and control logic was reviewed to identify any contact control devices in SILO circuits that would prevent the system from functioning. Circuits that contain seal-ins were identified, however, these seal-ins all pertain to the LOOP/LOCA initiation signal and would cause the system to initiate and the pump to start. As this is the desired state, these contact devices do not meet the criteria for selection. However, chatter on the IFC 50/51 relays located on the pump circuit breaker would result in the breaker tripping open and require an operator action to reset the lockout. These relays are listed in ***Table B-1***, below.

HPCS Injection MOV

The HPCS Injection MOV (1E22F0004) is normally closed, and is desired to open to permit HPCS injection. The control logic contains relays and motor contactors which include seal-ins, so chatter due to a seismic event may result in the valve opening. Opening of the injection valve without the pump running will not result in a potential RPV drain path due to the presence of the testable check valve, 1E22F0005, between the injection valve and the RPV. There is an additional relay which may seal-in and hold the valve closed, thereby preventing it from opening. However, this seal-in is broken by a low RPV level signal as part of the LOCA initiation logic, and therefore will not prevent the valve from opening when HPCS injection is needed. Thus, no contact devices were identified that met the criteria for selection.

HPCS Suction Supply Valves

The HPCS suction supply from Suppression Pool MOV (1E22F0015) and the suction supply from the CST MOV (1E22F0001) were reviewed for chatter impacts. Typically, one of these valves is open while the other is closed, as the HPCS is always aligned to one suction supply or the other. The control logic includes motor contactors with seal-ins. It is possible for chatter to result in either or both of these valves to change state. However, the 1E22F0001 valve control logic also includes input from the 1E22F0015 limit switch. If the 1E22F0015 valve is full open, 1E22F0001 will automatically close. Similarly, if 1E22F0015 is closed, then 1E22F0001 will automatically open. Therefore, there will always be a single suction supply to the HPCS pump.

There are no other relays that will seal-in or inhibit the automatic reposition due to the 1E22F0015 limit switch. Thus, no contact devices were identified that met the criteria for selection.

HPCS Minimum Flow Valve

During operation of the HPCS system, the injection valve will cycle open and shut as the RPV level cycles between Level 2 and Level 8. During the times that the injection valve is shut, the minimum flow valve (1E22F0012) is required to be open to prevent the HPCS pump from failing. This valve is normally closed. The motor contactors contain seal-ins; however, no other control logic contains seal-ins. It is possible for chatter to cause the motor contactor to seal-in and open the valve; however, the control logic will then automatically restore the valve to its desired state, based on HPCS pump and RPV conditions. No contact devices were identified that met the criteria for selection.

HPCS Test Return MOVs

Potential diversion pathways through the HPCS test return to Suppression Pool MOV (1E22F0023), and the test return to CST MOVs (1E22F0010, 1E22F0011) were reviewed. These valves are all normally closed. The control logic for these valves contains a relay that may seal-in; however, the only consequence is a closure signal to these three valves. This is the desired state. No contact devices were identified that met the criteria for selection.

2.5 AC/DC POWER SUPPORT SYSTEMS

The AC and DC power support systems were reviewed for contact control devices in SILO circuits that prevent the availability of DC and AC power sources. The following AC and DC power support systems were reviewed:

- Emergency Diesel Generators,
- Battery Chargers and Inverters,
- Emergency Diesel Generators (EDG) Ancillary Systems, and
- Switchgear, Load Centers, and MCCs.

Electrical power, especially DC, is necessary to support achieving and maintaining a stable plant condition following a seismic event. DC power relies on the availability of AC power to recharge the batteries. The availability of AC power is dependent upon the EDGs and their ancillary support systems. EPRI 3002004396 requires confirmation that the supply of emergency power is not challenged by a SILO device. The tripping of lockout devices or circuit breakers is expected to require some level of diagnosis to determine if the trip diagnose the fault condition is real or an artifact of seismically induced vibration, which could substantially delay the restoration of emergency power.

In order to ensure contact chatter cannot compromise the emergency power system, control circuits were analyzed for the EDG, Battery Chargers, Vital AC Inverters, and Switchgear/Load Centers/MCCs as necessary to distribute power from the EDGs to the battery chargers and EDG Ancillary Systems. General information on the arrangement of safety-related AC and DC systems, as well as operation of the EDGs, was obtained from the PNPP Updated Final Safety Analysis Report (UFSAR). PNPP EDGs provide emergency power to the safety-related buses. PNPP has three divisions of Class 1E loads with one EDG for each division.

The analysis considers the reactor is operating at power with no equipment failures or LOCA prior to the seismic event. The EDGs are not operating but are available. The seismic event is presumed to cause a LOOP and a normal reactor SCRAM.

In response to bus under-voltage relaying detecting the LOOP, the Class 1E control systems must automatically shed loads, start the EDGs, and sequentially load the Diesel Generators as designed. Ancillary systems required for EDG operation as well as Class 1E battery chargers and inverters must function as necessary. The goal of this analysis is to identify any vulnerable contact devices that could chatter during the seismic event, seal-in or lock-out, and prevent these systems from performing their intended safety-related function of supplying electrical power during the LOOP.

The following sections contain a description of the analysis for each element of the AC/DC Support Systems. Contact devices are identified by description in this narrative and apply to all divisions.

Emergency Diesel Generators

The analysis of the EDGs is broken down into the generator protective relaying and diesel engine control. General descriptions of these systems and controls appear in the UFSAR.

Diesel Engine Control and Protective Relaying

Chatter analysis was performed for the diesel engine control logic and the diesel generator output circuit breaker, as well as the bus under-voltage and LOOP signal logic. This review also included the safety-related 4160 V switchgear, due to interlocks and dependencies in this control logic. The control circuits for the EDG circuit breakers include bus overcurrent lockout (86B) and protective relaying generator lockout (86G). Chatter of the generator lockout relay will prevent the diesel from starting. Chatter of the bus overcurrent lockout relay will cause the bus preferred supply breaker, alternate preferred supply breaker, and diesel generator supply breaker to trip open and prevent them from re-closing until the relay has been reset. The Division 1 and Division 2 Diesel Generator Up to Voltage auxiliary lockout relay (59DX) however will not result in a trip of the diesel output breaker and only provides a permissive for the diesel output breaker to close. An additional diesel generator lockout relay (86G1) associated with the definite time overcurrent protection, reverse power relays, are bypassed with a LOOP signal and will not prevent the diesel from starting or loading the bus if needed. The 59NX and 59EX diesel generator lockout relays are bypassed with permanently installed jumpers and will not prevent the diesel from starting or the diesel generator output breaker from closing. Chatter of the phase-overcurrent protection relays (51A/B/C/N) will result in an actuation of the included bus overcurrent lockout (86B). Division 3 reverse power, definite time overcurrent protection or timing relay chatter will result in tripping the Diesel generator lockout relay (86G1) will prevent the diesel from starting or loading the bus if needed. Those relays whose chatter results in a lockout of the diesel generator and/or safety buses are listed in ***Table B-1***, below.

EDG Ancillary Systems

In order to start and operate the EDGs require a number of components and systems. For the purpose of identifying electrical contact devices, only systems and components which are electrically controlled are analyzed. Information in the UFSAR was used as appropriate for this analysis.

Starting Air

Based on diesel generator availability as an initial condition the passive air reservoirs are presumed pressurized and the only active components in this system required to operate are the air start solenoids, which are covered under the EDG engine control analysis above.

Combustion Air Intake and Exhaust

The combustion air intake and exhaust for the Diesel Generators are passive systems which do not rely on electrical control.

Lube Oil

The Diesel Generators utilize engine-driven mechanical lubrication oil pumps which do not rely on electrical control.

Fuel Oil

The Diesel Generator Fuel Oil System is described in the UFSAR. The Diesel Generators utilize engine-driven mechanical pumps and DC-powered auxiliary pumps to supply fuel oil to the engines from the day tanks. The day tanks are re-supplied using AC-powered Diesel Oil Transfer Pumps. Chatter analysis of the control circuits for the electrically-powered auxiliary and transfer pumps concluded they do not include SILO devices. The mechanical pumps do not rely on electrical control.

Cooling Water

The Standby Diesel Generator Jacket Water Cooling System is described in the UFSAR. Engine-driven pumps are credited when the engine is operating. These mechanical pumps do not rely on electrical control. The electric jacket water pump is only used during shutdown periods and is thus not included in this analysis.

The Standby Diesel Generator Jacket Water Cooling System is cooled by the Emergency Service Water System (ESW). The ESW pump (1P45C0001A/B and 1P45C0002) control logic was reviewed. Additionally, the control logic for the pump discharge MOVs (1P45F0130A/B and 1P45F0140) was reviewed. Note that the RHR Heat Exchanger (HX) inlet and outlet isolation valves (1P45F0014A/B and 1P45F0068A/B) have been de-energized in the "Open" position. There are no other MOVs along the key flowpaths to support required systems or to maintain minimum flow. Relays were identified through which chatter during a seismic event could start the ESW pumps; however, these relays do not seal-in. The control logic for the RHR HX inlet isolation valves contains contacts through which chatter during a seismic event could cause these normally-open valves to close. However, these valves will automatically open upon receipt of an ESW start signal or on a LOCA signal. This control logic does not contain any relays through which a seal-in would inhibit the automatic action. However, chatter on the IFC 50/51 and HFC 50A/C relays located on the ESW Pump A and B circuit breakers would result in those circuit breakers tripping open and require an operator action to reset. These relays are listed in ***Table B-1***, below. No other contact devices were identified that met the criteria for selection.

Ventilation

The Diesel Generator Enclosure Ventilation System is described in the UFSAR. Ventilation for each Diesel Generator Enclosure is provided via two supply fans and one exhaust fan. In automatic mode the supply fans are started via the EDG start signal. Chatter analysis of the EDG start signal is included above. Other than SILO devices identified for the EDG start signal, chatter analysis of the control circuits for these fans concluded they do not include SILO devices.

<u>Battery Chargers</u>

Chatter analysis on the battery chargers was performed using information from the UFSAR, as well as vendor schematic diagrams. The solid-state battery chargers each have a filtered DC output for float and equalizing modes. Each battery charger is equipped with a DC voltmeter, DC ammeter, charger failure relay, high battery voltage relay, and low battery voltage relay. The Division 3 Unit 1 and Unit 2 battery chargers have a high voltage shutdown circuit, which is intended to protect the batteries and DC loads from output overvoltage due to charger failure. The high voltage shutdown circuit has a magnetic latching output relay which disconnects the auxiliary voltage transformer, shutting the charger down. Chatter in the contacts of this output relay will cause the charger to trip and remain in a tripped state until manually reset. No other adverse impacts from chatter that would affect the availability of the battery chargers.

Inverters

At PNPP inverters are only used as a power supply to the Reactor Protection System (RPS). Any failure of the inverters would not prevent the RPS from performing its function to scram the reactor. No chatter analysis is necessary.

