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August 11, 2017
L-17-244

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
Mitigating Strategies Assessment (MSA) Report for the Reevaluated Seismic Hazard Information – NEI 12-06, Appendix H, Revision 2, H.4.4 Path 4: GMRS < 2xSSE (CAC No. MF3729)

The purpose of this letter is to provide the results of the MSA for Perry Nuclear Power Plant (PNPP) to demonstrate that the FLEX mitigating strategies developed, implemented, and maintained in accordance with Nuclear Regulatory Commission (NRC) Order EA-12-049 can be implemented considering the impact of the reevaluated seismic hazard. The assessment was performed in accordance with the guidance provided in Appendix H of Nuclear Energy Institute (NEI) 12-06, Revision 2 (Reference 1), which was endorsed by the NRC (Reference 2).

The mitigating strategies seismic hazard information (MSSHI) is the licensee's reevaluated seismic hazard information, developed using a probabilistic seismic hazard analysis (PSHA). The MSSHI includes a performance-based ground motion response spectrum (GMRS), uniform hazard response spectra (UHRS) at various annual probabilities of exceedance, and a family of seismic hazard curves at various frequencies and fractiles developed at the site control point elevation. FirstEnergy Nuclear Operating Company submitted the PNPP reevaluated seismic hazard information including the UHRS, GMRS, and the hazard curves to the NRC in References 3 and 4. The NRC staff concluded that the MSSHI that was submitted adequately characterizes the reevaluated seismic hazard for the site (Reference 5).

Based upon the MSA provided in the enclosure to this letter, the mitigating strategies for PNPP considering the impacts of the reevaluated seismic hazard can be implemented as designed.

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
Seismic Mitigating Strategies Assessment Perry Nuclear Power Plant

References:

1. NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide*, Revision 2, December 2015, Agencywide Documents Access and Management System (ADAMS) Accession Number ML16005A625.
2. JLD-ISG-2012-01, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, Revision 1, dated January 22, 2016, ADAMS Accession Number ML15357A163.
3. FENOC Letter, FirstEnergy Nuclear Operating Company (FENOC) Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident – 1.5 Year Response for CEUS Sites, dated September 11, 2013, ADAMS Accession Number ML13254A312.
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. 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 Numbers ML15208A034.

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

Enclosure
L-17-244

Seismic Mitigating Strategies Assessment
Perry Nuclear Power Plant

(49 pages follow)

FIRST ENERGY NUCLEAR OPERATING COMPANY

Seismic Mitigating Strategies Assessment

Perry Nuclear Power Plant

APPROVALS

Report Name: **Seismic Mitigating Strategies Assessment, Perry Nuclear Power Plant**

Date: **June 30, 2017**

Revision No.: **Revision 0**

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2734298-R-017
Revision 0

Seismic Mitigating Strategies Assessment Perry Nuclear Power Plant

June 28, 2017

Prepared for:
FirstEnergy Nuclear Operating Company

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

SEISMIC MITIGATING STRATEGIES ASSESSMENT PERRY NUCLEAR POWER PLANT

ABSG CONSULTING INC. REPORT NO. 2734298-R-017
REVISION 0
RIZZO REPORT NO. R13 12-4734
JUNE 28, 2017

ABSG CONSULTING INC.
RIZZO ASSOCIATES

ABS Consulting
RIZZO

APPROVALS

Report Name: Seismic Mitigating Strategies Assessment
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

1-AX	UNIT 1 AUXILIARY BUILDING
2-AX	UNIT 2 AUXILIARY BUILDING
ABS	ABSG CONSULTING INC.
ADS	AUTOMATIC DEPRESSURIZATION SYSTEM
CC	CONTROL COMPLEX
DG	DIESEL GENERATOR BUILDING
EL	ELEVATION
ELAP	EXTENDED LOSS OF AC POWER
EPRI	ELECTRIC POWER RESEARCH INSTITUTE
ESEL	EXPEDITED SEISMIC EQUIPMENT LIST
ESEP	EXPEDITED SEISMIC EVALUATION PROCESS
ESW	EMERGENCY SERVICE WATER
ESWPH	EMERGENCY SERVICE WATER PUMPHOUSE
FENOC	FIRSTENERGY NUCLEAR OPERATING COMPANY
FHB	FUEL HANDLING BUILDING
FIP	FINAL INTEGRATED PLAN
FIRS	FOUNDATION INPUT RESPONSE SPECTRA
FLEX	DIVERSE AND FLEXIBLE COPING STRATEGIES
ft	FEET
g	ACCELERATION OF GRAVITY
GMRS	GROUND MOTION RESPONSE SPECTRA
HF	HIGH FREQUENCY
Hz	HERTZ
IB	INTERMEDIATE BUILDING
ISRS	IN-STRUCTURE RESPONSE SPECTRA
LUHS	LOSS OF NORMAL ACCESS TO THE ULTIMATE HEAT SINK
MSA	MITIGATING STRATEGIES ASSESSMENT
MSSHI	MITIGATING STRATEGIES SEISMIC HAZARD INFORMATION

LIST OF ACRONYMS (CONTINUED)

NEI	NUCLEAR ENERGY INSTITUTE
NRC	UNITED STATES NUCLEAR REGULATORY COMMISSION
NTTF	NEAR-TERM TASK FORCE
OIP	OVERALL INTEGRATED PLAN
PGA	PEAK GROUND ACCELERATION
PNPP	PERRY NUCLEAR POWER PLANT
PSHA	PROBABILISTIC SEISMIC HAZARD ANALYSIS
RB	REACTOR BUILDING
RCIC	REACTOR CORE ISOLATION COOLING
RIZZO	RIZZO ASSOCIATES
RLE	REVIEW LEVEL EARTHQUAKE
SFP	SPENT FUEL POOL
SILO	SEAL-IN OR LOCK-OUT
SPRA	SEISMIC PROBABILISTIC RISK ASSESSMENT
SSCs	STRUCTURES, SYSTEMS, AND COMPONENTS
SSE	SAFE SHUTDOWN EARTHQUAKE
UHRS	UNIFORM HAZARD RESPONSE SPECTRA
USAR	UPDATED SAFETY ANALYSIS REPORT

MITIGATING STRATEGIES ASSESSMENT
PERRY NUCLEAR POWER PLANT

1.0 BACKGROUND

Perry Nuclear Power Plant (PNPP) has completed mitigating strategies assessment (MSA) for the impacts of the reevaluated seismic hazard to determine if the mitigating (FLEX) strategies developed, implemented, and maintained in accordance with Nuclear Regulatory Commission (NRC) Order EA-12-049 remain acceptable at the reevaluated seismic hazard levels. The MSA was performed in accordance with the guidance provided in Appendix H of Nuclear Energy Institute (NEI) 12-06 Revision 2 (Reference 1) which was endorsed by the NRC (Reference 2).

