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U.S. Nuclear Regulatory Commission
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DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNITS 2 AND 3
REEVALUATED SEISMIC HAZARD
MITIGATING STRATEGIES ASSESSMENT REPORT

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 [ADAMS Accession Nos. ML12056A046 and ML12053A340]
2. Dominion Nuclear Connecticut, Inc. Letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – Seismic Hazard and Screening Report (CEUS Sites) for Recommendation 2.1," dated March 31, 2014 [ADAMS Accession No. ML14092A417]
3. NRC Letter, "Millstone Power Station, Units 2 and 3 – 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 (TAC Nos. MF3968 and MF3969)," dated December 15, 2015 [ADAMS Accession No. ML15328A268]
4. NRC Letter, "Millstone Power Station, Units 2 and 3 – Supplement to 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 (CAC Nos. MF3968 and MF3969)," dated March 15, 2016 [ADAMS Accession No. ML16057A785]
5. NEI 12-06, Revision 4, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide*, December 2016 [ADAMS Accession No. ML16354B421]
6. JLD-ISG-2012-01, Revision 2, *Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*, February 2017 [ADAMS Accession No. ML17005A188]
7. Dominion Nuclear Connecticut, Inc. Letter, "Millstone Power Station Unit 2, Compliance Letter and Final Integrated Plan in Response to the March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond Design Basis External Events (Order Number 12-049)," dated December 29, 2015 [ADAMS Accession No. ML16005A184]

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8. Dominion Nuclear Connecticut, Inc. Letter, "Millstone Power Station Unit 3, Compliance Letter and Final Integrated Plan in Response to the March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond Design Basis External Events (Order Number EA-12-049)," dated June 23, 2015 [ADAMS Accession No. ML15182A012]

The purpose of this letter is to provide the results of the assessment for Millstone Power Station Units 2 and 3 to demonstrate that the FLEX strategies developed, implemented and maintained in accordance with NRC Order EA-12-049 can remain acceptable considering the impacts of the reevaluated seismic hazard.

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1 to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 1 of Reference 1 requested each addressee in the Central and Eastern United States (CEUS) to submit a Seismic Hazard and Screening Report (SHSR). The SHSR submitted for Millstone Power Station (Reference 2) provided the reevaluated seismic hazard information, including a performance-based Ground Motion Response Spectrum (GMRS). References 3 and 4 document the NRC staff's conclusion that the GMRS submitted for Millstone Power Station (MPS) adequately characterizes the reevaluated seismic hazard for the site.

The assessment of mitigating (FLEX) strategies for MPS Units 2 and 3 was performed in accordance with the guidance provided in Appendix H Section H.4.4 of NEI 12-06 Revision 4 (Reference 5) which was endorsed by the NRC (Reference 6).

Based upon the mitigating strategies assessment (MSA) results provided in Attachments 1 and 2, the FLEX strategies for MPS Units 2 and 3, as described in References 7 and 8, are acceptable considering the impacts of the reevaluated seismic hazard.

If you have any questions regarding this information, please contact Diane E. Aitken at (804) 273-2694.

Sincerely,

Dan Stoddard

Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer
Dominion Nuclear Connecticut, Inc.

Vicki L. Hull
NOTARY PUBLIC
Commonwealth of Virginia
Reg. # 140542
My Commission Expires May 31, 2018

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Daniel G. Stoddard, who is Senior Vice President and Chief Nuclear Officer of Dominion Nuclear Connecticut, Inc. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 27TH day of April, 2017.

My Commission Expires: May 31, 2018

Vicki L. Hull
Notary Public

Commitments made in this letter: No new regulatory commitments

Attachments:

1. Mitigating Strategies Assessment for Millstone Unit 2
2. Mitigating Strategies Assessment for Millstone Unit 3

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ATTACHMENT 1

MITIGATING STRATEGIES ASSESSMENT FOR MILLSTONE UNIT 2

MILLSTONE POWER STATION UNIT 2
DOMINION NUCLEAR CONNECTICUT, INC.

1.0 BACKGROUND

Millstone Power Station Unit 2 (MPS2) has completed a mitigating strategies assessment (MSA) to determine if the diverse and flexible (FLEX) mitigating strategies developed, implemented, and maintained for compliance with 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 NEI 12-06 (Reference 1), which was endorsed by the NRC (Reference 2).

The Mitigating Strategies Seismic Hazard Information (MSSHI) is the reevaluated seismic hazard information at Millstone Power Station (MPS) 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 MPS control point elevation. MPS2 submitted the reevaluated seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC (Reference 3). The NRC staff concluded that the GMRS that was submitted adequately characterizes the reevaluated seismic hazard for the MPS site (Reference 4). Section 6.1.2 of Reference 2 identifies the method described in Section H.4.3 of Reference 1 as applicable to MPS2. Section 6.1.1 of Reference 2 identifies that the method described in Section H.4.4 of Reference 1 is applicable to plants for which Section H.4.3 is applicable.