Switchgear, Load Centers, and MCCs

Power distribution from the EDGs to the necessary electrical loads (Battery Chargers, Fuel Oil Pumps, and EDG Ventilation Fans) was traced to identify any SILO devices, which could lead to a circuit breaker trip and interruption in power. This effort excluded the EDG circuit breakers and the ESW pump breakers which are covered in above, as well as component-specific contactors and their control devices, which are covered in the analysis of each component above. The medium- and low-voltage power circuit breakers in switchgear and load centers supplying power to loads identified in this section are included in this evaluation. The Molded-Case Circuit Breakers used in the motor control centers are seismically rugged; and DC power distribution is via non-vulnerable disconnect switches. The only circuit breakers affected by contact devices (not already covered) were those that distribute power from the safety-related buses to the load centers. A chatter analysis of the control circuits for these circuit breakers indicates that chatter of the IFC 50/51 relays on the 4160/480 VAC transformer input circuit breakers could result in these breakers tripping open. There is no automatic closure signal; these breakers would have to be manually reclosed. These relays are listed in ***Table B-1***, below.

2.6 SUMMARY OF SELECTED COMPONENTS

In total 95 contact devices were identified that require a High-Frequency Confirmation. These 95 contact devices include 18 different model types encompassing 15 evaluations. A list of these contact devices requiring a High-Frequency Confirmation is provided in ***Appendix B***.

3.0 SEISMIC EVALUATION

3.1 HORIZONTAL SEISMIC DEMAND

Per Reference 3, Section 4.3, the basis for calculating high-frequency seismic demand on the subject components in the horizontal direction is the PNPP horizontal GMRS, which was generated as part of the PNPP ESEP report (Reference 7) submitted to the NRC on December 19, 2014, and accepted by the NRC on September 23, 2015 (Reference 19).

It is noted in Reference 3 that a Foundation Input Response Spectrum (FIRS) may be necessary to evaluate buildings whose foundations are supported at elevations different than the Control Point elevation. However, for sites founded on rock, per Reference 3, "The Control Point GMRS developed for these rock sites are typically appropriate for all rock-founded structures and additional FIRS estimates are not deemed necessary for the High-Frequency Confirmation effort."

The PNPP nominal plant grade elevation is 625 ft. Most major structures are founded in the Chagrin Shale bedrock at foundation elevations varying between 561 ft for the RB and the Auxiliary Building (AUX) to 564 ft for the Fuel Handling Building (FHB) and the Control Complex (CC) Building. The foundation of the Diesel Generator Building (DGB) is at elevation (EL) 615 ft founded on 30 ft of Class A backfill and 20 ft of glacial till, which extends to the in-situ rock at EL 565 ft. The design basis analysis applies the SSE ground motion at the respective building foundations. Therefore, the SSE, and the GMRS, Control Point elevation is taken to be the deepest foundation level, which is the base of the RB foundation, EL 561 ft. The bedrock immediately underlying the RB foundation (EL 561 ft) is characterized by shear-wave velocities (Vs) of about 5,200 feet per second (ft/s).

The RB, AUX, FHB, and CC buildings at PNPP are founded on rock; therefore, the Control Point GMRS at EL 561 ft is representative of the input at the building foundation. For the DGB a separate FIRS is developed at EL 615 ft through a separate site response analysis to the base of the DGB at EL 615 ft.

The horizontal GMRS values for RB foundation (EL 561 ft) and horizontal FIRS for DGB foundation are provided in ***Table 3-2*** and ***Table 3-3***, respectively.

3.2 VERTICAL SEISMIC DEMAND

As described in Section 3.2 of Reference 3, the horizontal GMRS and site soil conditions are used to calculate the vertical GMRS (VGMRS), which is the basis for calculating high-frequency seismic demand on the subject components in the vertical direction. The site's soil mean Vs vs. depth profile is provided in Reference 10, Table 5-3, and reproduced below in ***Table 3-1*** for RB foundation.

TABLE 3-1
SOIL MEAN SHEAR-WAVE VELOCITY AND DEPTH PROFILE FOR THE FIRST 100 FT; REACTOR BUILDING FOUNDATION (EL 561 FT)

LAYER	LAYER END DEPTH [ft]	LAYER END DEPTH [m]	LAYER THICKNESS d_i [ft]	Vs_i [ft/s]	d_i / Vs_i	Σ [d_i / Vs_i]	Vs30 [ft/s]
1	55	16.8	55	4772	0.01153	0.01153	4985
2	100	30.5	45	5273	0.00853	0.02006	

Using the Vs vs. depth profile of RB foundation (***Table 3-1***), the velocity of a shear wave traveling from a depth of 30m (100 ft) to the surface of the site (Vs30) is calculated per the methodology of Reference 3, Section 3.5.

- The time for a shear wave to travel through each soil layer is calculated by dividing the layer depth (d_i) by the shear-wave velocity (Vs) of the layer (Vs_i).
- The total time for a wave to travel from a depth of 30m to the surface is calculated by adding the travel time through each layer from depths of 0m to 30m ($\Sigma[d_i/Vs_i]$).
- The velocity of a shear wave traveling from a depth of 30m to the surface is therefore the total distance (30m) divided by the total time; i.e., $Vs30 = (30\ m)/\Sigma[d_i/Vs_i]$.

The vertical FIRS is derived using the Vertical-to-Horizontal (V/H) spectral ratio for rock sites in Western United States (WUS) and Central and Eastern United States (CEUS) from NUREG/CR-6728 (McGuire et al., 2001) (Reference 11). The average Vs in the upper 30 meters (100 ft) is used to weight the WUS and CEUS V/H values. The average Vs in the upper 30 meters (m) (Vs30) for EL 561 ft is 4,985 ft/sec (1,519 meters per second [m/s]). The Vs30 for WUS and CEUS rock sites are 520 m/s and 2800 m/s, respectively (Reference 11). The V/H ratios at EL 561 ft use a weight of (2800-1519)/(2800-520)=0.56 for WUS V/H ratios and (1519-520)/(2800-520)=0.44 for CEUS V/H ratios.

The V/H ratios from Reference 11 are also dependent on peak ground acceleration (PGA). The spectral ordinate of horizontal FIRS at 100 Hertz (Hz) is used as the PGA to determine the V/H ratios. Since the spectral acceleration (SA) of the horizontal FIRS at 100 Hz is 0.243g, the V/H ratios for the PGA range of 0.2g – 0.5g from Reference 11 are used.

The vertical GMRS is then calculated by multiplying the mean V/H ratio at each frequency by the horizontal GMRS acceleration at the corresponding frequency.

The resulting V/H ratios and VGMRS values for RB foundation (EL 561 ft) are provided in ***Table 3-2***. ***Figure 3-1*** below provides a plot of the horizontal GMRS, V/H ratios, and vertical GMRS for EL 561 ft at the PNPP.

A similar process is used to determine the V/H spectral ratio for EL 615 ft (DGB foundation elevation). The VS30 for DGB foundation is 1,842 ft/s (562 m/s). This leads to weights of 0.98 for the WUS V/H ratios from McGuire et al., (2001) (Reference 11) and 0.02 for the CEUS V/H ratios. The 100-Hz SA value for the DGB FIRS is 0.418g, which corresponds to the V/H ratios for the 0.2g – 0.5g range. The final horizontal and vertical FIRS for EL 615 ft are shown on ***Table 3-3*** and ***Figure 3-2***.

TABLE 3-2
HORIZONTAL AND VERTICAL GMRS FOR RB FOUNDATION (EL 561 FT)

FREQUENCY (Hz)	HGMRS (g)	V/H RATIO	VGMRS (g)
0.10	0.0030	0.6425	0.0020
0.13	0.0045	0.6425	0.0029
0.16	0.0065	0.6425	0.0042
0.20	0.0095	0.6425	0.0061
0.26	0.0139	0.6425	0.0089
0.33	0.0208	0.6425	0.0134
0.42	0.0322	0.6266	0.0202
0.50	0.0458	0.6146	0.0281
0.53	0.0489	0.6130	0.0300
0.67	0.0626	0.6068	0.0380
0.85	0.0784	0.5955	0.0467
1.00	0.0895	0.5882	0.0527
1.08	0.0991	0.5863	0.0580
1.37	0.1228	0.5822	0.0713
1.74	0.1277	0.5803	0.0742
2.21	0.1489	0.5842	0.0874
2.50	0.1769	0.5916	0.1047
2.81	0.2103	0.6008	0.1262
3.56	0.2721	0.6258	0.1701
4.52	0.3287	0.6636	0.2183
5.00	0.3618	0.6817	0.2465
5.74	0.4020	0.7113	0.2859
7.28	0.4664	0.7795	0.3636
9.24	0.5424	0.8648	0.4688
10.00	0.5663	0.8956	0.5072
11.72	0.5773	0.9483	0.5474
14.87	0.5851	0.9803	0.5736
18.87	0.5976	0.9881	0.5897
23.95	0.5788	0.9642	0.5579
25.00	0.5722	0.9586	0.5484
30.39	0.5389	0.9433	0.5081
38.57	0.4868	0.9455	0.4599
48.94	0.4233	0.9708	0.4109
62.10	0.3443	0.9760	0.3357
78.80	0.2672	0.9576	0.2567
100.00	0.2426	0.9149	0.2219

TABLE 3-3
HORIZONTAL AND VERTICAL FOUNDATION INPUT RESPONSE SPECTRA (FIRS) FOR DGB FOUNDATION (EL 615 FT)

FREQUENCY (Hz)	HFIRS (g)	V/H RATIO	VFIRS (g)
0.10	0.0035	0.5618	0.0020
0.13	0.0049	0.5618	0.0028
0.16	0.0071	0.5618	0.0040
0.20	0.0101	0.5618	0.0057
0.26	0.0147	0.5618	0.0082
0.33	0.0218	0.5618	0.0122
0.42	0.0336	0.5340	0.0179
0.50	0.0478	0.5128	0.0245
0.53	0.0512	0.5103	0.0261
0.67	0.0665	0.4994	0.0332
0.85	0.0834	0.4796	0.0400
1.00	0.0939	0.4668	0.0438
1.08	0.1030	0.4635	0.0477
1.37	0.1297	0.4564	0.0592
1.74	0.1430	0.4531	0.0648
2.21	0.1883	0.4599	0.0866
2.50	0.2621	0.4727	0.1239
2.81	0.3677	0.4889	0.1798
3.56	0.5054	0.5327	0.2692
4.52	0.8000	0.5988	0.4790
5.00	0.9256	0.6304	0.5835
5.74	1.0452	0.6824	0.7132
7.28	1.1561	0.8016	0.9268
9.24	1.0515	0.9510	1.0000
10.00	1.0090	1.0048	1.0139
11.72	0.9249	1.0861	1.0045
14.87	0.8937	1.1251	1.0054
18.87	0.9118	1.1201	1.0214
23.95	0.8901	1.0351	0.9214
25.00	0.8791	1.0172	0.8942
30.39	0.7884	0.9450	0.7451
38.57	0.6894	0.8909	0.6142
48.94	0.6096	0.8567	0.5222
62.10	0.5203	0.8538	0.4443
78.80	0.4386	0.8530	0.3742
100.00	0.4178	0.8510	0.3556