The Mitigating Strategies Seismic Hazard Information (MSSHI) is the reevaluated seismic hazard information at PNPP developed using the Probabilistic Seismic Hazard Analysis (PSHA). The MSSHI includes a performance-based Ground Motion Response Spectrum (GMRS), Uniform Hazard Response Spectra (UHRS) at various annual probabilities of exceedance, and a family of seismic hazard curves at various frequencies and fractiles developed at the PNPP control point elevation. PNPP submitted the reevaluated seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC on March 31, 2014 (Reference 3). The NRC staff concluded that the GMRS that was submitted adequately characterizes the reevaluated seismic hazard for the PNPP site (Reference 4). Section 6.1.1 of Reference 2 identifies the method described in Section H.4.4 of Reference 1 as applicable to PNPP.

Subsequent to the March 31, 2014 (Reference 3), submittal, the seismic hazard was updated considering site specific damping in rock. The updated seismic hazard is the basis for the recent station Seismic Probabilistic Risk Assessment (SPRA) and also for the Expedited Seismic Evaluation Process (ESEP) Reports submitted by FirstEnergy Nuclear Operating Company (FENOC) on December 19, 2014 (Reference 10).

Figure 1-1 presents the comparison of the Safe Shutdown Earthquake (SSE), ESEP GMRS (Reference 10) and the GMRS reported in the PNPP March 2014 submittal (Reference 3). 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 17).

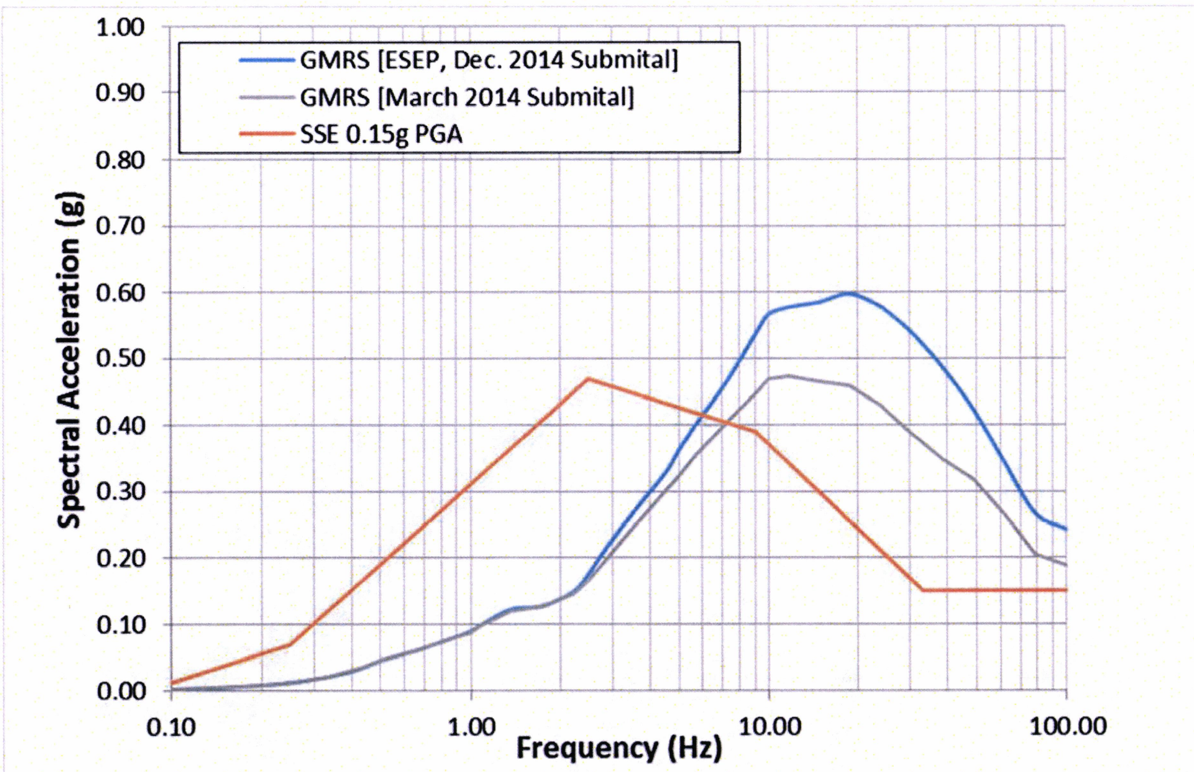

FIGURE 1-1
COMPARISON OF GMRS AND SSE AT THE PNPP CONTROL POINT (EL 561 FT)

In a letter dated September 23, 2015 (Reference 13), the NRC staff conveyed its acceptance of the PNPP ESEP. Therefore, ESEP GMRS, characterized by a peak ground acceleration (PGA) of 0.24g, is the review level earthquake (RLE) considered for the MSA.

2.0 ASSESSMENT TO MSSHI

Consistent with Section H.4.4 (Path 4) of Reference 1, the PNPP GMRS has spectral accelerations greater than the SSE but no more than two times the SSE anywhere in the 1 Hertz (Hz) to 10 Hz frequency range. As described in the Final Integrated Plan (FIP) (Reference 14), the plant equipment relied on for FLEX strategies have previously been evaluated as seismically robust to the SSE levels. The basic elements within the MSA of Path 4 structures, systems, and components (SSCs) are described in Reference 1. Implementation of each of these basic Path 4 elements for the PNPP site is summarized below.

2.1 STEP 1 – SCOPE OF MSA PLANT EQUIPMENT

The scope of SSCs considered for the Path 4 MSA was determined following the guidance used for the ESEP defined in EPRI 3002000704 (Reference 9). FLEX SSCs excluded from consideration in the ESEP were added to the MSA equipment scope. In addition, SSC failure modes not addressed in the ESEP that could potentially affect the FLEX strategies were added and evaluated.

SSCs associated with the FLEX strategy that are inherently rugged or sufficiently rugged are discussed in ***Section 2.3*** below and identified in Section H.4.4 (Path 4) of Reference 1. These SSCs were not explicitly added to the scope of MSA plant equipment.

2.2 STEP 2 – ESEP REVIEW

Equipment used in support of the FLEX strategies has been evaluated to demonstrate seismic adequacy following the guidance in Section 5 of NEI 12-06. As stated in Appendix H of NEI 12-06, previous seismic evaluations should be credited to the extent that they apply for the assessment of the MSSHI. This includes the ESEP evaluations (Reference 10) for the FLEX strategies which were performed in accordance with Electric Power Research Institute (EPRI) 3002000704 (Reference 9). The ESEP evaluations remain applicable for this MSA since these evaluations directly addressed the most critical 1 Hz to 10 Hz part of the new seismic hazard using seismic responses from the scaling of the design basis analyses. Since all equipment in the Expedited Seismic Equipment List (ESEL) satisfies the ESEP requirements, they also meet the requirements for this MSA. Therefore, any component on the ESEL requires no further evaluation to show the $C_{10\%}$ capacity is acceptable. Separate evaluations are performed to address high-frequency (HF) exceedances under the HF sensitive equipment assessment process, as required, and are documented in ***Section 4.0*** of this report.

2.3 STEP 3 – INHERENTLY/SUFFICIENTLY RUGGED EQUIPMENT

The qualitative assessment of certain SSCs not included in the ESEP was accomplished using (1) a qualitative screening of "inherently rugged" SSCs and (2) evaluation of SSCs to determine if they are "sufficiently rugged." Reference 1 documents the process and the justification for this ruggedness assessment. SSCs that are either inherently rugged or sufficiently rugged are described in Reference 1 and no further evaluations for these rugged SSCs are required under the MSA.