MPS2 performed the reevaluated seismic hazard screening based on the Individual Plant Examination of External Events (IPEEE) high confidence of a low probability of failure (HCLPF) spectrum (IHS) as described in Reference 3. Consistent with the guidance in Reference 1, Appendix H, Section H.4.3, the MSA evaluation follows Section H.4.4 guidance.

2.0 ASSESSMENT TO MSSHI

Consistent with Section H.4.4 (Path 4) of Reference 1, the MPS2 GMRS has spectral accelerations greater than the Safe Shutdown Earthquake (SSE) but no more than 2 times the SSE anywhere in the 1 to 10 Hz frequency range. As described in the Final Integrated Plan (FIP) (Reference 11), the plant equipment relied on for FLEX strategies are generally seismically robust to the SSE levels, with certain specified exceptions. The MPS2 MSA evaluation described in the following sections provides a confirmation that a minimum of one success path for each FLEX strategy relies on equipment that is seismically robust to the SSE levels. The evaluation further considers the adequacy of the equipment for the MSSHI seismic demand. The basic elements within the MPS2 MSA of Path 4 structures, systems, and components (SSCs) are described in Reference 1. Implementation of each of these basic Path 4 elements for MPS2 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 expedited seismic evaluation process (ESEP) defined in EPRI 3002000704 (Reference 8). FLEX SSCs excluded from consideration in the ESEP described in Reference 8 were included in the MSA equipment scope. In addition, SSC failure modes not addressed in the ESEP that could potentially affect the FLEX strategies were included 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.

2.2 STEP 2 – ESEP REVIEW

As described in a letter to the NRC dated July 21, 2014 (Reference 13), the review of a limited set of components (FLEX-credited equipment) to the reevaluated seismic hazard demand levels, in accordance with the Expedited Seismic Evaluation Process (ESEP) guidance (Reference 8), would not provide a significant increase in safety insight or indication of seismic margin for MPS2 beyond what was already provided by the IPEEE Program. Therefore, ESEP was not performed for MPS2. The NRC staff reviewed the information provided in the July 21, 2014 letter and concluded that the justification for not performing the ESEP was sufficient (Reference 14). The ESEP results were not submitted to NRC. However, an Expedited Seismic Equipment List (ESEL) was developed in accordance with the guidance in Reference 8 and this list included the ESEP equipment, which has been evaluated for the MSA as further described in Section 2.4.

2.3 STEP 3 – INHERENTLY / SUFFICIENTLY RUGGED EQUIPMENT

Consistent with the guidance in NEI 12-06, Section H.4.4, the assessment of certain SSCs was accomplished using (1) a qualitative screening of "inherently rugged" SSCs and (2) an evaluation of SSCs to determine if they are "sufficiently rugged." Reference 1 documents the process and the justification for this ruggedness assessment.

The following types of inherently rugged components have high seismic capacity and require no further evaluation for the MSA per Reference 1:

- Strainers and small line mounted tanks
- Welded and bolted piping
- Manual valves, check valves, and rupture discs
- Power operated valves (MOVs and AOVs) not required to change state

As documented in Reference 3, the MSSHI (i.e., GMRS) for MPS2 is less than twice the SSE in the 1 to 10 Hz range, and less than 0.8g peak spectral acceleration, such that the following types of SSCs have sufficiently high seismic capacities and are determined to be sufficiently rugged per Reference 1:

- Concrete containment and containment internal structures
- Shear walls, footings and containment shield walls
- Diaphragms (floors)
- Category I concrete frame structures
- Category I steel frame structures
- Raceways (Cable Trays and Conduit)
- NSSS components (piping and vessels)

2.4 STEP 4 – EVALUATIONS

This section provides the evaluation of MPS2 SSCs relied upon for implementation of FLEX strategies that were not determined to be inherently / sufficiently rugged as described in Section 2.3. As described in Section 2.2, MPS2 did not perform an ESEP. Therefore, the evaluation below includes the SSCs listed for evaluation in Reference 1, Section H.4.4 along with the ESEL SSCs. The portion of the MPS2 MSA described in this section includes the evaluation of the following SSCs:

1. ESEL SSCs that are not inherently / sufficiently rugged (as described in Section 2.3)
2. FLEX equipment storage building and Non-Seismic Category 1 Structures that could impact FLEX implementation
3. Operator Pathways credited in the FLEX Strategies
4. Tie down of FLEX portable equipment
5. Seismic Interactions that could affect FLEX strategies
6. Haul Paths