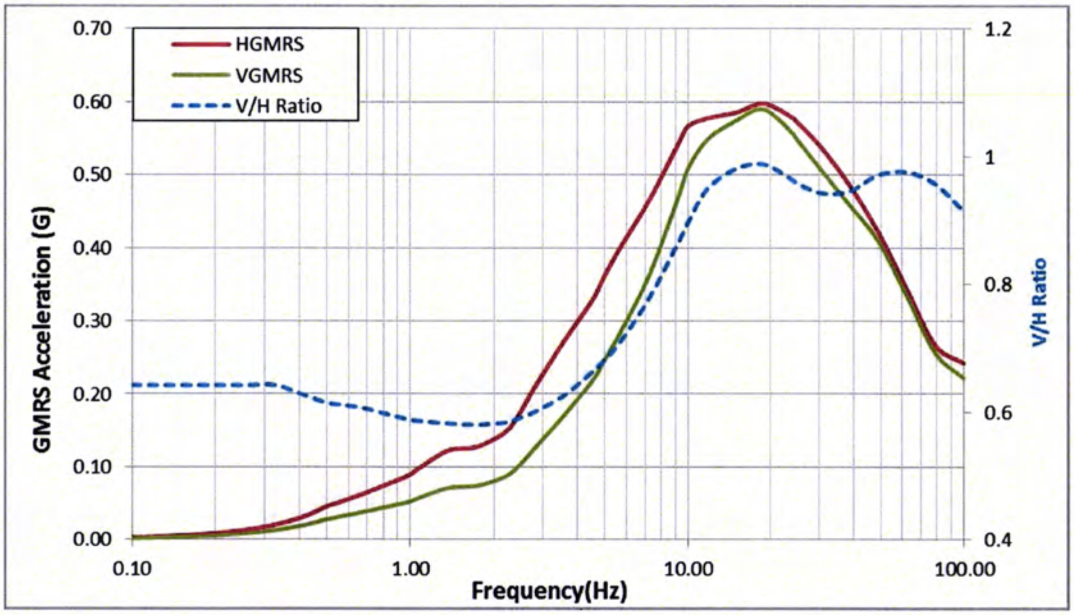


FIGURE 3-1
PLOT OF THE HORIZONTAL AND VERTICAL GROUND MOTION RESPONSE SPECTRA AND V/H RATIOS FOR EL 561 FT (RB FOUNDATION)

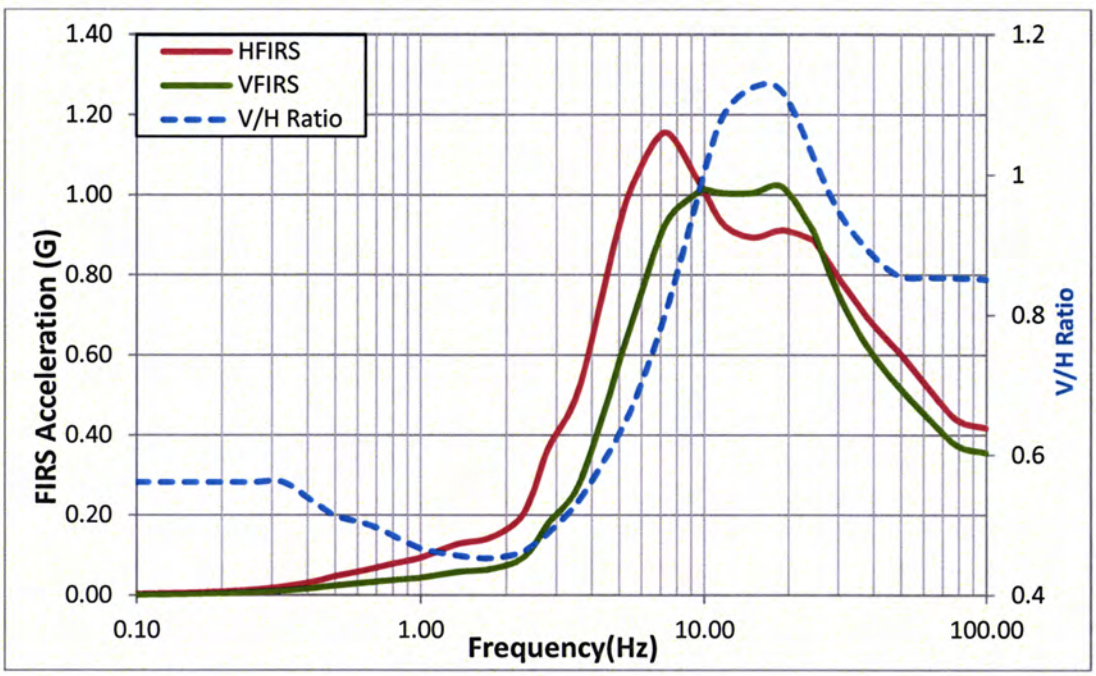


FIGURE 3-2
PLOT OF THE HORIZONTAL AND VERTICAL GROUND MOTION RESPONSE SPECTRA AND V/H RATIOS FOR EL 615 FT (DGB FOUNDATION)

3.3 COMPONENT HORIZONTAL SEISMIC DEMAND

The horizontal seismic demands to be used in this evaluation are the in-structure response spectra (ISRS) at the base of the equipment, amplified by amplification factors suggested in Reference 3 for the specific type of equipment. Alternatively, if the seismic capacities to which the seismic demands are compared are based on assembly (e.g., cabinet) tests and the test spectra are defined at the base of the assembly, the horizontal amplification factor is taken as 1.0. The required 5% damped ISRS are obtained from Reference 12 which is developed as part of the Seismic Probabilistic Risk Assessment (SPRA) program at PNPP. If there are sharp peak(s) in the ISRS in the frequency range of interest, these peaks are clipped in accordance with the guidelines in EPRI NP-6041-SL (Reference 13).

Per Reference 3, the peak horizontal acceleration is amplified using the horizontal in-cabinet amplification factor AF_c to account for seismic amplification within the host equipment (cabinet, switchgear, or motor control center).

The in-cabinet amplification factor, AF_c is associated with a given type of cabinet construction. The three general cabinet types are identified in Reference 3 and Appendix I of EPRI NP-7148 (Reference 14) assuming 5% in-cabinet response spectrum damping. EPRI NP-7148 (Reference 14) classified the cabinet types as high amplification structures, such as switchgear panels and other similar large flexible panels; medium amplification structures, such as control panels and control room benchboard panels; and low amplification structures, such as motor control centers.

All of the electrical cabinets containing the components subject to High-Frequency Confirmation (see ***Table B-1*** in ***Appendix B***) can be categorized into one of the in-cabinet amplification categories in Reference 3 as follows:

- Switchgear cabinets 1R22S0006, 1R22S0007, and 1R22S0009 are large cabinets consisting of a lineup of several interconnected sections typical of the high amplification cabinet category. Each section is a wide box-type structure with height-to-depth ratios of about 1.2 and may include wide stiffened panels. This results in lower stresses and hence less damping which increases the enclosure response. Components can be mounted on the wide panels, which results in the higher in-cabinet amplification factors.

- Control cabinets 1E22P0002, 1H13P0618, 1H13P0621, 1H13P0628, 1H13P0631, 1H13P0632, and 1H13P0642 are in a lineup of several interconnected sections with moderate width. Each section consists of structures with height-to-depth ratios of in the range of 1.7 to 2.5, which results in moderate frame stresses and damping. The response levels are mid-range between motor control centers and switchgear and; therefore, these cabinets can be considered in the medium amplification category.
- Motor control centers 1R24S0018 and 1R24S0026 and battery chargers 1E22S0006 and 2E22S0006 contain devices within the scope of the High-Frequency Confirmation. The seismic capacities of the devices utilize assembly based tests of the MCCs and battery chargers where the test spectra are defined at the bases of the assemblies. Therefore, amplification factors are taken as 1.0 for high frequency evaluation of the devices within these motor control centers and battery chargers.

3.4 Component Vertical Seismic Demand

The component vertical demand is determined using the peak acceleration of the 5% damped vertical ISRS from Reference 12 between 15 Hz and 40 Hz and amplifying it using the vertical in-cabinet amplification factor AF_c to account for seismic amplification within the host equipment (cabinet, switchgear, or motor control center). The in-cabinet amplification factor, AF_c is derived in Reference 3 and is 4.7 for all cabinet types. Alternatively, if the seismic capacities to which the seismic demands are compared are based on assembly (e.g., cabinet) tests and the test spectra are defined at the base of the assembly, the vertical amplification factor is taken as 1.0. If there are sharp peak(s) in the ISRS in the frequency range of interest, these peaks are clipped in accordance with the guidelines in EPRI NP-6041-SL (Reference 13).

4.0 CONTACT DEVICE EVALUATIONS

Per Reference 3, seismic capacities (the highest seismic test level reached by the contact device without chatter or other malfunction) for each subject contact device are determined by the following procedures:

1. If a contact device was tested as part of the EPRI High-Frequency Testing program (Reference 15), then the component seismic capacity from this program is used.
2. If a contact device was not tested as part of Reference 15, then one or more of the following means to determine the component capacity were used:
   a. Device-specific seismic test reports (either from the station or from the SQURTS testing program).
   b. Generic Equipment Ruggedness Spectra (GERS) capacities per Reference 16 and Reference 17.
   c. Assembly (e.g., electrical cabinet) tests where the component functional performance was monitored.

The high-frequency capacity of each device was evaluated with the component mounting point demand from ***Section 3.0*** using the criteria in Section 4.5 of Reference 3. A total of 95 components are identified that required High-Frequency Confirmation evaluation. The 95 components are grouped into 15 main groups based on device type and capacity and enclosure dynamic characteristics and location.

A summary of the high-frequency evaluation conclusions is provided in ***Table B-1*** in ***Appendix B***.

5.0 CONCLUSIONS

5.1 General Conclusions

The PNPP has performed a High-Frequency Confirmation evaluation in response to the NRC's 50.54(f) letter (Reference 1) using the methods in EPRI Report 3002004396 (Reference 3).

The evaluation identified a total of 95 components that required High-Frequency Confirmation evaluation. The 95 components identified are grouped into 15 main groups based on device type and capacity and enclosure dynamic characteristics and location. The high-frequency evaluation is performed for the 15 main groups and the results are summarized in ***Table B-1*** in ***Appendix B***. The evaluation shows that all 15 main groups (95 total components) have adequate seismic capacity and none of the components required resolution following the criteria in Section 4.6 of Reference 3.

5.2 Identification of Follow-Up Actions

For PNPP, all the identified 95 components have adequate seismic capacity and no follow-up actions were identified.

6.0 REFERENCES

1. NRC (E. Leeds and M. Johnson) Letter to All Power Reactor Licensees et al., "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident," March 12, 2012, ADAMS Accession Number ML12053A340.

2. EPRI 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," February 2013.

3. EPRI 3002004396, "High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation," July 2015.

4. NRC (J. Davis) Letter to Nuclear Energy Institute (A. Mauer), "Endorsement of Electric Power Research Institute Final Draft Report 3002004396, High Frequency Program: Application Guidance for Functional Confirmation and Fragility," September 17, 2015, ADAMS Accession Number ML15218A569.

5. NRC (W. Dean) Letter to the Power Reactor Licensees on the Enclosed List, "Final Determination of Licensee Seismic Probabilistic Risk Assessments Under the Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 2.1 "Seismic" of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," October 27, 2015, ADAMS Accession Number ML15194A015.

6. FirstEnergy Nuclear Operating Company (FENOC) Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54 (f) Regarding Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident: Enclosure D – NTTF 2.1 Seismic Hazard and Screening Report for Perry Nuclear Power Plant dated March 31, 2014, ADAMS Accession Number ML14092A203.

7. FirstEnergy Nuclear Operating Company (FENOC) Expedited Seismic Evaluation Process (ESEP) Reports, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident: Enclosure D – Expedited Seismic Evaluation Process (ESEP) Report for Perry Nuclear Power Plant dated December 19, 2014, ADAMS Accession Number ML14353A059.