2.4 STEP 4 – EVALUATIONS USING SECTION H.5 OF REFERENCE 1

Step four for Path 4 plants includes the evaluations of:

1. FLEX Equipment Storage Buildings and Non-Seismic Category 1 Structures that could Impact FLEX Implementation
2. Operator Pathways
3. Tie-Down of FLEX Portable Equipment
4. Seismic Interactions not included in ESEP that could Affect FLEX Strategies
5. Haul Paths

The results of the reviews of each of these five areas are described in the sections below.

In addition to the FLEX portable equipment, anchored termination cabinets were installed in the Diesel Generator Building (DG) and Emergency Service Water Pumphouse (ESWPH) in support of the FLEX strategy. This equipment was also evaluated under the GMRS level demand and found to all have $C_{10\%}$ capacities in excess of the RLE PGA.

For evaluations performed in accordance with Section H.5 of Reference 1, seismic demand developed in support of the recent SPRA for PNPP is used as input. As part of the SPRA seismic demand development, detailed building model analyses were performed for all Seismic Category I structures. Using SPRA Foundation Input Response Spectra (FIRS) consistent with the GMRS as input, in-structure response spectra (ISRS) were obtained from these analyses. The SPRA ISRS was also used to complete the ESEP analysis (Reference 10).

2.4.1 FLEX Equipment Storage Buildings

The DG and Unit 2 Auxiliary Building (2-AX) are used for FLEX equipment storage. The DG is designated for "N" FLEX equipment storage and the 2-AX for "N+1" equipment storage. Other FLEX equipment is located inside the ESWPH, Unit 1 Auxiliary Building (1-AX), Intermediate Building (IB), Fuel Handling Building (FHB), and Control Complex (CC) typically near locations where the equipment will be used. A few alternate FLEX piping connections points have been installed in the Water Treatment Building.

Diesel Generator Building

The DG is an existing Seismic Category 1 structure which houses equipment serving safety-related functions. The Unit 2 portions of the Building have been purposed for FLEX equipment storage and FLEX electrical connections. This storage location is designated as FLEX Equipment Bay 1. The building is designed for loads due to the PNPP site SSE characterized by a 0.15g PGA.

The DG is adjacent to the Radwaste Building (north), the CC (east), and the Service Building (south); the west facade of the building is exposed. The DG is a single-story reinforced concrete building approximately 165 ft-long in the north-south direction and 78 ft-wide in the east-west direction. A reinforced concrete air intake structure, 165 ft-long, 32 ft-wide, and 20 ft-high, is mounted to the roof of the building. The top of the foundation mat of the DG is at EL 620.5 ft, and the total height of the building is 26 ft. A 4-inch layer of protective concrete and an additional 4-inch layer of fill concrete are provided beneath the foundation mat. These layers bear on 30.3 ft of Class A fill, placed on the native lower till formation. The building is isolated from the adjacent buildings through 3-inch rattle space joints. This spacing allows the DG to behave as an independent structure under gravity and seismic loads.

The lateral resistance of the building structure is derived primarily from the shear resistance of its reinforced concrete walls. The walls transfer vertical and shear forces, as well as bending moments to the reinforced concrete foundation mat bearing on fill.

Based on the structural systems comprising the DG, the guidance of Reference 1 Section H.4.4 indicates the building has sufficient seismic capacity to withstand the RLE based on the EPRI NP-6041 (Reference 12) screening criteria and does not require additional evaluation to demonstrate robustness. Regarding the DG foundation, the underlying Class A fill consists of sand and gravel obtained from commercial quarries. Class A fill was placed with an average and minimum relative density of 85 percent and 80 percent, respectively, in load-bearing areas, where structures are founded above the fill. The PNPP USAR (Reference 19) reports liquefaction analyses of Class A fill, the lower till, and lacustrine sediments. Based on these analyses, USAR Section 2.5.4.7 concludes that the lower till and Class A fill bearing materials will not be susceptible to liquefaction, or significant compression due to SSE motions. The shale is not susceptible to loss of strength during cyclic loading. Based on the above discussion, liquefaction potential and excessive settlements due to seismic ground motion are considered unlikely and are accordingly screened out. Therefore, it is concluded that the PNPP DG has adequate seismic capacity to withstand the RLE and meets the requirements to satisfy Reference 1 Appendix H.

Emergency Service Water Pumphouse

The ESWPH is an existing Seismic Category 1 structure which houses equipment serving safety-related functions. It has also been purposed for FLEX equipment storage and FLEX piping and electrical connections. It is designed for loads due to the PNPP site SSE characterized by a 0.15g PGA.

The ESWPH is the closest safety-related structure to the Lake Erie shoreline, located approximately 410 ft inland. The pump house is a reinforced concrete structure, rectangular in plan, located between the non-safety-class service water pump house and the non-safety-class discharge tunnel entrance structure. The ESWPH is approximately 111 ft by 64 ft in plan and 116 ft in height above the foundation level. The foundation level consists of a reinforced concrete mat resting on rock at EL 532 ft, approximately 87 ft below the grade at EL 619 ft. The main floor is located at EL 586 ft and the roof is at EL 648 ft.

The ESWPH is composed primarily of reinforced concrete slabs and walls. Resistance to lateral forces is primarily provided by the concrete shear walls. The north and south upper walls are buttressed by reinforced concrete pilasters that support the steel roof trusses and gantry crane runway rails at EL 629 ft.

Based on the structural systems comprising the ESWPH, the guidance of Reference 1 Section H.4.4 indicates the building has sufficient seismic capacity to withstand the RLE based on the EPRI NP-6041 (Reference 12) screening criteria and does not require additional evaluation to demonstrate robustness. Liquefaction failures of the soil under the ESWPH are not required to be considered since the structure is founded on rock. Therefore, it is concluded that the PNPP ESWPH has adequate seismic capacity to withstand the RLE and meets the requirements to satisfy Reference 1 Appendix H.

Unit 1 Auxiliary Building

The 1-AX is an existing Seismic Category 1 structure which houses equipment serving safety-related functions. It has also been purposed for FLEX equipment storage and FLEX piping and electrical connections. It is designed for loads due to the PNPP site SSE characterized by a 0.15g PGA.

The 1-AX is a reinforced concrete structure approximately 97 ft-high by 102 ft-wide by 192 ft-long with the top of mat at EL 568.3 ft. This building is adjacent to the RB, IB, Turbine Power Complex, Steam Tunnel, and Radwaste Building. The 1-AX has three stories. Floor 1 is located at EL 568.3 ft and EL 574.8 ft, Floor 2 is at EL 599 ft, and Floor 3 is at EL 620.5 ft (grade). The third floor of the building is divided by the portion of the Steam Tunnel that extends from the RB through the Turbine Power Complex to the Turbine Building.

The lateral resistance of the 1-AX is derived primarily from the shear resistance of its reinforced concrete walls. The walls largely transfer vertical and shear forces, as well as bending moments to the reinforced concrete foundation mat bearing on rock. The building is isolated from the adjacent buildings through expansion joints that allow them to behave as independent structures under gravity and seismic loads.