2.4.1 USE OF NEI 12-06, SECTION H.5 CRITERION FOR MPS2

The MSA evaluation for MPS2 SSCs was performed using the guidance in NEI 12-06 (Reference 1), Section H.5 Seismic Evaluation Criteria ($C_{10\%}$), to demonstrate adequate seismic ruggedness of the SSC for the MSSHI. As described in Reference 1, Section H.5, the FLEX strategies serve as a defense in depth to the existing safety systems and, as such, a 90% probability of success criterion is judged to be sufficient to verify adequate capacity for this beyond design basis seismic review. The basis for applying this criterion to the MSA is provided in Reference 1. For this evaluation, the MPS GMRS was set as the Review Level Earthquake (RLE).

Comparing the spectral ordinates of the MPS2 SSE and the GMRS in the 1 to10 Hz range from Reference 3, the maximum GMRS exceedance of the SSE occurs at 10 Hz. At this spectral frequency, GMRS amplitude equals 0.4036g and the SSE spectral amplitude equals 0.300g. The maximum exceedance ratio (GMRS/SSE) is 1.345.

In accordance with EPRI NP-6041 SL Revision 1 (Reference 10) [reference page 2-55], it is conservative to accept the SSE as the CDFM Seismic Margin Earthquake level (or HCLPF capacity or $C_{1\%}$ capacity). Therefore, for SSCs designed to SSE seismic demand levels, the design basis capacity of the SSC can conservatively be considered the $C_{1\%}$ capacity. Considering Section H.5 of Reference 1 for a realistic lower bound case, the ratio of $C_{10\%}$ to $C_{1\%}$ from Table H.1 is 1.36. Therefore, since the maximum GMRS-to-SSE exceedance ratio in the 1 to 10 Hz spectral frequency range is less than 1.36, it follows that SSCs designed to the SSE seismic demand level have lower bound $C_{10\%}$ capacities (i.e., $C_{1\%}$ times 1.36) exceeding the RLE (i.e., GMRS). For certain types of SSCs, the $C_{10\%}$ / $C_{1\%}$ ratio from Table H.1 could be higher, which results in a higher predicted $C_{10\%}$ capacity.

2.4.2 SSC EVALUATIONS

2.4.2.1 ESEL SSCs

As indicated in Section 2.2, a MPS2 ESEL was developed in accordance with the guidance in Reference 8. This list defined the single train/single channel set of FLEX-credited permanent plant equipment relied upon for successful implementation of FLEX strategies supporting the core cooling, reactor coolant system inventory, and containment functions, including key parameter instrumentation, during Phase 1 and Phase 2 of the plant response to an extended loss of all AC power (ELAP) concurrent with a loss of access to the ultimate heat sink (LUHS).

NEI 12-06 (Reference 1) provides guidance for addressing seismic design of SSCs that support FLEX strategies as equivalent to the design basis, and for consideration of beyond design basis seismic events, in Section 5. The guidance also generally provides that FLEX-credited SSCs should be robust with respect to external hazards, including seismic events, for implementation of FLEX strategies. NEI 12-06 defines robust in Appendix A, Glossary of Terms, as:

> *Robust (designs): the design of an SSC either meets the current plant design basis for the applicable external hazards or has been shown by analysis or test to meet or exceed the current design basis.*

The FIP (Reference 11) describes water sources, FLEX connections, system flow paths, and electrical power sources as meeting the MPS2 seismic design basis. However, although the intent of the development of FLEX strategies was to include at least one path that meets seismic design basis requirements, the level of detail for the credited plant equipment in a success path has not been addressed at the level of detail that exists on the ESEL. For the purposes of this evaluation, the seismic design of equipment on the ESEL has been confirmed by the review of the safety classification and seismic design information for each applicable SSC using the MPS2 Safety Classification and Seismic indicators in the equipment database. The MPS2 Final Safety Analysis Report (Reference 15), Section 1.4.1, Plant Design, Appendix 1.A AEC General Design Criteria for Nuclear Power Plants, Criterion 4 - Environmental and Missile Design Bases, and Section 5.8.1.1, Design Response Spectra, confirm that SSCs classified as safety-related are designed to the SSE seismic demand.

The review concluded that the SSCs on the ESEL were designed or otherwise evaluated for the design basis SSE loading conditions. Therefore, using the approach described in Section 2.4.1, the ESEL SSCs have been demonstrated to have adequate seismic ruggedness for the MPS2 MSSHI and will support implementation of the MPS2 FLEX strategies in the event of a beyond design basis earthquake.