8. NRC Letter, Perry Nuclear Power Plant, Unit 1 – Staff Assessment of Information provided Pursuant to Title 10 of the Code of Federal Regulations Part 50, Section 50.54(f), Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated August 3, 2015, ADAMS Accession Number ML15208A034.

9. Stokoe, K. H., W. K. Choi, and F.-Y. Menq, 2003, "Summary Report: Dynamic Laboratory Tests: Unweathered and Weathered Shale Proposed Site of Building 9720-82 Y-12 National Security Complex, Oak Ridge, Tennessee," Department of Civil Engineering, The University of Texas at Austin, Austin, Texas, 2003.

10. ABS Consulting/RIZZO Associates, "Probabilistic Seismic Hazard Analysis and Ground Motion Response Spectra, Perry Nuclear Power Plant, Seismic PRA Project," 2734298-R-003, Revision 1, 2014.

11. McGuire, R. K, W. J. Silva, and C. J. Constantino, 2001, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines," NUREG/CR-6728, U.S. Nuclear Regulatory Commission, October 2001.

12. ABS Consulting/ RIZZO Associates Report 2734298-R-005, Part C and Part D, "Building Seismic Analysis, Perry Nuclear Power Plant, Seismic Probabilistic Risk Assessment Project," Revision 1, 2014.

13. EPRI NP-6041-SL, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Revision 1, Electric Power Research Institute, June 1994.

14. Procedure for Evaluating Nuclear Power Plant Relay Seismic Functionality EPRI, Palo Alto, CA: 1990, NP-7148.

15. EPRI 3002002997, "High Frequency Program: High Frequency Testing Summary," September 2014.

16. EPRI NP-7147-SL, "Seismic Ruggedness of Relays," August 1991.

17. EPRI NP-7147 SQUG Advisory 2004-02, "Relay GERS Corrections," September 10, 2004.

18. EPRI 1015109, "Program on Technology Innovation: Seismic Screening of Components Sensitive to High-Frequency Vibratory Motions," October 2007.

19. NRC Letter, Perry Nuclear Power Plant Unit 1 – Staff Review of Interim Evaluation Associated with Reevaluated Seismic Hazard Implementating Near-Term Task Force Recommendation 2.1, dated September 23, 2015, ADAMS Accession Number ML15240A032.

APPENDIX A

REPRESENTATIVE SAMPLE COMPONENT EVALUATIONS

A Representative Sample Component Evaluations

A1.0 Purpose

The purpose of this calculation is to show two examples of High Frequency Confirmation evaluation for sensitive components that required evaluation at Perry Nuclear Power Plant. This calculation is in support of plant response to NRC Near-Term Task Force recommendation 2.1 for performing high frequency confirmation.

A2.0 Scope

The complete list of the components selected for High Frequency confirmation evaluation are listed in Table B-1. The two components selected for example calculation are presented in Table A-1. These example calculations show the detailed procedure for the High Frequency confirmation evaluation.

Table A-1: Components selected for sample High Frequency confirmation evaluation

Relay Model	Relay Manufacturer	Host Panel	Additional Panels	Building	Elev.	ISRS Point	EPRI Equip. Class	State
12HFA151A2H	GE	1E22P002	--	Diesel Generator	620'	2	20. I & CP	Energized (NO/NC)
12IFC53A1A, 12IFC53B1A	GE	1R22S0007-E14	1R22S0007-E15 1R22S0007-E04 1R22S0007-E13 1R22S0009-001 1R22S0009-E03 1R22S0009-005	Control Complex	620	1	3. MVSG	De-Energized
		1R22S0006-E12	1R22S0006-E13 1R22S0006-E04 1R22S0006-E09			3		

A3.0 Methodology

The methodology in Reference A1 will be used to calculate Capacity to Demand ratios for the subject relays in the High Frequency range of 15-40 Hz. The capacity is obtained from the EPRI HF Test program (Ref. A2), or from GERS (Refs. A7, A8 & A11), or other shake table tests (Refs. A4, A6, A12 & A13) if the EPRI Program did not include the specific relay model. The EPRI HF Test Program reports a representative average spectral acceleration (SA) in the high frequency range. While the capacities in References A4, A6-A8, & A11-A13 are for the Low Frequency region (i.e., 4.5-16 Hz), according to the conclusions in References A1 and A2, the Low Frequency capacities are always lower than the High Frequency capacities and therefore could be used conservatively in the HF confirmation program.

The seismic Demand to be used in this evaluation are the in-structure response spectra at the base of the equipment, amplified by amplification factors suggested in Reference A1 for the specific type of equipment. Reference A3 provides the required 5% damped ISRS, which were developed as part of the Seismic PRA program at Perry Nuclear Power Plant. If there are sharp peak(s) in the ISRS in the frequency range of interest (15 Hz to 40 Hz), these peaks are clipped in accordance with the guidelines in Reference A10.

While not required for HF confirmation task, the C10% capacities are calculated and also reported here for each relay using guidance in Reference A5.

A4.0 References

A1. EPRI Technical Report No. 3002004396, "High Frequency Program - Application Guidance for Functional Confirmation and Fragility Evaluation," Final Report, July 2015.

A2. EPRI Technical Report No. 3002002997, "High Frequency Program - High Frequency Testing Summary," Final Report, September 2014.

A3. ABS Consulting/Rizzo Associates Report 2734298-R-005/R7-12-4734, Part C & Part D, "Building Seismic Analysis of Perry Nuclear Power Plant: Seismic PRA Project," Rev.1, 2014.

A4. Trentec Inc. Test Report S8004.0, Rev.0, "Seismic Test Report for General Electric Relays," September 2008.

A5. NEI 12-06, Appendix H, December 2015.

A6. Electroswitch Technical Publication LOR-1, "High Speed Multi-Contact Lock-Out Relays For Power Industry Applications," September 2012.

A7. EPRI TR-105988, "GERS Formulated Using Data from the SQURTS Program," April 1996.

A8. EPRI NP-7147-SL," Seismic Ruggedness of Relays," August 1991.

A9. FENOC, "Perry Relay Chatter Analysis," SPRA-011 Rev. 0, May 18, 2017.

A10. EPRI NP-6041-SL, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Rev.1, Electric Power Research Institute, June 1994.

A11. EPRI NP-5223-SLR1, "Generic Seismic Ruggedness of Power Plant Equipment", Rev.1, August 1991.

A12. Brown Boveri Electric, Inc. Report Number 37-51958-S, Rev.0, "Seismic Certification Report for Class1E Electrical Equipment", March 1983.

A13. ABB Power T&D Co., "Seismic Qualification Report RC-5503-A, Type 50D/H Overcurrent Relays," January 1997.

A5.0 High Frequency Confirmation Evaluations

The HF confirmation of the relays shown in Section A2.0 above is performed in the following sections. These evaluations use the methodology cited in Reference A1, as described in Section A3.0 above.

A5.1 HF Evaluation for GE Relay 12HFA151A2H

Relay Model	Relay Manufacturer	Host Panel	Additional Panels	Building	Elev.	RRS Point	EPRI Equip. Class
12HFA151A2H (excludes Code 06)	GE	1E22P0002		DG	620	2	20. Instrument & Control Panel

A5.1.1 Capacity

$SA := 21.30g$ — HF seismic capacity of HFA151 relay in Energized state from Reference A2, Table 5-12

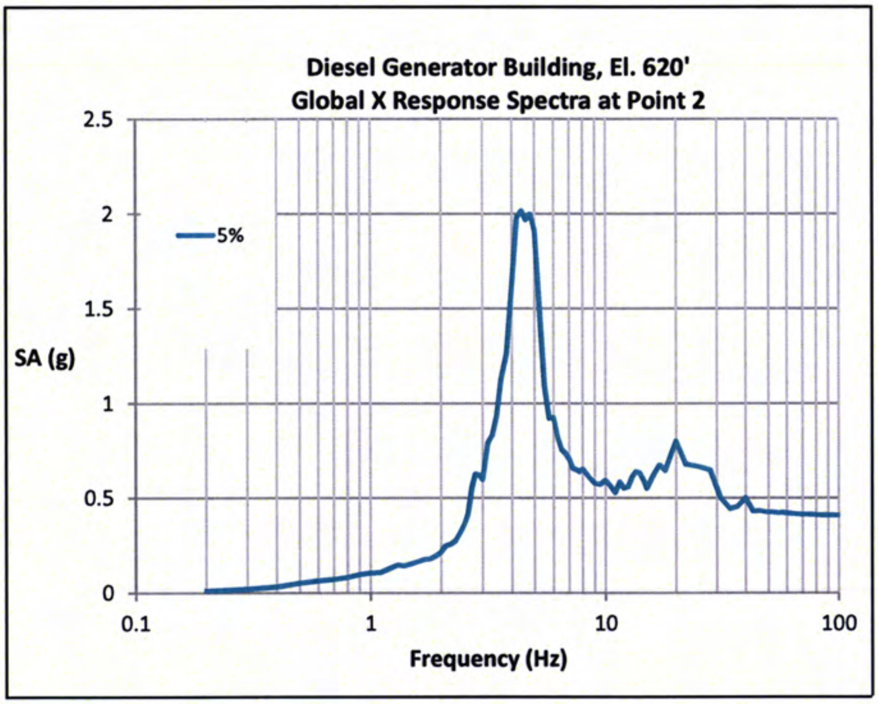
$SA_T := SA + 0.625g = 21.93 \cdot g$ — Effective spectral test capacity per Ref. A1