Based on the structural systems comprising the 1-AX, the guidance of Reference 1 Section H.4.4 indicates the building has sufficient seismic capacity to withstand the RLE based on the EPRI NP-6041 (Reference 12) screening criteria and does not require additional evaluation to demonstrate robustness. Liquefaction failures of the soil under the 1-AX are not required to be considered since the structure is founded on rock. Therefore, it is concluded that the PNPP 1-AX has adequate seismic capacity to withstand the RLE and meets the requirements to satisfy Reference 1 Appendix H.

Intermediate Building and Fuel Handling Building

The IB and FHB are existing Seismic Category 1 structures which house equipment serving safety-related functions. They have also been purposed for storage of minor FLEX equipment. They are designed for loads due to the PNPP site SSE characterized by a 0.15g PGA.

The IB is a five-story building located between the Unit 1 and Unit 2 RBs in the north-south direction and located between FHB and CC in the east-west direction. The building shares a foundation and is integral with the FHB. The top of the shared mat foundation is at EL 574.8 ft and the bottom at EL 565.3 ft. Approximate plan dimensions for the IB are 242.5 ft by 81.5 ft. The building has several intermediate stories. Slabs are located at ELs: 574.8 ft, 585 ft, 599 ft, 620.5 ft, 639.5 ft, 654.5 ft, 665 ft, 682.5 ft, 707.5 ft, and 721.5 ft.

Approximate plan dimensions for the FHB are 144 ft by 108 ft. The east part of the FHB, founded at EL 620.5 ft, is supported on piers. The piers are socketed into rock at EL 559 ft. The length of these piers is about 57.5 ft. The total height of the building, including piers, is approximately 123.5 ft. Slabs are located at ELs 574.8 ft, 599 ft, 620.5 ft, and 682.5 ft.

Both the IB and FHB are largely reinforced concrete construction, including the common foundation mat, the walls, and the roof slab. The roof slab is supported by structural steel framing. Reinforced concrete is used for the interior walls, columns, and slabs. The IB and FHB are isolated from other neighboring structures which allow them to behave as independent structures under gravity and seismic loads.

The lateral resistance of the building structures is derived primarily by the shear resistance of the walls. The walls transfer vertical and shear forces, as well as bending moments, to the reinforced concrete mat foundation that bears on rock and, for the east portion of the FHB, to the reinforced concrete piers socketed into rock.

Based on the structural systems comprising the IB and FHB, the guidance of Reference 1 Section H.4.4 indicates the buildings have sufficient seismic capacity to withstand the RLE based on the EPRI NP-6041 (Reference 12) screening criteria and do not require additional evaluation to demonstrate robustness. Liquefaction failures of the soil under the IB and FHB are not required to be considered since the structures are founded on rock. Therefore, it is concluded that the PNPP IB and FHB have adequate seismic capacity to withstand the RLE and meet the requirements to satisfy Reference 1 Appendix H.

Control Complex

The CC is an existing Seismic Category 1 structure which houses equipment serving safety-related functions. It has also been purposed for storage of FLEX cabling. It is designed for loads due to the PNPP site SSE characterized by a 0.15g PGA.

The CC is a six-story steel-framed structure with exterior reinforced concrete walls of approximate dimensions 132.5-ft high, 141-ft wide, and 142-ft long. The CC is bounded on the north by the Radwaste Building, on the east by the IB, on the south by the Service Building, and on the west by the DG. The CC floor levels are located at ELs 574.8 ft, 599 ft, 620 ft, 638.5 ft, 654.5 ft, and 679.5 ft. The building is supported on a 6.0 ft thick mat foundation that bears on bedrock at EL 568.8 ft. The outside walls and roof of the CC are typically 2.0-ft-thick reinforced concrete, with certain parts of the exterior walls increased to 3.0 ft in thickness. The interior structure consists of steel columns, girders, and beams with the floor decks of reinforced concrete.

The lateral resistance of the CC is derived primarily from the shear resistance of its reinforced concrete walls. The walls largely transfer vertical and shear forces, as well as bending moments to the reinforced concrete foundation mat bearing on rock. The building is isolated from the adjacent buildings through expansion joints that allow them to behave as independent structures under gravity and seismic loads.

Based on the structural systems comprising the CC, the guidance of Reference 1 Section H.4.4 indicates the building has sufficient seismic capacity to withstand the RLE based on the EPRI NP-6041 (Reference 12) screening criteria and does not require additional evaluation to demonstrate robustness. Liquefaction failures of the soil under the CC are not required to be considered since the structure is founded on rock. Therefore, it is concluded that the PNPP CC has adequate seismic capacity to withstand the RLE and meets the requirements to satisfy Reference 1 Appendix H.

Unit 2 Auxiliary Building

The 2-AX is an abandoned structure originally intended to serve PNPP Unit 2 which was never completed. In support of FLEX strategies, the east side of EL 620 ft has been purposed as FLEX Equipment Bay 2.

The building's geometry and construction are essentially identical to that of its Unit 1 counterpart. Although the structure is abandoned, it is designated as Safety Related, Seismic Category 1, per the USAR (Reference 19), and likely has a seismic capacity similar to that of the Seismic Category 1 1-AX.

Similar to 1-AX, 2-AX is a reinforced concrete structure approximately 97 ft-high by 102 ft-wide by 192 ft-long with the top of the base mat at EL 568.3 ft. This building is adjacent to the Unit 2 RB, IB, and Unit 2 Turbine Power Complex. The 2-AX has three stories. Floor 1 is located at EL 568.3 ft and EL 574.8 ft, Floor 2 is at EL 599 ft, and Floor 3 is at EL 620.5 ft (grade).

The lateral resistance of the 2-AX is derived primarily from the shear resistance of its reinforced concrete walls. The walls largely transfer vertical and shear forces, as well as bending moments to the reinforced concrete foundation mat bearing on rock. The building is isolated from the adjacent buildings through expansion joints that allow them to behave as independent structures under gravity and seismic loads.

Based on the structural systems comprising the 2-AX, the guidance of Reference 1 Section H.4.4 indicates the building has sufficient seismic capacity to withstand the RLE based on the EPRI NP-6041 (Reference 12) screening criteria and does not require additional evaluation to demonstrate robustness. Liquefaction failures of the soil under the 2-AX are not required to be considered since the structure is founded on rock. Therefore, it is concluded that the PNPP 2-AX has adequate seismic capacity to withstand the RLE and meets the requirements to satisfy Reference 1 Appendix H.

Non-Seismic Category 1 Structures

A non-Seismic Category 1 structure, the Water Treatment Building, was identified to serve functions related to the PNPP FLEX strategies. The following provides a description of the structure's construction, design criteria, and FLEX functions served.

Water Treatment Building

The Water Treatment Building is a non-Seismic Category 1 two-story structure. The building is located on the Unit 1 side of the plant. It is bounded by the turbine building on the east; the north, south and west walls are exposed. No safe shutdown equipment is located in the Water Treatment Building. A few alternate FLEX piping connections and isolation valves have been installed in Water Treatment Building.