2.4.2.2 FLEX EQUIPMENT STORAGE BUILDING AND NON-SEISMIC CATEGORY I STRUCTURES

The FLEX portable equipment and accessories that support implementation of FLEX strategies for MPS2 and MPS3 are stored in the BDB Storage Building.

2.4.2.2.1 BDB STORAGE BUILDING EVALUATION

The MPS BDB Storage Building, which stores the portable FLEX equipment and accessories, is a reinforced concrete dome-shaped structure. The structure is designed to meet the plant's design basis for earthquake ground motions, tornado missiles, and severe weather events.

The structure is located on the plant site north of the protected area of the station, and founded on an approximately 37 ft thickness soil overburden at elevation 33 ft. The structure is 120 feet in diameter and 38 feet tall with 24 inch shell thickness, and includes two large equipment entries and two personnel entries each with steel closure doors. The structure foundation is a conventionally reinforced cast-in-place shallow ring-beam concrete foundation five feet wide by four feet depth. The floor slab is 8 inch thick reinforced concrete slab-on-grade designed to support the FLEX equipment loading.

The seismic design of the BDB Storage Building was based on the rock-based MPS Unit 3 SSE amplified to account for the location of the building relative to the SSE control point. The SSE was amplified to represent the ground motion input at the building foundation due to the soil profile at the building location, which was estimated at 40 feet deep at the time of the building design. The amplified 5% damping SSE spectrum was developed using the relationships between soil and rock ground motions and the methods described in EPRI TR-102293 (Reference 16).

The BDB Storage Building was evaluated to demonstrate adequate seismic ruggedness with respect to the MSSHI using the guidance in NEI 12-06 (Reference 1), Section H.5 Seismic Evaluation Criteria ($C_{10\%}$). The following steps were applied to evaluate the building:

1. Determine the MSSHI input motion at the BDB Storage Building foundation (amplified GMRS)
2. Determine the $C_{1\%}$ capacity of the BDB Storage Building
3. Determine the $C_{10\%}$ capacity of the building and compare to the amplified GMRS demand

The MSSHI demand at the structure foundation was determined consistent with the original design methods (based on Reference 16) relative to the GMRS control point elevation of +15 ft from Reference 3. The 37 foot deep soil profile beneath the building foundation to bedrock was used to determine soil amplification factors from Reference 16. The amplified horizontal GMRS was calculated by multiplying the horizontal control point GMRS from Reference 3 by the appropriate frequency-based amplification factors. The corresponding amplified vertical GMRS was determined from the amplified horizontal GMRS using Table 4-5 of NUREG/CR-6728 (Reference 17).

Consistent with the methods described in Section 2.4.1, the $C_{1\%}$ capacity of the building was conservatively taken as the amplified SSE demand level based on the original seismic design analysis of the BDB Storage Building described above. Based on the original design dynamic analysis, the structure fundamental response modes are at 5.5 Hz horizontal and at 9.75 Hz vertical. The amplified SSE spectral accelerations at these frequencies are 1.393g and 0.667g, respectively.

The $C_{10\%}$ capacity for the structure is based on Reference 1, Section H.5, Table H.1, for item "Structures and Major Passive Mechanical Components on Ground or Low Elevation Within Structures." The corresponding $C_{10\%}$ / $C_{1\%}$ Ratio of 1.44 was used to determine the $C_{10\%}$ capacity for the BDB Storage Building.

The results of the evaluation of the BDB Storage Building are summarized below and demonstrate that the structure has adequate seismic ruggedness with respect to the MSSHI.

Fundamental Mode	**Frequency**	**SSE Acceleration (Amplified) [$C_{1\%}$ Capacity]**	**$C_{10\%}$ Capacity**		**GMRS Acceleration (Amplified)**	**Conclusion**
Horizontal	5.5 Hz	1.393g	2.01g	>	0.57g	Acceptable
Vertical	9.75 Hz	0.667g	0.96g	>	0.63g	Acceptable

2.4.2.2.2 NON-SEISMIC CATEGORY I STRUCTURES

As described in the FIP, FLEX mechanical and electrical connections, and access to the connections and other areas requiring operator action, are located in seismically designed structures / areas of the plant. These structures are considered sufficiently rugged as described in Section 2.3.

There are various non-Seismic Category I structures/equipment located along the FLEX equipment deployment haul paths, such as light poles, electrical transmission poles and towers, fencing, security towers, etc. The failure of these non-seismically designed SSCs was evaluated. As a result, the preferred haul paths minimize travel through areas with trees, power lines, narrow passages, etc., to the extent practical. The FIP includes multiple haul path routings and other pre-planned options, including assessment of de-energization of downed power lines and clearing of debris using FLEX-dedicated heavy equipment stored in the BDB Storage

Building, to ensure success of FLEX strategy implementation.