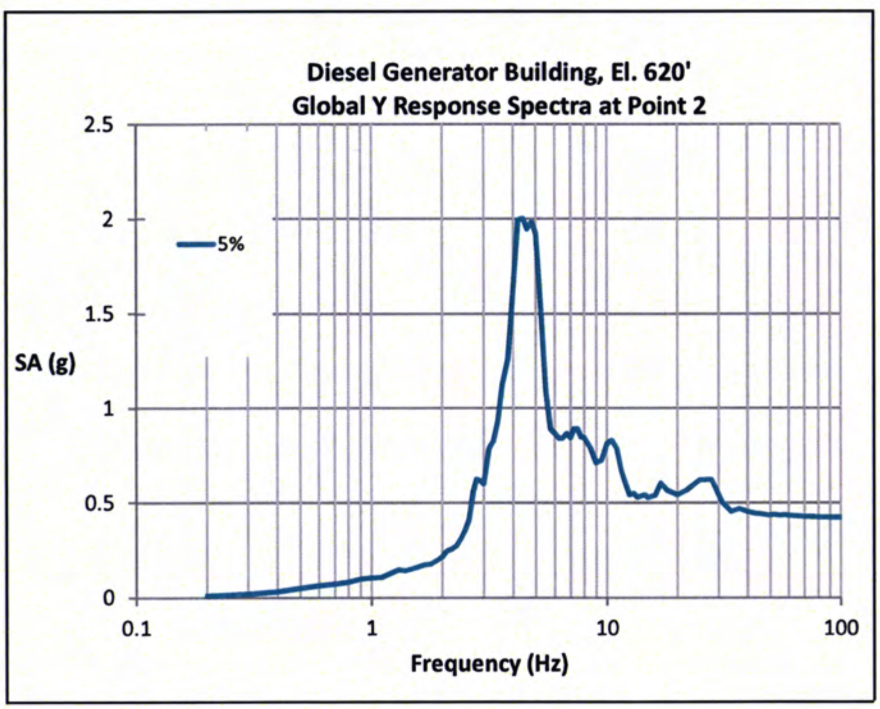
A5.1.2 Demand

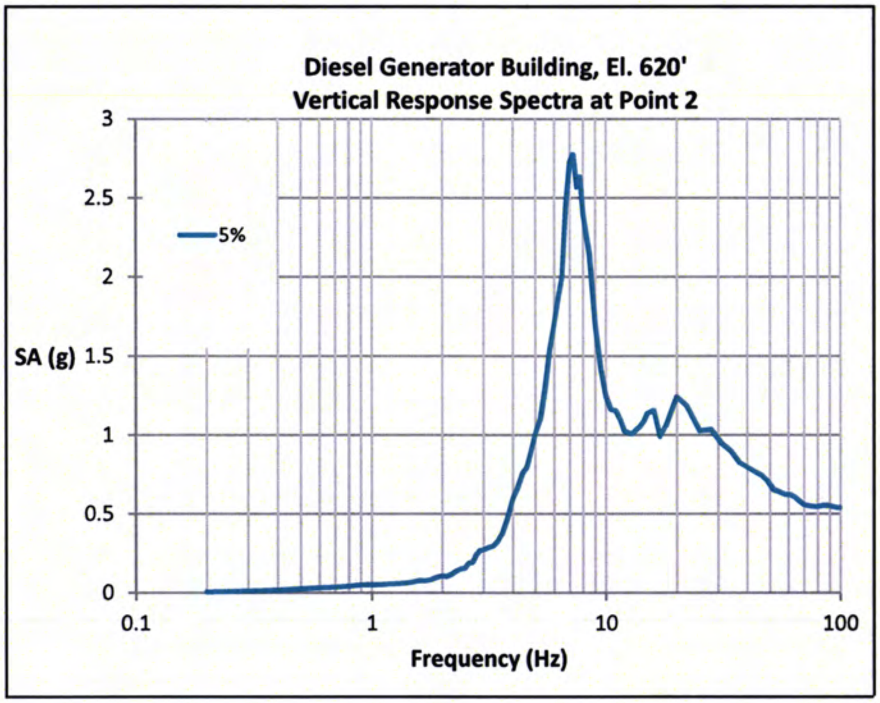
The 5% damped in-structure response spectra at the location of the host panel in both horizontal and vertical directions are shown below (from Reference A3). The HF demand in the 15Hz to 40 Hz are:

$SA_{H\_DG620\_2} := 0.75g$ — Maximum horizontal acceleration (X or Y direction) in the 15Hz to 40Hz range (Note: No clipping required in the frequency range of interest)

$SA_{V\_DG620\_2} := 1.20g$ — Maximum vertical acceleration (z direction) in the 15Hz to 40Hz range (Note: No clipping required in the frequency range of interest)


Diesel Generator Building, El. 620'
Global X Response Spectra at Point 2
5%
SA (g)
Frequency (Hz)
2.5
2
1.5
1
0.5
0
0.1
1
10
100


Diesel Generator Building, El. 620'
Global Y Response Spectra at Point 2
5%
SA (g)
Frequency (Hz)
2.5
2
1.5
1
0.5
0
0.1
1
10
100



$AF_{C\_H} := 4.5$ — Maximum horizontal in-cabinet amplification factor for instrument and control panels per Ref. A1

$AF_{C\_V} := 4.7$ — Maximum vertical in-cabinet amplification factor for instrument and control panels per Ref. A1

$ICRS_{H\_Pt2} := SA_{H\_DG620\_2} \cdot AF_{C\_H}$ — Maximum Horizontal in-cabinet response spectra (Note: no clipping was necessary in the frequency range of interest)

$ICRS_{H\_Pt2} = 3.38 \cdot g$

$ICRS_{V\_Pt2} := SA_{V\_DG620\_2} \cdot AF_{C\_V}$ — Maximum vertical in-cabinet response spectra (Note: no clipping was necessary in the frequency range of interest)

$ICRS_{V\_Pt2} = 5.64 \cdot g$

5.1.3 Capacity-Demand Ratio

$F_k := 1.56$ — CDFM Knockdown factor for fragility threshold from high frequency test program (Table 4-2 of Ref. A1)

$F_{MS} := 1.20$ — Multi-axis to single-axis correction factor from section 4.5.2 of Ref. A1

$$TRS := \left(\frac{SA_T}{F_k}\right)\cdot\left(F_{MS}\right) = 16.87\cdot g$$

effective wide-band component capacity acceleration

$$CDR_{H\_Pt2} := \frac{TRS}{ICRS_{H\_Pt2}}$$

Capacity-Demand-Ratio in horizontal direction

$\boxed{CDR_{H\_Pt2} = 5.00}$ > 1.0 i.e., Capacity > Demand --> O.K.

$$CDR_{V\_Pt2} := \frac{TRS}{ICRS_{V\_Pt2}}$$

Capacity-Demand-Ratio in vertical direction

$\boxed{CDR_{V\_Pt2} = 2.99}$ > 1.0 i.e., Capacity > Demand --> O.K.

5.1.4 HCLPF Capacities ($C_{1\%}$ and $C_{10\%}$)

The PGA used in developing the Perry in-structure response spectra is 0.24g from Reference A3.

$$PGA := 0.24g$$

β_c is the composite uncertainty for relays taken from Table H.1 of Reference A5. This composite uncertainty is considered to be Realistic Lower Bound Case according to Table H.1 of Reference A5, and it is suggested for use in calculating the median capacity.

$$\beta_c := 0.30$$

$$HCLPF_{HFA151\_C1\%} := \min\left(CDR_{H\_Pt2}, CDR_{V\_Pt2}\right) \cdot PGA$$

$$\boxed{HCLPF_{HFA151\_C1\%} = 0.72 \cdot g}$$

$$A_{m\_HFA151\_C1\%} := HCLPF_{HFA151\_C1\%} \cdot e^{\left(2.33 \cdot \beta_c\right)}$$

$$\boxed{A_{m\_HFA151\_C1\%} = 1.44 \cdot g}$$

$Ratio_{C10\%\_C1\%} := 1.36$ Ratio of $C_{10\%}/C_{1\%}$ from Table H.1 of Ref. A5

$$HCLPF_{HFA151\_C10\%} := Ratio_{C10\%\_C1\%} \cdot HCLPF_{HFA151\_C1\%}$$

$$\boxed{HCLPF_{HFA151\_C10\%} = 0.98 \cdot g}$$

A5.2 HF Evaluation for GE Relays 12IFC53A1A and 12IFC53B1A

Relay Model	Relay Manufacturer	Host Panel	Additional Panels	Building	Elev.	RRS Point	EPRI Equip. Class
12IFC53A1A 12IFC53B1A	GE	1R22S0007-E14	1R22S0007-E15 1R22S0007-E04 1R22S0007-E13 1R22S0009-001 1R22S0009-E03 1R22S0009-005	CC	620	1	3. MVSG
		1R22S0006-E12	1R22S0006-E13 1R22S0006-E04 1R22S0006-E09			3	

A5.2.1 Capacity

According to the guidance in Reference A1, the HF capacity can be established based on relay's low frequency capacity. The high-frequency capacity of this relay is established based on its tested capacity in the 4.5-16 Hz frequency range in the horizontal and vertical directions. The overall HF capacity will be calculated by geometric averaging of the capacities in three orthogonal directions (consistent with Ref. A1 recommendation)

$TRS_x := 9.88g$ Average De-Energized/No Contacts TRS accel. in X-dir, 5% damping (from test report in Ref. A4, and shown in Table Below) - Table Limit

$TRS_y := 8.63g$ Average De-Energized/No Contacts TRS accel. in Y-dir, 5% damping (from test report in Ref. A4, and shown in Table Below) - Table Limit

$TRS_z := 8.63g$ Average De-Energized/No Contacts TRS accel. in Z-dir, 5% damping (from test report in Ref.A4, and shown in Table Below) - Table Limit

$SA := \left(TRS_x \cdot TRS_y \cdot TRS_z\right)^{\frac{1}{3}} = 9.03 \cdot g$ HF seismic capacity of IFC53 relays in De-Energized state

$SA_T := SA = 9.03 \cdot g$ Effective spectral test capacity per Ref. A1

5% Damping TRS from Reference A4			
SSE Test#7 (De-Energized)			
Freq. (Hz)	X-Dir. Acc. (g)	Y-Dir. Acc. (g)	Z-Dir. Acc. (g)
1.00	0.77	0.66	0.56
1.12	0.76	0.81	0.81
1.26	1.37	1.32	1.04
1.41	1.66	1.47	1.46
1.58	2.10	1.95	1.49
1.78	2.42	1.75	2.38
2.00	3.12	2.82	3.73
2.24	3.53	4.10	3.96
2.51	5.52	4.98	4.77
2.82	6.31	6.17	7.00
3.16	7.58	7.02	6.92
3.55	9.37	7.35	7.38
3.98	9.56	8.14	8.27
4.47	8.74	8.76	11.68
5.01	11.80	10.15	9.48
5.62	8.75	10.50	10.21
6.31	10.29	8.56	7.63
7.08	10.31	8.26	8.44
7.94	12.05	7.84	6.63
8.91	10.27	6.37	7.20
10.00	10.93	8.73	8.21
11.22	8.98	10.06	11.00
12.59	10.27	8.99	8.26
14.13	8.44	7.59	7.97
15.85	7.73	7.76	6.84
17.78	7.99	10.66	7.01
19.95	7.11	11.32	8.34
22.39	6.20	9.71	7.00
25.12	7.18	7.81	5.12
28.18	6.36	7.00	5.93
31.62	6.29	7.57	4.77
35.48	5.95	7.03	5.34
39.81	5.47	6.67	4.89
44.67	5.15	6.13	4.71
50.12	5.09	5.91	4.41
56.23	4.90	5.64	4.50
63.10	4.54	5.84	4.71
70.79	4.58	5.71	4.60
79.43	4.54	5.44	4.50
89.13	4.57	5.52	4.50
100.00	4.58	5.46	4.96
Ave. Spec. Accel. (g)	9.88	8.63	8.63

A5.2.2 Demand

The 5% damped in-structure response spectra at the locations of the switchgears (located at Points 1 and 3 in Control Complex El. 620') in both horizontal and vertical directions are shown below (from Reference A3). The HF demand in the 15Hz to 40 Hz are:

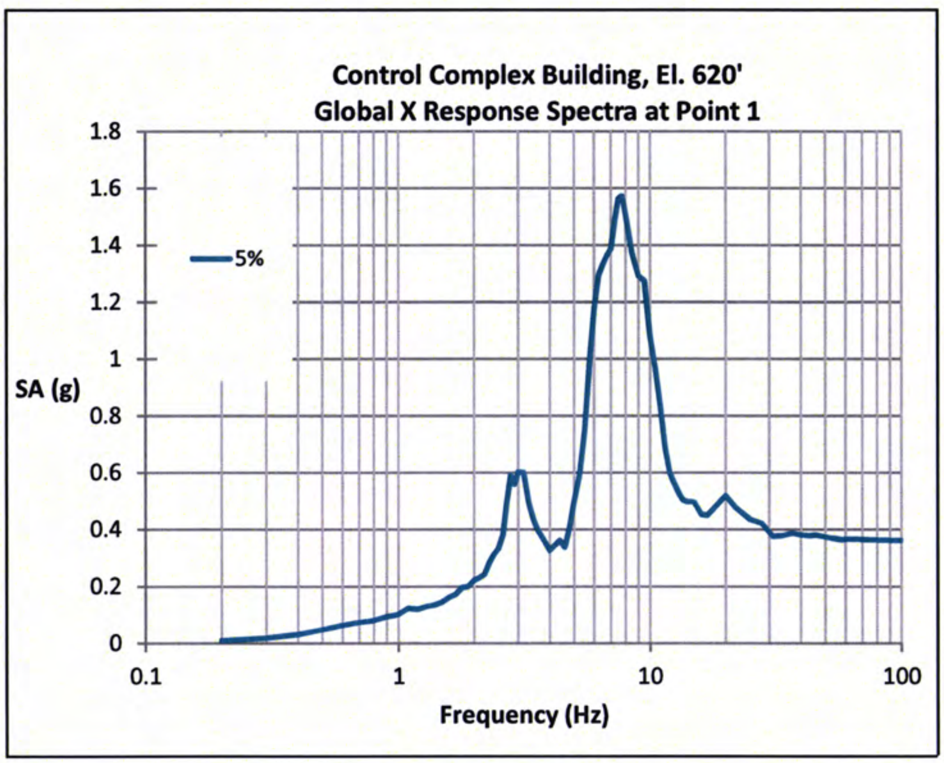
$SA_{H\_CC620\_1} := \max(0.52g, 0.69g) = 0.69 \cdot g$ Maximum horizontal acceleration (X or Y direction) in the 15Hz to 40Hz range corresponding to Pt.1 (no clipping required)

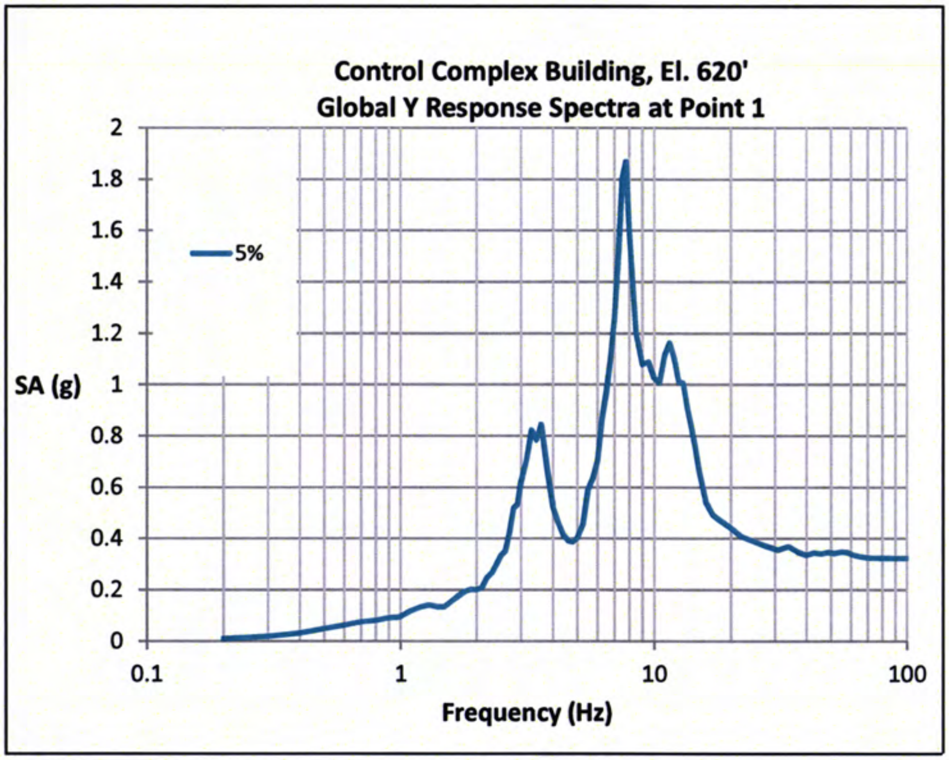
$SA_{V\_CC620\_1} := 0.79g$ Maximum vertical acceleration (z direction) in the 15Hz to 40Hz range corresponding to Pt.1 (no clipping required)

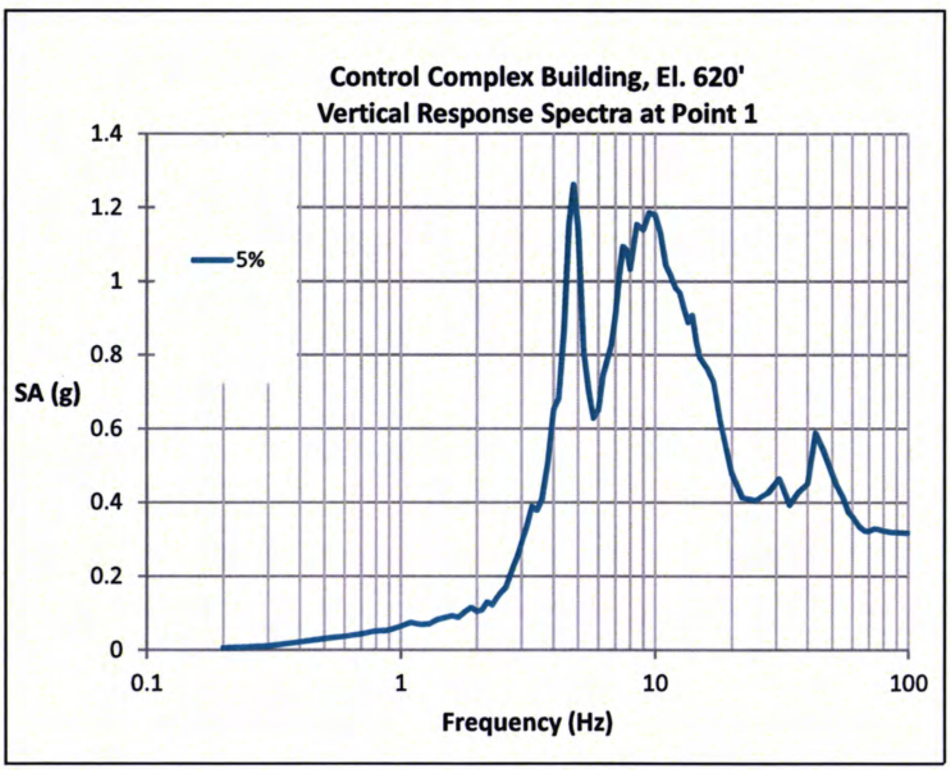
$SA_{H\_CC620\_3} := \max(0.70g, 0.64g) = 0.70 \cdot g$ Maximum horizontal acceleration (X or Y direction) in the 15Hz to 40Hz range corresponding to Pt.3 (no clipping required)

$SA_{cV\_CC620\_3} := 0.71g$ Clipped vertical acceleration (z direction) in the 15Hz to 40Hz range corresponding to Pt.3 (see clipping below)

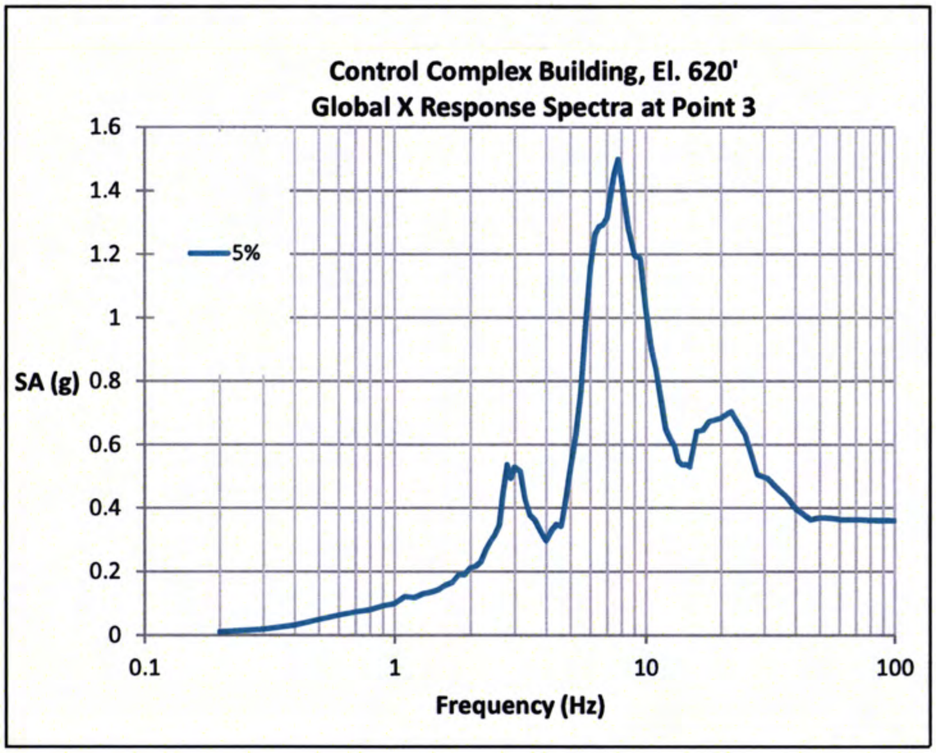
- ***ISRS at Elevation 620', Point 1 of the Control Complex:***