Per Reference 1 Section H.4, equipment required to support an alternative means to accomplish a function is not required to be included in the MSA and therefore no further review is required for the Water Treatment Building and the FLEX connections within it.

2.4.2 Operator Pathways

PNPP has reviewed the operator pathways and verified that the operator pathways are not impacted by the MSSHI. Considerations for this review included:

- Multiple Available Pathways or Multiple FLEX Components
- Pathway includes only Seismic Category 1 Structures with Previous Reviews for Seismic Ruggedness
- Debris Removal Capabilities for Moderate to Smaller Seismic Interactions
- Available Time for Operator Actions
- Operator Pathways were Reviewed during a Walkdown to Assess Seismic Interactions Associated with a GMRS Level Seismic Event

In responding to seismic events, mitigation procedures include guidance pertaining to accessing and moving equipment following seismic events. Such guidance includes alternate routes or strategies to access and remove equipment if debris or structural damage prevents normal access.

A review of the locations of the FLEX actions with respect to the starting point in the control room indicates there are multiple available pathways located within Seismic Category 1 structures. A walkdown was performed for the operator pathways as part of the MSA, including the rooms and hallways where FLEX equipment and connections are located, and were found to be free from potential interactions.

To access FLEX Equipment Bay 1 in the Unit 2 portion of the DG, a potential path through Seismic Category 1 buildings starts by exiting the control room at EL 654 ft of the Control Complex through the west door (CC-508) of the room. The path continues in the hallway and through the nearby Door CC-502. The path goes down the stairs to EL 620 ft and out of Door CC-302. A short walk in the hallway leads to Door DG-113. Once through the door and into the DG, FLEX Equipment Bay 1 is located through Door DG-109. The yard can be then be accessed through a number of doors from the rooms off the DG hallway, where several of the FLEX staging and operations take place, including transit to the ESWPH for performance of primary or alternative FLEX actions and transit to the 2-AX for performance of alternative FLEX actions.

Various other FLEX actions take place in the IB and the 1-AX. The IB can be accessed directly from the CC ELs 574 ft, 599 ft, and 679 ft. Once inside the IB, the elevations where the FLEX actions are to be performed can be accessed via stairs. From the IB, the 1-AX can be accessed at ELs 574 ft, 599 ft, and 620 ft. Alternatively, the 1-AX can be accessed via the yard at EL 620 and stairs taken to the elevation where the FLEX action is to occur.

Per the FIP (Reference 14), two hours are dedicated to deploy debris removal equipment. A debris removal truck is located in each FLEX Equipment Bay. Additionally, a Bobcat Skid Loader is stored in FLEX Equipment Bay 2 for debris removal.

Given the number and variety of potential paths, verification that multiple backup paths are in Seismic Category 1 structures, debris removal capability, available time for operator actions, and walkdown observations, it is probable operators will be able to gain access to the locations of the FLEX actions after the RLE.

2.4.3 Tie-Down of FLEX Portable Equipment

All portable "N" and "N+1" equipment staged for use in the FLEX strategy is stored in the ESWPH, DG, or 2-AX. The portable "N" equipment essential for the success of the FLEX strategy include:

- FLEX Lake Water Pump
- Portable Pump
- FLEX Turbine Marine (2)
- Portable Generators (2)
- Pickup Truck
- Several Pieces of Ancillary Hook-Up Equipment

Descriptions for where each of these fits into the FLEX strategy can be found in the FIP (Reference 14).

In addition, several other minor items are stored in these buildings. These items include:

- Fans.
- Portable light unit.
- Local FLEX tool boxes staged in ESWPH, 1-AX 574 ft and 599 ft levels, and IB 620 ft level.

Stored equipment were evaluated (for stability and restraint as required/necessary) and protected from seismic interactions to the SSE level as part of the FLEX design process to ensure that unsecured and/or non-seismic components do not damage the FLEX equipment. In addition, large FLEX equipment such as pumps and power supplies were secured as necessary to protect them during an SSE seismic event.

For the purposes of satisfying this MSA, all essential portable equipment is reevaluated to the RLE in accordance with Section H.5 of Reference 1. For large restrained portable equipment, the tie downs were evaluated and all were found to have $C_{10\%}$ capacities in excess of the RLE PGA. For smaller unrestrained or minimally restrained portable equipment, given their light weight, low seismic demand, and passive function, $C_{10\%}$ capacities are judged greater than the RLE PGA.

PNPP has reviewed the storage requirements (including any tie-down or restraint devices) in effect for FLEX portable equipment and verified that the equipment has no adverse interactions or significant damage that could impair the ability of the equipment to perform its mitigating strategy function during or following the RLE using the methods described in Section H.5 of Reference 1.

2.4.4 Additional Seismic Interactions

Seismic interactions that could potentially affect the FLEX strategies and were not previously reviewed as part of the ESEP program (e.g., flooding from non-seismically robust tanks, interactions to distributed systems associated with the ESEP equipment list, etc.) were reviewed for PNPP.

This walkdown included the DG, 2-AX, EWSPH, 1-AX, and Water Treatment Building. The majority of FLEX equipment and FLEX connections were walked down. For the FLEX connections and isolation valves located in the Reactor Core Isolation Cooling (RCIC) room that were inaccessible during walkdowns, plant documentation was reviewed to assess these items. The review indicates that FLEX connections and isolation valves in the RCIC Room are well-supported and are similar to all other FLEX connections and isolation valves which were observed to rugged in nature and free from potential interactions. Overall, FLEX equipment was found to be well-supported and without potential seismic vulnerabilities.

PNPP has reviewed the additional seismic interactions and verified that the Mitigation Strategy is not adversely impacted by the GMRS.

2.4.5 Haul Path

PNPP will use haul paths (also called deployment paths), which refer to the route from a storage location to the staging location for various equipment.

The deployment strategies from the FLEX Equipment Bays to each staging area are identified. There are 5 FLEX Deployment Paths detailed in the FIP, only one of which is necessary for a preferred FLEX action. The remaining four are typically used for alternate actions. Per Reference 1 Section H.4, equipment required to support an alternative means to accomplish a function is not required to be included in the MSA and therefore no further review is performed for those haul paths supporting alternate FLEX actions.

The haul path required for preferred FLEX actions originates at FLEX Equipment Bay 1 in the DG and is directed west directly outside to Operation Area 1. Here the two N FLEX generators with support equipment are deployed in support of the primary FLEX strategy. Other haul paths within the Protected Area are shown in the FIP (Reference 14) and include alternate pathways from both FLEX Equipment Bays 1 and 2. Flex Support Guideline (FSG) 80.1 (Reference 18) describes the procedure to survey the haul path, log observations, and provide the information to operators in the control room following the RLE. FSG 80.1 also describes that if debris is an issue, the debris removal truck is to be used to clear the operation areas. Per the FIP (Reference 14), 2 hours are dedicated to deploy debris removal equipment. A debris removal truck is located in each FLEX Equipment Bay. Additionally, a Bobcat Skid Loader is stored in FLEX Equipment Bay 2 for debris removal.