Therefore, no further evaluation of non-Seismic Category I structures is necessary to support the MSA.

2.4.2.3 OPERATOR PATHWAYS

As described in the FIP, operator pathways to access FLEX mechanical and electrical connections, and to perform required local operator actions, do not require access through non-seismically designed structures. Operator pathways were further reviewed during a plant walkdown for the MSA, including pathways near internal masonry block walls, and no spatial interaction concerns were identified that could prevent implementation of the FLEX strategies. Additional information related to the masonry block wall review is included in Section 2.4.2.5.

2.4.2.4 TIE DOWN OF FLEX PORTABLE EQUIPMENT

FLEX portable equipment and associated accessories are stored in the BDB Storage Building described in Section 2.4.2.2.1. The stored portable equipment and accessories are described in the FIP. The stability of the stored equipment has been evaluated considering the MSSHI.

The stored FLEX portable equipment, including miscellaneous support equipment stored on shelving units within the BDB Storage Building, was evaluated using a static coefficient analysis. The equipment was evaluated for stability against overturning, resistance to sliding, and the potential for adverse interaction. The horizontal and vertical amplified GMRS accelerations, developed as described in Section 2.4.2.2.1, were used as input to the evaluation. The vertical acceleration was increased to the peak spectral value (0.67g) for the portable equipment and shelving stability evaluations to ensure the minimum factors of safety for overturning were evaluated.

The evaluation was performed by identifying the dimensions, weight, and location of the center of gravity for each stored piece of portable equipment and for the shelving units. Each item was evaluated for overturning using a factor of safety (FS) criterion of 1.0, which is appropriate based on the low probability of a GMRS magnitude seismic event and that overturning would require significant additional energy input beyond this point to actually overturn the equipment since FS=1.0 simply indicates the point of uplift. Similarly, since the initiation of sliding results in significant energy dissipation in friction, sliding was evaluated for equipment and shelving using an FS of 1.0. For equipment or shelving that indicates an overturning FS</=1.0, factors of safety for overturning and sliding were compared to determine if sliding occurred first, thereby limiting overturning. If sliding was predicted, the potential for interaction with nearby equipment was evaluated.

The evaluation concluded that the portable equipment stored in the BDB Storage Building is stable against overturning and sliding considering the MSSHI. Storage shelving units are stable against overturning, however the potential for sliding was identified. The potential for interaction with stored equipment was evaluated and it was determined that no adverse interaction was feasible based on the minimal expected lateral displacement of the shelving units and the open floor area between shelving units and stored equipment necessary to allow for access to the equipment stored on the shelves.

2.4.2.5 ADDITIONAL SEISMIC INTERACTIONS

Seismic interactions that could potentially affect the implementation of FLEX strategies were reviewed for the MPS2 MSA. Seismic interactions that were reviewed included failure of masonry block walls near FLEX-credited equipment or operator pathways, failure of piping attached to tanks, flooding from non-seismically robust tanks, interactions to distributed systems (raceways and piping) associated with FLEX-credited equipment, and general area reviews of interactions with FLEX-credited equipment.

2.4.2.5.1 MASONRY BLOCK WALL REVIEW

The potential for failure of masonry block walls in the vicinity of FLEX-credited equipment or operator pathways was evaluated considering the MSSHI.

Masonry block walls in areas housing safety-related equipment were previously evaluated in accordance with the NRC Inspection and Enforcement Bulletin (IEB) No. 80-11, "Masonry Wall Design" requirements. The MPS2 IEB 80-11 Program review resulted in either finding the masonry block wall to be acceptable as-is or, in some cases modifications were implemented to strengthen the wall to meet SSE demand and other applicable loading conditions. With one exception, the masonry block walls near FLEX-credited equipment or operator pathways were included within the scope of the IEB 80-11 Program.

A masonry block wall at the end of the stairwell of a FLEX-credited operator pathway was not reviewed by the IEB 80-11 Program. This wall is four feet wide by approximately sixteen feet tall and is located adjacent, and perpendicular, to a block wall that was reviewed in the Program on one end and a reinforced concrete wall on the other. The unreviewed wall is not located near safety-related (or FLEX-credited) equipment. The wall was determined to be adequately robust considering the short lateral span (4'). In addition, in the event of degradation of the wall due to the MSSHI-level seismic event, the resulting debris within the stairwell would be limited and would not be expected to prevent operator transit through the pathway.