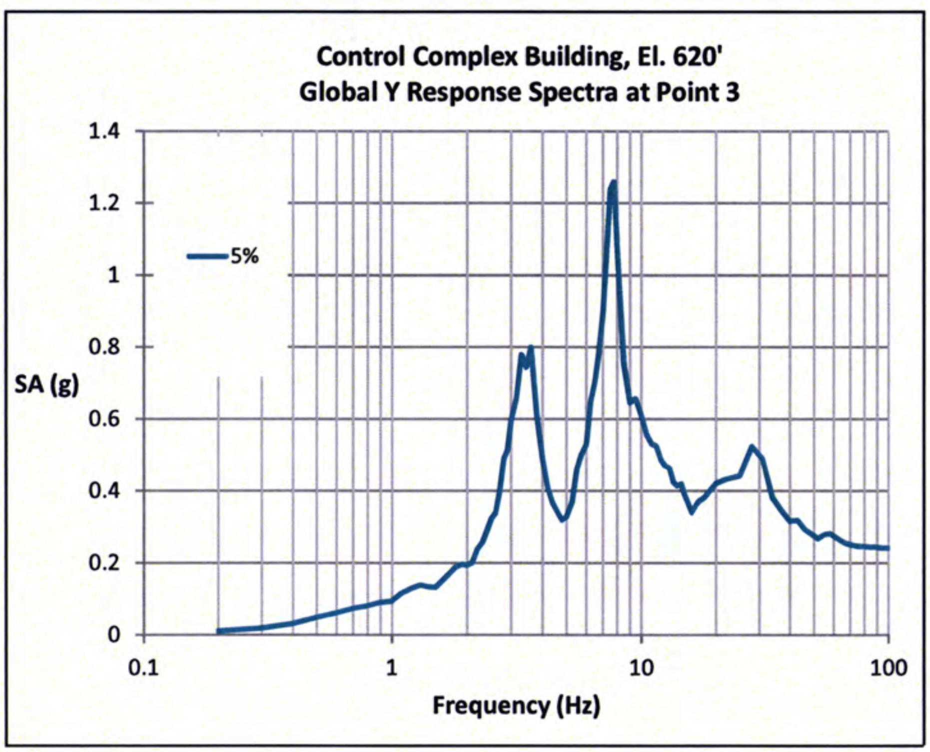


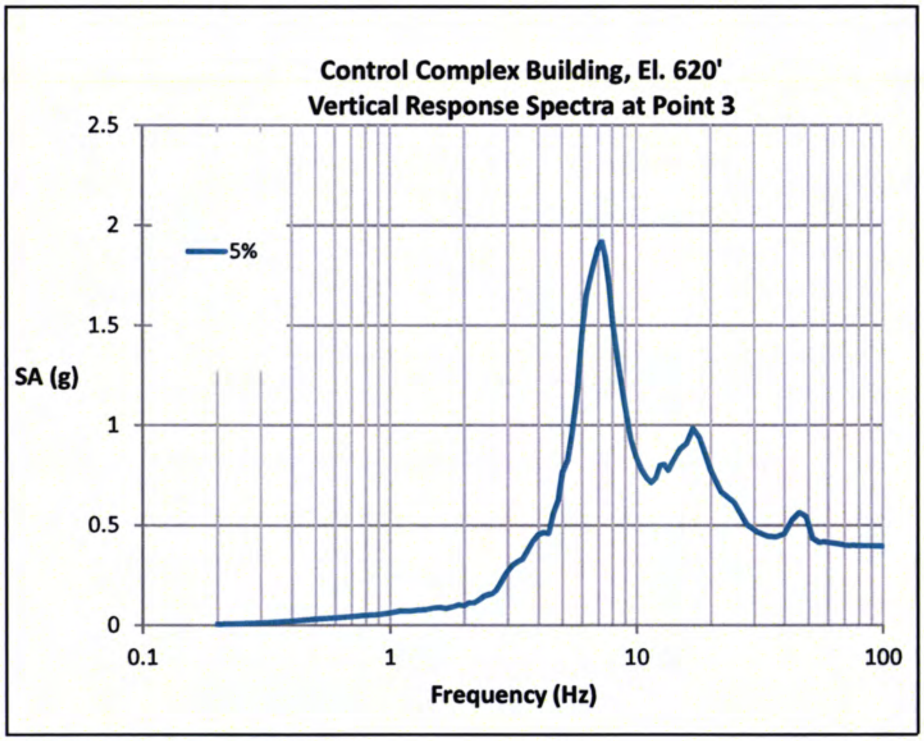

Control Complex Building, El. 620'
Global Y Response Spectra at Point 1
SA (g)
Frequency (Hz)
5%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0.1
1
10
100


Control Complex Building, El. 620'
Vertical Response Spectra at Point 1
SA (g)
Frequency (Hz)
5%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0.1
1
10
100

- ***ISRS at Elevation 620', Point 3 of the Control Complex:***







Clip RRS_z at fc=17Hz

$f_C := 17Hz$ $S_{a\_peak} := 0.98g$

$S_{a\_peak} \cdot 80\% = 0.78 \cdot g$

$f_1 := 13.6Hz$ $f_2 := 20Hz$

$\Delta f_{0.8} := f_2 - f_1 = 6.40 \cdot Hz$

$$B := \frac{\Delta f_{0.8}}{f_c} = 0.38$$

$$C_C := \begin{cases} 0.55 & \text{if } B \le 0.2 \\ 0.4 + 0.75 \cdot B & \text{if } 0.2 \le B \le 0.8 \\ 1.0 & \text{if } B > 0.8 \end{cases} \qquad C_C = 0.68$$

$S_{a\_clip} := C_C \cdot S_{a\_peak} = 0.67 \cdot g$

$S_{a\_valley} := 0.71g$ spectral acceleration corresponding to the valley at 11.5Hz

$S_{a\_clip\_z} := \max(S_{a\_clip}, S_{a\_valley}) = 0.71 \cdot g$

$AF_{C\_H} := 7.2$ Maximum horizontal in-cabinet amplification factor for medium voltage switchgears per Ref. A1

$AF_{C\_V} := 4.7$ Maximum vertical in-cabinet amplification factor for panels per Ref. A1

$ICRS_{H\_Pt1} := SA_{H\_CC620\_1} \cdot AF_{C\_H} = 4.97 \cdot g$ Maximum Horizontal in-cabinet response spectra at Point 1 (Note: no clipping was necessary in the frequency range of interest)

$ICRS_{V\_Pt1} := SA_{V\_CC620\_1} \cdot AF_{C\_V} = 3.71 \cdot g$ Maximum vertical in-cabinet response spectra at Point 1 (Note: no clipping was necessary in the frequency range of interest)

$ICRS_{H\_Pt3} := SA_{H\_CC620\_3} \cdot AF_{C\_H} = 5.04 \cdot g$ Maximum Horizontal in-cabinet response spectra at Point 3 (Note: no clipping was necessary in the frequency range of interest)

$ICRS_{V\_Pt3} := SA_{cV\_CC620\_3} \cdot AF_{C\_V} = 3.34 \cdot g$ Maximum clipped vertical in-cabinet response spectra at Point 3

A5.2.3 Capacity-Demand Ratio

$F_k := 1.20$ — CDFM Knockdown factor for IEEE qualification test from Table 4-2 of Ref. A1

$F_{MS} := 1.20$ — Multi-axis to single-axis correction factor from section 4.5.2 of Ref. A1

$$TRS := \left(\frac{SA_T}{F_k}\right)\cdot\left(F_{MS}\right) = 9.03\cdot g$$

effective wide-band component capacity acceleration

$$CDR_{H\_Pt1} := \frac{TRS}{ICRS_{H\_Pt1}}$$

Capacity-Demand-Ratio in horizontal direction at Point 1

$\boxed{CDR_{H\_Pt1} = 1.82}$ > 1.0 i.e., Capacity > Demand --> O.K.

$$CDR_{V\_Pt1} := \frac{TRS}{ICRS_{V\_Pt1}}$$

Capacity-Demand-Ratio in vertical direction at Point 1

$\boxed{CDR_{V\_Pt1} = 2.43}$ > 1.0 i.e., Capacity > Demand --> O.K.

$$CDR_{H\_Pt3} := \frac{TRS}{ICRS_{H\_Pt3}}$$

Capacity-Demand-Ratio in horizontal direction at Point 3

$\boxed{CDR_{H\_Pt3} = 1.79}$ > 1.0 i.e., Capacity > Demand --> O.K.

$$CDR_{V\_Pt3} := \frac{TRS}{ICRS_{V\_Pt3}}$$

Capacity-Demand-Ratio in vertical direction at Point 3

$\boxed{CDR_{V\_Pt3} = 2.71}$ > 1.0 i.e., Capacity > Demand --> O.K.

A5.2.4 HCLPF Capacities ($C_{1\%}$ and $C_{10\%}$)

The PGA used in developing the Perry in-structure response spectra is 0.24g from Reference A3.

$$PGA := 0.24g$$

β_c is the composite uncertainty for relays taken from Table H.1 of Reference A5. This composite uncertainty is considered to be Realistic Lower Bound Case according to Table H.1 of Reference A5, and it is suggested for use in calculating the median capacity.

$$\beta_c := 0.30$$

$$HCLPF_{IFC53\_C1\%\_1} := \min\left(CDR_{H\_Pt1}, CDR_{V\_Pt1}\right) \cdot PGA$$

$$\boxed{HCLPF_{IFC53\_C1\%\_1} = 0.44 \cdot g}$$

$$A_{m\_IFC53\_C1\%\_1} := HCLPF_{IFC53\_C1\%\_1} \cdot e^{\left(2.33 \cdot \beta_c\right)}$$

$$\boxed{A_{m\_IFC53\_C1\%\_1} = 0.88 \cdot g}$$

$Ratio_{C10\%\_C1\%} := 1.36$ Ratio of $C_{10\%}/C_{1\%}$ from Table H.1 of Ref. A5

$$HCLPF_{IFC53\_C10\%\_1} := Ratio_{C10\%\_C1\%} \cdot HCLPF_{IFC53\_C1\%\_1}$$

$$\boxed{HCLPF_{IFC53\_C10\%\_1} = 0.59 \cdot g}$$

$$HCLPF_{IFC53\_C1\%\_3} := \min\left(CDR_{H\_Pt3}, CDR_{V\_Pt3}\right) \cdot PGA$$

$$\boxed{HCLPF_{IFC53\_C1\%\_3} = 0.43 \cdot g}$$

$$A_{m\_IFC53\_C1\%\_3} := HCLPF_{IFC53\_C1\%\_3} \cdot e^{\left(2.33 \cdot \beta_c\right)}$$

$$\boxed{A_{m\_IFC53\_C1\%\_3} = 0.86 \cdot g}$$

$$HCLPF_{IFC53\_C10\%\_3} := Ratio_{C10\%\_C1\%} \cdot HCLPF_{IFC53\_C1\%\_3}$$

$$\boxed{HCLPF_{IFC53\_C10\%\_3} = 0.58 \cdot g}$$

APPENDIX B

COMPONENTS IDENTIFIED FOR HIGH-FREQUENCY CONFIRMATION

TABLE B-1
COMPONENTS IDENTIFIED FOR HIGH-FREQUENCY CONFIRMATION

HF Relay Group	Unit	Component					Enclosure		Building	Floor Elev. (ft)	Component Evaluation			C1%* (g)	C10%* (g)
		ID	Type	System Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Min. C/D Ratio	Evaluation Result		
1	1	1E22B-K0015	Control Relay	Diesel Engine Lockout	General Electric	12HEA61B234/235	1E22P0002	Control Cabinet	Diesel Generator	620	EPRI HF Test	3.06	Capacity > Demand	0.73	1.00
2	1	1R22Q0637A	Protective Relay	Actuates Bus Lockout	General Electric	12IFC53A1A	1R22S0007-E14	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.79	Capacity > Demand	0.43	0.58
		1R22Q0637B	Protective Relay	Actuates Bus Lockout			1R22S0007-E14								
		1R22Q0637C	Protective Relay	Actuates Bus Lockout			1R22S0007-E14								
		1R22Q0642A	Protective Relay	Actuates Bus Lockout			1R22S0007-E15								
		1R22Q0642B	Protective Relay	Actuates Bus Lockout			1R22S0007-E15								
		1R22Q0642C	Protective Relay	Actuates Bus Lockout			1R22S0007-E15								
		1R22Q0643	Protective Relay	Actuates Bus Lockout			1R22S0007-E15								
		1R22Q0728A	Protective Relay	Actuates Bus Lockout			1R22S0006-E12								
		1R22Q0728B	Protective Relay	Actuates Bus Lockout			1R22S0006-E12								
		1R22Q0728C	Protective Relay	Actuates Bus Lockout			1R22S0006-E12								
		1R22Q0732A	Protective Relay	Actuates Bus Lockout			1R22S0006-E13								
		1R22Q0732B	Protective Relay	Actuates Bus Lockout			1R22S0006-E13								
		1R22Q0732C	Protective Relay	Actuates Bus Lockout			1R22S0006-E13								
		1R22Q0806A	Protective Relay	Actuates Bus Lockout			1R22S0009-001								
		1R22Q0806B	Protective Relay	Actuates Bus Lockout			1R22S0009-001								
		1R22Q0806C	Protective Relay	Actuates Bus Lockout			1R22S0009-001								
		1R22Q0810A	Protective Relay	Actuates Bus Lockout			1R22S0009-E03								
		1R22Q0810B	Protective Relay	Actuates Bus Lockout			1R22S0009-E03								
		1R22Q0810C	Protective Relay	Actuates Bus Lockout			1R22S0009-E03								