To ensure that the strategies can be implemented, areas adjacent to the equipment storage and staging areas, as well as the deployment and hose routing paths are maintained clear at all times.

The PNPP USAR (Reference 19) reports liquefaction analyses of Class A fill, the lower till, and lacustrine sediments. Based on these analyses, USAR Section 2.5.4.7 concludes that the lower till and Class A fill bearing materials will not be susceptible to liquefaction, or significant compression due to SSE motions. The shale is not susceptible to loss of strength during cyclic loading. Based on the above discussion, liquefaction potential and excessive settlements due to seismic ground motion are considered unlikely and are therefore screened out.

PNPP has reviewed the haul paths and verified that the haul paths are not adversely impacted by the MSSHI.

3.0 SPENT FUEL POOL COOLING REVIEW

3.1 SPENT FUEL POOL COOLING EVALUATION

The evaluation of spent fuel pool (SFP) cooling for PNPP was performed based on the initial conditions established in NEI 12-06 (Reference 1) for spent fuel cooling coping in the event of an Extended Loss of AC Power (ELAP)/Loss of normal access to the Ultimate Heat Sink (LUHS). The evaluation also used the results of pool heat-up analyses from the ELAP evaluation as input.

The FLEX strategy for SFP cooling utilizes SFP level monitoring and make-up capability as described in PNPP FIP (Reference 14). SFP make-up capability is provided using the portable FLEX Lake Water Pump, which is lowered into the ESWPH suction bay, supplied by Lake Erie via the normal or alternate intake structures and through the emergency service water (ESW) traveling screens. Hoses will be connected between the FLEX Lake Water Pump and installed Storz connectors on the ESW A Pump discharge piping. The lake water is then supplied through the ESW pipes to a new make-up header along the west end of the SFP.

The permanently installed plant equipment relied on for the implementation of the SFP Cooling FLEX strategy has been designed and installed, or evaluated to remain functional, in accordance with the plant design basis to the SSE loading conditions. The SFP integrity evaluations demonstrated inherent margins of the SFP structure and interfacings plant equipment above the SSE to a peak spectral acceleration of 0.8g (Reference 16). The portable FLEX equipment availability, including its storage and deployment pathways, and the permanently installed plant equipment needed to accomplish SFP cooling have subsequently been evaluated considering the GMRS-consistent loading conditions.

4.0 HIGH-FREQUENCY REVIEW

A HF review consistent with Reference 1 Sections H.4.2 and H.4.4 was performed. The scope of the HF review consists of devices with the potential to affect the following functions: Reactor Trip/SCRAM, RCS Inventory, RCS Pressure, Phase 1 FLEX, and Phase 2 FLEX.

Reactor Trip/SCRAM, RCS Pressure, and RCS inventory are overlapping scope items between the Near-Term Task Force (NTTF) 2.1 HF confirmation performed in accordance with EPRI 3002004396 and NEI 12-06 Appendix H MSA Path 4 HF evaluation.

The reactor trip/SCRAM function is identified as a key function in EPRI 3002004396 (Reference 7) to be considered in the HF confirmation. The same report also states that "the design requirements preclude the application of seal-in or lock-out circuits that prevent reactor trip/SCRAM functions" and that "No high-frequency review of the reactor trip/SCRAM systems is necessary".

Similarly, the reactor vessel pressure control function is identified as a key function in EPRI 3002004396 (Reference 7) to be considered in the HF 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".

HF sensitive devices with the potential to affect RCS inventory have already been evaluated as part of the NTTF 2.1 HF confirmations and these evaluations can serve as the capacity bases for these devices for MSA Path 4 HF review.

HF sensitive devices supporting Phase 1 FLEX and Phase 2 FLEX are items unique to the NEI 12-06 Appendix H Path 4 MSA review scope. A review of the equipment which encompasses the FLEX Phase 1 strategy indicates the NTTF 2.1 HF confirmation has evaluated all potentially high-frequency sensitive devices of concern. Relays associated with RCS inventory and Phase 1 FLEX were addressed in the HF review, and are identified in Enclosure 1. FLEX Phase 2 equipment is installed such that they will not automatically start and connect to the plant and consequently there are no potentially HF sensitive devices of concern.

The PNPP NTTF 2.1 HF confirmation (Reference 5) results show that the $C_{10\%}$ capacities of all devices evaluated exceed the GMRS PGA of 0.24g. The HF review concludes that potentially HF sensitive devices will not adversely impact the success of the FLEX strategy via relay chatter for the RLE.

5.0 CONCLUSION

Therefore, strategies for PNPP as described in the FIP (Reference 14) are acceptable as specified and no further seismic evaluations are necessary.

6.0 REFERENCES

1. NEI 12-06, Revision 2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, December 2015, ADAMS Accession Number ML16005A625.

2. JLD-ISG-2012-01, Revision 1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, February 2016, ADAMS Accession Number ML15357A163.

3. 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.

4. 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.

5. Perry Nuclear Power Plant 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 Review of Insights from the Fukushima Dai-ichi Accident.

6. Not used.

7. EPRI 3002004396, Final Report, July 2015, High Frequency Program Application Guidance for Functional Confirmation and Fragility Evaluation, ADAMS Accession Number ML15223A102.

8. 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.

9. EPRI, "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic", Report Number 3002000704, Palo Alto, CA, April, 2013.

10. 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.

11. EPRI, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic", Report Number 1025287, Palo Alto, CA, November, 2012.

12. EPRI, "EPRI NP-6041-SL Revision 1: A Methodology for Assessment of Nuclear Plant Seismic Margin, Revision 1", Palo Alto, CA, August, 1991.

13. 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.

14. Perry Nuclear Power Plant, "Perry Nuclear Power Plant FLEX Final Integrated Plan," NORM-LP-7303, Revision 4, 7/18/16.

15. Perry Nuclear Power Plant, Unit 1 – Safety Evaluation Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (CAC Nos. MF0962 and MF0802), May 16, 2016, ADAMS Accession Number ML16056A560.

16. FirstEnergy Nuclear Operating Company Spent Fuel Pool Evaluation Supplemental Report, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Perry Nuclear Power Plant, dated November 22, 2016, ADAMS Accession Number ML16333A042.

17. 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.

18. Perry Nuclear Power Plant, "Establishing FLEX Travel Paths," FSG 80.1, Revision 1, 7/9/15.

19. Perry Nuclear Power Plant Updated Safety Analysis Report (USAR)," Revision 19.

ENCLOSURE 1

NEI 12-06 APPENDIX H PATH 2 HF REVIEW

ENCLOSURE 1 – NEI 12-06 APPENDIX H PATH 2 HF REVIEW

1.0 INTRODUCTION

A HF review consistent with NEI 12-06 (Reference 1) Sections H.4.2 and H.4.4 was performed. NEI 12-06 Appendix H Section H.4.2 refers to EPRI 3002004396 (Reference 7) for the high-frequency contact device analysis approach. Reference 7 is used for the PNPP engineering evaluations described in this report. Acceptance criteria for the evaluations are found in Reference 1, Appendix H, Section H.5. Note that a previous High Frequency Confirmation, based on EPRI 3002004396, was submitted to the NRC (Reference 9). This Enclosure refers back to that submittal where possible.