The masonry block walls within the scope of the IEB 80-11 Program and determined to be in the vicinity of FLEX-credited equipment or operator pathways were evaluated to the SSE seismic loading requirements for the IEB 80-11 Program. The walls were evaluated for the MSA to demonstrate adequate seismic ruggedness using the approach from Reference 1, Section H.5 as described in Section 2.4.1. The $C_{10\%}$ capacity for the walls was determined based on a $C_{10\%}$ / $C_{1\%}$ ratio of 1.36 from Reference 1, Section H.5, Table H.1, and a conservative $C_{1\%}$ capacity equal to the SSE demand. Consistent with the discussion in Section 2.4.1, the $C_{10\%}$ capacities for the walls were determined to exceed the GMRS demand, and adequate seismic ruggedness was demonstrated.

Therefore, MPS2 masonry block walls in the vicinity of FLEX-credited equipment or operator pathways are adequate considering the MSSHI.

2.4.2.5.2 REVIEW OF PIPING ATTACHED TO TANKS

Piping attached to tanks credited for implementation of FLEX strategies was reviewed to evaluate the possibility of failures due to differential displacements. The Condensate Storage Tank (CST) and Refueling Water Storage Tank (RWST) are credited as water sources for the FLEX strategy implementation and are founded on grade in the MPS2 Yard Area. The tanks are seismically-designed for the SSE seismic loading conditions. There are no buried tanks relied upon for the implementation of MPS2 FLEX strategies.

The CST and RWST were determined to be robustly anchored to the tank foundation such that no significant displacement of the tanks is expected. In addition, the tanks HCLPF capacities were evaluated to be greater than 0.3g during the IPEEE margins assessment, which is greater than the GMRS PGA.

Based on the robustness of the tanks and anchorage, and the HCLPF capacity greater than the GMRS PGA, the tanks and attached piping would not be subject to significant differential displacement and are acceptable for the MSSHI seismic demand.

2.4.2.5.3 FLOODING FROM NON-SEISMICALLY ROBUST TANKS

Large, non-seismically designed tanks located in the plant Yard Area were evaluated as potential sources of flooding due to seismic failure. Flooding originating from non-seismic sources within the MPS2 buildings was evaluated as described in the FIP and this evaluation remains valid for the MSSHI.

The evaluation of the potential for flooding from non-seismic sources in the Yard Area considered the flood volume from non-seismic tanks that do not include external containment systems (e.g., berms, dikes, etc.), the surface area available for flood water to disperse, and the slope of the ground in the vicinity of the tanks and plant structures. Potential impacts of flooding considered FLEX equipment staging areas in the yard, FLEX connection points in the yard, and flooding of MPS2 buildings.

A conservative assessment assuming the total volume of all of the non-seismic flood sources and the yard area available for dispersion of flood liquid concluded that only a few inches of flood water would accumulate that would not inhibit FLEX strategy implementation. Realistically, only a portion of the total volume of the tanks would contribute to the flooding, and the slope of the ground surface would generally direct water away from the plant. Considering the timeline for deployment of FLEX equipment and implementation of strategies described in the FIP, there is more than adequate time for flood water to drain away from staging areas, connection points, and plant buildings.

Therefore, flooding from non-seismic tanks would not affect implementation of MPS2 FLEX strategies considering the MSSHI.

2.4.2.5.4 <u>INTERACTIONS TO DISTRIBUTED SYSTEMS</u>

The potential for adverse equipment interactions to distributed systems (i.e., piping and electrical raceways) due to a MSSHI seismic event was evaluated by walkdown inspections of a sample of distributed system SSCs relied on for FLEX strategy implementation, consistent with the guidance in Reference 1, Section H.4.4.

The inspection sample included conduit and cable tray near electrical cabinets and devices credited for FLEX strategy implementation located in the general area of these components. The conduit and raceway was well supported such that displacement was limited and no potential for interaction with structures or nearby equipment was identified. Cable trays were observed to be lightly loaded. Adequate cable flexibility was observed in the inspection sample. No instances were observed where seismic excitation could interfere with the distributed system function.

The sample also included piping systems, including FLEX connections, associated with FLEX strategy implementation. The piping was well supported and displacement would be limited in a seismic event. No close-proximity structure or equipment was identified that could interact adversely with the piping.

Therefore, no credible interactions with distributed systems that would affect the implementation of FLEX strategies were identified considering the MSSHI.

2.4.2.5.5 <u>GENERAL AREA REVIEW OF INTERACTIONS</u>

General areas in the vicinity of a sample of FLEX equipment were also walked down to identify potential seismic interaction concerns. The review identified overhead lighting, stored mobile carts, work desks, and non-permanent / transient items in the areas. The failure of overhead lighting (bulbs, diffusers) near electrical cabinets was determined not to represent a significant interaction hazard due to its lightweight in relation to target components. The carts, desk, and transient items were stored and secured in accordance with the station seismic housekeeping program and did not constitute an interaction hazard.