TABLE B-1
COMPONENTS IDENTIFIED FOR HIGH-FREQUENCY CONFIRMATION
(CONTINUED)

HF Relay Group	Unit	Component ID	Component Type	Component System Function	Component Manufacturer	Component Model No.	Enclosure ID	Enclosure Type	Building	Floor Elev. (ft)	Component Evaluation: Basis for Capacity	Component Evaluation: Min. C/D Ratio	Component Evaluation: Evaluation Result	C1%* (g)	C10%* (g)
2	1	1R22Q0710A	Protective Relay	Overcurrent Protection	General Electric	12IFC53B1A	1R22S0006-E04	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.79	Capacity > Demand	0.43	0.58
		1R22Q0710B	Protective Relay	Overcurrent Protection			1R22S0006-E04								
		1R22Q0710C	Protective Relay	Overcurrent Protection			1R22S0006-E04								
		1R22Q0722A	Protective Relay	Overcurrent Protection			1R22S0006-E09								
		1R22Q0722B	Protective Relay	Overcurrent Protection			1R22S0006-E09								
		1R22Q0722C	Protective Relay	Overcurrent Protection			1R22S0006-E09								
		1R22Q0612A	Protective Relay	Overcurrent Protection			1R22S0007-E04								
		1R22Q0612B	Protective Relay	Overcurrent Protection			1R22S0007-E04								
		1R22Q0612C	Protective Relay	Overcurrent Protection			1R22S0007-E04								
		1R22Q0635A	Protective Relay	Overcurrent Protection			1R22S0007-E13								
		1R22Q0635B	Protective Relay	Overcurrent Protection			1R22S0007-E13								
		1R22Q0635C	Protective Relay	Overcurrent Protection			1R22S0007-E13								
		1R22Q0821A	Protective Relay	Overcurrent Protection			1R22S0009-005								
		1R22Q0821B	Protective Relay	Overcurrent Protection			1R22S0009-005								
		1R22Q0821C	Protective Relay	Overcurrent Protection			1R22S0009-005								
3	1	86B/EH12	Control Relay	Bus Lockout	Electro Switch	7805LR	1R22S0006-E02	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	2.48	Capacity > Demand	0.60	0.81
		86G/EH12	Control Relay	Diesel Generator Lockout			1R22S0006-E01								
		86B/EH11	Control Relay	Bus Lockout			1R22S0007-E03								
		86G/EH11	Control Relay	Diesel Generator Lockout			1R22S0007-E02								

TABLE B-1
COMPONENTS IDENTIFIED FOR HIGH-FREQUENCY CONFIRMATION
(CONTINUED)

HF Relay Group	Unit	Component					Enclosure		Building	Floor Elev. (ft)	Component Evaluation			C1%* (g)	C10%* (g)
		ID	Type	System Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Min. C/D Ratio	Evaluation Result		
3	1	86B/EH13	Control Relay	Bus Lockout	Electro Switch	7805LR	1R22S0009-E01	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	2.48	Capacity > Demand	0.60	0.81
		86G/EH13	Control Relay	Diesel Generator Lockout			1R22S0009-001								
4	1	42R (1E51F0063)	Motor Contactor	CIV Closure – RCIC Steam Supply	Cutler Hammer	C50C-1 Size 1	1R24S0026	Motor Control Center	Control Complex	620	GERS	1.24	Capacity > Demand	0.30	0.40
		42R (1E51F0064)	Motor Contactor	CIV Closure – RCIC Steam Supply			1R24S0018								
5	1	1B21C-K007A	Control Relay	ADS Logic	Amerace (Tyco)	EGPD and EGPB	1H13P0628	Control Cabinet	Control Complex	654	EPRI HF Test	3.26	Capacity > Demand	0.78	1.06
		1B21C-K008E	Control Relay	ADS Logic			1H13P0628								
		1B21C-K007B	Control Relay	ADS Logic			1H13P0631								
		1B21C-K008F	Control Relay	ADS Logic			1H13P0631								
		1B21C-K051A	Control Relay	ADS Logic			1H13P0628								
		1B21C-K051E	Control Relay	ADS Logic			1H13P0628								
		1B21C-K051B	Control Relay	ADS Logic			1H13P0628								
		1B21C-K051F	Control Relay	ADS Logic			1H13P0631								
		1E51A-K008	Control Relay	RCIC Steam Supply			1H13P0621								
		1E51A-K015	Control Relay	RCIC Steam Supply			1H13P0621								
		1E51A-K024	Control Relay	RCIC Steam Supply			1H13P0621								
		1E51A-K033	Control Relay	RCIC Steam Supply			1H13P0618								
		1E51A-K066	Control Relay	Rcic Isolation Signal			1H13P0621								
		1E51A-K067	Control Relay	RCIC Steam Supply			1H13P0621								
		1E51A-K086	Control Relay	Rcic Isolation Signal			1H13P0618								

TABLE B-1
COMPONENTS IDENTIFIED FOR HIGH-FREQUENCY CONFIRMATION
(CONTINUED)

HF Relay Group	Unit	Component					Enclosure		Building	Floor Elev. (ft)	Component Evaluation			C1%* (g)	C10%* (g)
		ID	Type	System Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Min. C/D Ratio	Evaluation Result		
5	1	1E51A-K100	Control Relay	RCIC Leak Detection	Amerace (Tyco)	EGPD and EGPB	1H13P0621	Control Cabinet	Control Complex	654	EPRI HF Test	3.26	Capacity > Demand	0.78	1.06
		1E51A-K101	Control Relay	RCIC Steam Supply			1H13P0618								
6	1	1E51Q7064	Control Relay	RCIC Isolation Signal	Agastat	ETR14B3B004 and ETR14B3C004	1H13P0621	Control Cabinet	Control Complex	654	EPRI HF Test	3.60	Capacity > Demand	0.86	1.17
		1E51Q7065	Control Relay	RCIC Isolation Signal			1H13P0621								
		1E51Q7072	Control Relay	RCIC Isolation Signal			1H13P0621								
		1E51Q7084	Control Relay	RCIC Isolation Signal			1H13P0618								
		1E51Q7085	Control Relay	RCIC Isolation Signal			1H13P0618								
7	1	1E22Q0008	Control Relay	Impacts Diesel Lockout	General Electric	12HFA151A2H	1E22P0002	Control Cabinet	Diesel Generator	620	EPRI HF Test	2.99	Capacity > Demand	0.72	0.98
		1E22Q0009	Control Relay	Impacts Diesel Lockout			1E22P0002								
		1E22Q0010	Control Relay	Impacts Diesel Lockout			1E22P0002								
		1E22Q0011	Control Relay	Impacts Diesel Lockout			1E22P0002								
		1E22Q0013	Control Relay	Impacts Diesel Lockout			1E22P0002								
8	1	1R22Q7021	Protective Relay	Impacts Diesel Lockout	Agastat	E7012PB	1R22S0009-001	Switchgear	Control Complex	620	EPRI HF Test	3.36	Capacity > Demand	0.81	1.10
9	1	1R22Q0638	Protective Relay	Impacts Diesel Lockout	General Electric	12IFC51A2A	1R22S0007-E14	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.49	Capacity > Demand	0.36	0.49
		1R22Q0729	Protective Relay	Impacts Diesel Lockout			1R22S0006-E12								
		1R22Q0733	Protective Relay	Impacts Diesel Lockout			1R22S0006-E13								
10	1	1R22Q0801A	Protective Relay	Impacts Diesel Lockout	General Electric	12ICW52B	1R22S0009-001	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.51	Capacity > Demand	0.36	0.49
		1R22Q0801B	Protective Relay	Impacts Diesel Lockout			1R22S0009-001								
		1R22Q0801C	Protective Relay	Impacts Diesel Lockout			1R22S0009-001								
11	1	1R22Q1010	Protective Relay	Impacts Diesel Lockout	Brown Boveri Electric Inc.	ITE-50D	1R22S0009-001	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	3.12	Capacity > Demand	0.75	1.02

TABLE B-1
COMPONENTS IDENTIFIED FOR HIGH-FREQUENCY CONFIRMATION
(CONTINUED)

HF Relay Group	Unit	Component ID	Component Type	System Function	Manufacturer	Model No.	Enclosure ID	Enclosure Type	Building	Floor Elev. (ft)	Basis for Capacity	Min. C/D Ratio	Evaluation Result	C1%* (g)	C10%* (g)
12	1	1E31A-K005 (1E31N0702A)	Control Relay	RCIC Isolation Signal	Tyco/Potter Brumfield	KHS-17D12-5	1H13P0632	Control Cabinet	Control Complex	654	GERS	2.44	Capacity > Demand	0.59	0.80
		1E31A-K005 (1E31N0702B)	Control Relay	RCIC Isolation Signal			1H13P0642								
		1E31A-K013 (1E31N0702A)	Control Relay	RCIC Isolation Signal			1H13P0632								
		1E31A-K013 (1E31N0702B)	Control Relay	RCIC Isolation Signal			1H13P0642								
13	1	HVSD (1E22S0006)	High Voltage Shutdown Relay	Isolate Battery and Charger	Potter Brumfield	HVSD	1E22S0006	Battery Charger	Control Complex	620	GERS	2.03	Capacity > Demand	0.49	0.66
		HVSD (2E22S0006)	High Voltage Shutdown Relay	Isolate Battery And Charger			2E22S0006								
14	1	1R22Q0617A	Protective Relay	Lockout Breaker To ESW Pump	General Electric	12IFC66KD1A	1R22S0007-E06	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.49	Capacity > Demand	0.36	0.49
		1R22Q0617B	Protective Relay	Lockout Breaker To ESW Pump			1R22S0007-E06								
		1R22Q0617C	Protective Relay	Lockout Breaker To ESW Pump			1R22S0007-E06								
		1R22Q0712A	Protective Relay	Lockout Breaker To ESW Pump			1R22S0006-E05								
		1R22Q0712B	Protective Relay	Lockout Breaker To ESW Pump			1R22S0006-E05								
		1R22Q0712C	Protective Relay	Lockout Breaker To ESW Pump			1R22S0006-E05								
		1R22Q0814A	Protective Relay	Lockout Breaker To HPCS Pump			1R22S0009-004								
		1R22Q0814B	Protective Relay	Lockout Breaker To HPCS Pump			1R22S0009-004								

TABLE B-1
COMPONENTS IDENTIFIED FOR HIGH-FREQUENCY CONFIRMATION
(CONTINUED)

HF Relay Group	Unit	Component					Enclosure		Building	Floor Elev. (ft)	Component Evaluation			C1%* (g)	C10%* (g)
		ID	Type	System Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Min. C/D Ratio	Evaluation Result		
14	1	1R22Q0814C	Protective Relay	Lockout Breaker To HPCS Pump	General Electric	12IFC66KD1A	1R22S0009-004	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.49	Capacity > Demand	0.36	0.49
15	1	1R22Q0618	Protective Relay	Lockout Breaker To ESW Pump	General Electric	12HFC22B2A	1R22S0007-E06	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.74	Capacity > Demand	0.42	0.57
		1R22Q0713	Protective Relay	Lockout Breaker To ESW Pump			1R22S0006-E05								

Note:

* While not required for the NTTF 2.1 HF confirmation task, the C1% and C10% capacities are calculated and reported. This information is utilized to demonstrate compliance with the NEI 12-06 Appendix H requirements that C10% exceeds the GMRS. The reported values are representative of the 15 Hz to 40 Hz frequency range.

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