2.0 SELECTION OF COMPONENTS

The fundamental objective of the MSA evaluation is to determine whether the FLEX strategies developed, implemented and maintained in accordance with NRC Order EA-12-049 (Reference 8) can be implemented considering the impacts of the reevaluated seismic hazard. Within the applicable functions identified in Section H.4.2 (Path 2) (Reference 1), the components that would need a high frequency evaluation are contact control devices subject to intermittent states in seal-in or lockout (SILO) circuits. Plants in Path 2 are required to evaluate SILO devices in the control systems of four specific categories: (1) Reactor Trip/Scram, (2) Reactor Vessel Coolant Inventory leakage pathways, (3) FLEX Phase 1 Components, and (4) Automatically Operated FLEX Phase 2 Components to ensure those functions perform as necessary in the FLEX strategies. The equipment selection process for each of those categories is described below. Note that categories (1) and (2) were addressed in the High Frequency Evaluation (Reference 9). Additionally, category (3) components were addressed in the High Frequency Evaluation, although not explicitly identified as FLEX Phase 1 components in that submittal.

2.1 REACTOR TRIP/SCRAM

Section H.4.2 of NEI 12-06 Appendix H (Reference 1) identifies the Reactor Trip/SCRAM function as a function to be considered in the high frequency evaluation, and was included in

Reference 9. The EPRI guidance for High Frequency Confirmation (Reference 7) notes 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". Therefore, no additional evaluations are necessary for the reactor trip/SCRAM function.

2.2 REACTOR VESSEL INVENTORY CONTROL

The equipment in the Reactor Vessel Inventory Control function are the same equipment evaluated in the PNPP NTTF 2.1 High Frequency Confirmation, and was included in Reference 9. The primary concern for both the NTTF 2.1 and MSA programs is the actuation of valves that have the potential to cause a loss-of-coolant accident (LOCA). A LOCA following a seismic event could provide a challenge to the mitigation strategies and lead to core damage. Control circuits for the Safety Relief Valves (SRV) as well as other Reactor Coolant System (RCS) valves were analyzed as part of the PNPP submittal to address NTTF 2.1 recommendations (Reference 9). The components covered in this category are the same as those covered in the RCS/Reactor Vessel Inventory Control category of EPRI 3002004396 PNPP submittal (Reference 9).

HF sensitive devices with the potential to affect RCS inventory have already been evaluated as part of the NTTF 2.1 HF confirmations and these evaluations can serve as the capacity bases for these devices for MSA Path 4 HF review. A number of relays were identified in the HF review, which are identified in ***Table A-1***.

2.3 FLEX PHASE 1

PNPP performed an Expedited Seismic Evaluation Process (ESEP) Report which was submitted to the NRC in December 2014 (Reference 13), and subsequently accepted by the NRC in September 2015 (Reference 14).

The ESEP developed an Expedited Seismic Equipment List (ESEL) following the guidelines of EPRI 3002000704 (Reference 15). The selection of equipment included on the ESEL was based on installed plant equipment credited in the FLEX strategies during Phases 1, 2, and 3 to sustain the critical functions of core cooling and containment integrity. The ESEL was developed by reviewing the PNPP OIP (Reference 16) to determine the major equipment involved in the FLEX strategies. Further reviews of plant drawings (e.g., Piping and Instrumentation Diagrams (P&ID) and Electrical One-Line Diagrams) were performed to identify the boundaries of the flowpaths to be used in the FLEX strategies and to identify specific components in the flowpaths needed to support implementation of the FLEX strategies. The ESEL was also compared to the Final Integrated Plan (FIP) (Reference 17) to ensure completeness.

Section H.4.2 of NEI 12-06 Appendix H (Reference 1) requires the analysis of relays and contactors that may lead to circuit seal-in or lockout that could impede the Phase 1 FLEX capabilities, including vital buses fed by station batteries through inverters. Phase 1 of the FLEX Strategy is defined in NEI 12-06 (Reference 1) as the initial response period where a plant is relying solely on installed plant equipment. During this phase the plant has no AC power and is relying on batteries, steam, and air accumulators to provide the motive force necessary to operate the critical pumps, valves, instrumentation, and control circuits.

As stated in Reference 13, during Plant Modes 1-4, Reactor Core Cooling and Heat Removal is achieved via steam-driven high pressure injection from the Reactor Core Isolation Cooling (RCIC) System. Decay heat from the reactor core is transferred to the Suppression Pool from (1) Safety Relief Valve (SRV) operation and (2) exhaust discharge from the RCIC Turbine. During FLEX Phase 1, the RCIC pump suction is aligned to the Suppression Pool. The Suppression Pool is the only credited Phase 1 suction source for the RCIC System pump. There are no Phase 1 FLEX actions necessary to maintain containment integrity.

A HF review of the RCIC System was performed in the High Frequency Confirmation (Reference 9), as part of the Section 2.4 Core Cooling evaluation. A number of relays were identified in the review, through which chatter during a seismic event could impact the RCIC system. These are identified in ***Table A-1***.

A HF review of the SRVs was performed in Reference 9, as part of the Section 2.2 Reactor Vessel Inventory Control. However, this review was from the perspective of chatter resulting in an undesired opening of the SRVs, rather than chatter resulting in the inability to later open SRVs when desired. Therefore, an additional review of the control logic for the SRVs was performed, from the perspective of chatter that would inhibit a later desired opening of the SRVs. No concerns were identified in this review.

The RCIC system, as well as SRV operation in the relief mode, are dependent on the availability of Division 1 125 VDC power. These components were also included in the ESEL, and a HF review was also performed in Reference 9, as part of the Section 2.5 AC/DC Power Support Systems evaluation. No concerns were identified in this review.

Finally, a comparison between the ESEL and the components selected for the above portions from Reference 9 was performed, to confirm that the HF component selection covered all the FLEX Phase 1 equipment.

2.4 FLEX Phase 2 Automatic Operation

The PNPP Phase 2 strategy includes continuation of the Phase 1 strategy, with the exception of the RCIC pump suction source. During Phase 2, alternate suction source(s) will be aligned to provide reduced temperature coolant and isolate pump suction from the elevated temperature of the Suppression Pool. The new RCIC alternate suction line will be connected via temporary hoses to one of several prioritized water supplies, with the credited source being the Emergency Service Water (ESW) System. The ESW System will provide raw water from Lake Erie from the fully robust normal lake intake structure. Additionally, the PNPP lake access design also includes a fully robust discharge structure that can act as an intake structure, if necessary. FLEX pumps located in the Emergency Service Water Pumphouse (ESWPH) provide the motive force for the alternate water supply to the RCIC pump suction.

The primary Phase 2 FLEX strategy for containment integrity entails repowering one train of hydrogen igniters (preventing the accumulation of explosive concentrations of hydrogen gas) and providing Suppression Pool heat removal via the employment of Suppression Pool Closed Loop Cooling (SPCLC). SPCLC essentially consists of a modified version of Residual Heat Removal (RHR) operating in Suppression Pool Cooling Mode; this operational mode is modified in that the motive force for process fluid is provided by smaller capacity 480 Voltage Alternating Current (VAC) pumps (in lieu of the larger 4,160 VAC RHR Pumps) and cooling water is provided by FLEX pumps (in lieu of the larger ESW Pumps).