Therefore, no credible seismic interactions with FLEX equipment that would affect the implementation of MPS2 FLEX strategies were identified considering the MSSHI.

2.4.2.6 <u>HAUL PATH</u>

The deployment of FLEX equipment from the BDB Storage Building (described in Section 2.4.2.2.1) to staging locations on the plant site requires availability of equipment haul routes / paths. MPS2 FLEX strategies include the use of primary and alternate routes / haul paths to ensure accessibility following extreme external events, including earthquakes. The haul paths are described in the FIP (Reference 11). The haul paths were evaluated for seismic induced liquefaction and interaction issues (failure of non-seismic SSCs along the haul route) and the results of the evaluation are summarized in the FIP. The conclusions of the FIP evaluation related to interactions of non-seismic SSCs impact on haul path availability remain valid for the MSSHI. The potential for liquefaction at the BDB Storage Building and along the haul paths was reevaluated considering the MSSHI to support the MSA.

As part of the geotechnical investigation for the BDB Storage Building and haul paths, two geophysical studies utilizing in-situ shear wave velocity data acquired with the multi-channel analysis of surface waves (MASW) method were performed in the area of the building and along the haul paths. For limited locations within the total area investigated in the vicinity of the building site, lenses about 7 to 8 feet below the surface were encountered in which the in-situ shear wave velocity was below approximately 600 feet per second. In haul path areas along the southern extremity of the MPS Protected Area (PA), low shear wave velocity layers were encountered at depth ranges varying from 6 feet to 13 feet, to as deep as 19 feet to 27 feet, below the surface. These subgrade layers near the BDB Storage Building and along the haul paths were considered potentially liquefiable with respect to the MSSHI ground accelerations and were further evaluated in a liquefaction study.

The study used the GMRS-equivalent PGA at the subgrade layer locations as the seismic source and determined the factor of safety (FS) against liquefaction. If the FS was equal to or less than 1.1, the study estimated the amount of potential settlement associated with the liquefied zone. Two methods were employed to estimate settlement: the first method estimates the settlement directly from the calculated FS and relative density derived with the measured shear wave velocity and the second method estimates the settlement from the calculated shear strains and relative density. The two methods provided a range of expected deformation in the ground surface, which was averaged to provide the estimated settlement.

The liquefaction study estimated that liquefaction could result in building settlements of approximately 0.1 inch, which was determined to have negligible impact on the function of the BDB Storage Building or the ability to access and remove FLEX portable equipment from the building for implementation of FLEX strategies. The study of the haul paths estimated a maximum potential settlement of the limited path area subject to liquefaction of approximately 5 inches. This was also determined to have a negligible impact on FLEX strategy implementation based on the heavy duty nature of the haul and clearing equipment available onsite and stored in the BDB Storage Building, which have significantly greater ground clearance than the potential ground surface settlements.

Therefore, MPS2 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

The FLEX mitigation strategy for maintaining the spent fuel pool (SFP) cooling function is described in the FIP (Reference 11) and consists of actions to maintain normal SFP water level to keep the stored spent fuel adequately cooled following an ELAP causing loss of the normal SFP cooling system.

The Phase 1 coping strategy is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051. The Phase 2 strategy is to initiate SFP makeup within 24 hours using a portable FLEX pump discharging through flexible hose to the FLEX SFP makeup connection located in the MPS2 Auxiliary Building. The strategy provides sufficient makeup water to the SFP to maintain the normal SFP level. The FLEX SFP makeup connection piping is seismically designed in accordance with the plant design basis and is protected from missiles in all directions. The SFP makeup connection piping ties into an existing SFP makeup line, which discharges directly into the SFP. Makeup water is provided from the RWST.

The SFP level instrumentation relied upon for the FLEX strategy is designed and installed to the SSE loading conditions. The instrumentation was evaluated for the MSA to demonstrate adequate seismic ruggedness using the approach from Reference 1, Section H.5 as described in Section 2.4.1. The $C_{10\%}$ capacity for the instrumentation was determined based on a $C_{10\%}$ / $C_{1\%}$ ratio of 1.36 from Reference 1, Section H.5, Table H.1, and a conservative $C_{1\%}$ capacity equal to the SSE demand. Consistent with the discussion in Section 2.4.1, the $C_{10\%}$ capacity for the instrumentation was determined to exceed the GMRS demand, and adequate seismic ruggedness was demonstrated.