NEI 12-06 Appendix H (Reference 1) requires the inclusion of SILO relays and contactors that could impede FLEX capabilities for mitigation of seismic events in permanently installed Phase 2 SSCs that have the capability to begin operation without operator manual actions.

With the loss of AC power, Phase 2 SSCs are limited to any permanently installed FLEX generator and, if allowed to automatically start, any electrical components powered by the FLEX generator and relied upon for Phase 2 of the FLEX Strategy. PNPP credits a portable FLEX generator for Phase 2 response, and the operator actions necessary to install and connect the generator excludes any devices from being identified in this category.

2.5 SUMMARY OF SELECTED COMPONENTS

A list of the contact devices requiring evaluation as part of the NTTF 2.1 High Frequency Confirmation (Reference 9) is provided in ***Table A-1***. The HF Relay Groups which also required evaluation as part of the NEI 12-06 Appendix H Path 2 High Frequency Confirmation are identified in the table by an asterisk. In total, 4 groups comprising 28 components were identified for NEI 12-06 Appendix H Path 2 High Frequency Confirmation.

3.0 SEISMIC EVALUATION

The generation of the high-frequency seismic demand on the subject components is documented in Section 3 of the NTTF 2.1 High Frequency Evaluation (Reference 9).

4.0 CONTACT DEVICES EVALUATIONS

The performance of the seismic evaluations is documented in Section 4 of the NTTF 2.1 High Frequency Evaluation (Reference 9). No additional components were identified in this assessment.

A summary of the high-frequency evaluation results is provided in ***Table A-1***.

5.0 CONCLUSIONS

The high-frequency capacity of each device was evaluated in Reference 9. These components and the results of the individual component evaluations are provided in ***Table A-1***, below. A total of 28 components are identified that required NEI 12-06 Appendix H Path 2 High-Frequency Confirmation evaluation. The 28 components are grouped into four main groups based on device type and capacity and enclosure dynamic characteristics and location. The four HF Relay groups in the scope of the NEI 12-06 Appendix H Path 2 are identified by asterisks in ***Table A-1***.

5.1 General Conclusions

PNPP completed the evaluation of potentially sensitive contact devices in accordance with NEI 12-06 (Reference 1), Appendix H Section H.4.2 and EPRI 3002004396 (Reference 7). The results of the evaluation confirm that the FLEX strategies for PNPP can be implemented as designed and no further seismic evaluations are necessary.

5.2 Identification of Follow-up Actions

For PNPP, all the identified 28 components have adequate seismic capacity and no follow-up actions were identified.

6.0 REFERENCES

1. NEI 12-06, Revision 2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, December 2015, ADAMS Accession Number ML16005A625.

2. JLD-ISG-2012-01, Revision 1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, February 2016, ADAMS Accession Number ML15357A163.

3. Revision of Final Integrated Plan Associated with Mitigating Strategies for Beyond-Design-Basis External Events (CAC No. MF0962), February 3, 2016, ADAMS Accession Number ML16036A310.

4. NRC Letter, Perry Nuclear Power Plant, Unit 1 – Safety Evaluation Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (CAC Nos. MF0962 and MF0802), May 16, 2016, ADAMS Accession Number ML16056A560.

5. 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.

6. 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.

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

8. NRC (E. Leeds) Letter to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012

9. Perry Nuclear Power Plant 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 Review of Insights from the Fukushima Dai-ichi Accident.

10. EPRI 3002002997, “High Frequency Program: High Frequency Testing Summary,” September 2014.

11. EPRI NP-7147-SL. “Seismic Ruggedness of Relays,” August 1991.

12. EPRI NP-7147 SQUG Advisory 2004-02, “Relay GERS Corrections,” September 10, 2004.

13. 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.

14. 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 (TAC NO. MF5261), September 23, 2015, Accession Number ML15240A032.

15. EPRI, “Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic”, Report Number 3002000704, Palo Alto, CA, April, 2013.

16. PNPP Overall Integrated Plan (OIP) in Response to the March 12, 2012, Commission Order EA-12-049, First Energy Corp., Letter No. L-14-25, "FirstEnergy Nuclear Operating Company's Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC Nos. MF084l, MF0842, MF0961, and MF0962," dated August 28, 2014.

17. Perry Nuclear Power Plant, “Perry Nuclear Power Plant FLEX Final Integrated Plan,” NORM-LP-7303, Revision 4, 7/18/16.

Table A-1, below, contains the results of the NTTF 2.1 High Frequency Confirmation from Reference 9. All components were identified and assessed in Reference 9. No new components were identified from this NEI 12-06 Appendix H MSA Path 2 High Frequency Confirmation. The components which are in the scope of the MSA Path 2 High Frequency Confirmation review are identified by an asterisk in ***Table A-1***. All components have a seismic capacity greater than the seismic demand.

TABLE A-1
COMPONENTS IDENTIFIED FOR HIGH FREQUENCY EVALUATION

HF Relay Group	Unit	Component ID	Component Type	Component System Function	Component Manufacturer	Component Model No.	Enclosure ID	Enclosure Type	Building	Floor Elev. (ft)	Basis for Capacity	Min. C/D Ratio	Evaluation Result	C1%** (g)	C10%** (g)
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								

TABLE A-1
COMPONENTS IDENTIFIED FOR HIGH FREQUENCY EVALUATION
(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	1R22Q0810B	Protective Relay	Actuates Bus Lockout			1R22S0009-E03	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	1.79	Capacity > Demand	0.43	0.58
		1R22Q0810C	Protective Relay	Actuates Bus Lockout			1R22S0009-E03								
		1R22Q0710A	Protective Relay	Overcurrent Protection	General Electric	12IFC53B1A	1R22S0006-E04								
		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								

TABLE A-1
COMPONENTS IDENTIFIED FOR HIGH FREQUENCY EVALUATION
(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	86G/EH11	Control Relay	Diesel Generator Lockout	Electro Switch	7805LR	1R22S0007-E02	Switchgear	Control Complex	620	IEEE/ANSI C37-98 Test	2.48	Capacity > Demand	0.60	0.81
		86B/EH13	Control Relay	Bus Lockout			1R22S0009-E01								
		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								
		1E51A-K100	Control Relay	RCIC Leak Detection			1H13P0621								
		1E51A-K101	Control Relay	RCIC Steam Supply			1H13P0618								

TABLE A-1
COMPONENTS IDENTIFIED FOR HIGH FREQUENCY EVALUATION
(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		
6*	1	1E51Q7064	Control Relay	RCIC Isolation Signal	Agastat	ETR14B3B004ETR14B3C004	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 A-1
COMPONENTS IDENTIFIED FOR HIGH FREQUENCY EVALUATION
(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		
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 A-1
COMPONENTS IDENTIFIED FOR HIGH FREQUENCY EVALUATION
(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								

Notes:

* Included in NEI 12-06 Appendix H Path 2 High Frequency Confirmation Scope

** Reported values are representative of the 15 Hz to 40 Hz frequency range

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