The piping associated with the FLEX SFP makeup connection and makeup flowpath is inherently rugged as discussed in Section 2.3. The portable FLEX equipment relied upon for the SFP cooling strategy is stored in the BDB Storage Building, which was evaluated considering the MSSHI and found acceptable in Sections 2.4.2.2.1 and 2.4.2.4, and is deployed along the haul paths evaluated in Section 2.4.2.6.

The spent fuel pool integrity evaluation described in Reference 12 demonstrated inherent margins of the spent fuel pool structure and interfacing plant equipment above the SSE to a peak spectral acceleration of 0.8g, which exceeds the MSSHI (GMRS) peak spectral acceleration of 0.42g (Reference 3).

Therefore, the MPS2 FLEX mitigating strategy to provide SFP cooling has been evaluated considering the MSSHI and demonstrated to be acceptable.

4.0 HIGH FREQUENCY REVIEW

The MPS2 MSSHI (GMRS) includes accelerations that exceed the SSE spectrum in the high frequency (i.e., greater than 10Hz) range as described in Reference 3. As described in NEI 12-

06 (Reference 1), Section H.4.4, an evaluation of high frequency (HF) sensitive equipment relied on for FLEX strategy implementation is to be conducted for the MSA in accordance with the methodology in Reference 1, Section H.4.2.

In accordance with Reference 1, Section H.4.2, the HF evaluation is to be performed using the methods described in EPRI 3002004396 (Reference 6), Sections 3 and 4. The HF evaluation scope includes contact control devices subject to intermittent states (e.g., relays and contactors that could chatter) in seal-in and lockout circuits for plant equipment relied on for Phase 1 FLEX strategy implementation (and permanently installed FLEX Phase 2 equipment with automatic start capability for which there are none relied on for MPS2 FLEX strategies). Per Reference 1, Section H.4.2, the evaluation focus is on the following systems and equipment:

- *Relays and contactors whose chatter could cause malfunction of a reactor SCRAM.*
- *Relays and contactors in seal-in or lockout circuits whose chatter could cause a reactor coolant system (RCS) leakage pathway that was not considered in the FLEX strategies.*
- *Relays and contactors that may lead to circuit seal-ins or lockouts that could impede the Phase 1 FLEX capabilities, including buses fed by station batteries through inverters.*
- *Relays and contactors that may lead to circuit seal-ins or lockouts 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.* [None for MPS2]

MPS2 performed a HF sensitive equipment evaluation in accordance with the guidance in Reference 6 to support the response to NRC 10 CFR 50.54(f) Request for Information letter (Reference 18) for NTTF Recommendation 2.1: Seismic and provided the results in Reference 5. The HF review documented in Reference 5 envelops the scope of the HF evaluation required for the MSA and was performed using the GMRS seismic demand. The HF sensitive components evaluated for the MSA that could result in control circuit seal-in or lockout for equipment relied on in the FLEX strategies are provided in Table 4.0-1: High Frequency Evaluation for Mitigating Strategies Assessment along with the results of the HF evaluation for these components from Reference 5. Details of the methods and criteria used are described in Reference 5.

As indicated in Table 4.0-1, the HF sensitive components evaluated were found to have adequate capacity against high frequency effects when considering the MSSHI seismic demand. Therefore, no adverse effects on MPS2 FLEX strategy implementation were identified due to HF seismic ground motions associated with the MSSHI.

Table 4.0-1: High Frequency Evaluation for Mitigating Strategies Assessment

	High-frequency Review Equipment List							Seismic Demand [2]		Seismic Capacity [2]			
Item No.	Equipment ID	Equipment Description	Key Safety Function	Relay ID(s)	Cabinet Type	Bldg	Elev	$ICRS_{cH}$	$ICRS_{cV}$	Relay Mfg. & Model	Seismic Capacity Source Document	TRS	Evaluation Result
1	2-FW-43A	S/G NO. 1 STEAM GENERATOR AUX FEEDWATER REGULATING VALVE - AVAILABLE TO THROTTLE	Core Cooling	20X/Z1-5276 (C05)	Control Cabinet	AUX	36'-6"	3.987	3.436	GE 12HFA151A2H (DC)	EPRI 3002002997	13.654	Capacity meets or exceeds demand
2	2-FW-43B	S/G NO. 2 STEAM GENERATOR AUX FEEDWATER REGULATING VALVE - AVAILABLE TO THROTTLE	Core Cooling	20X/Z2-5279 (C05)	Control Cabinet	AUX	36'-6"	3.987	3.436	GE 12HFA151A2H (DC)	EPRI 3002002997	13.654	Capacity meets or exceeds demand
3	2-FW-44	AFW PUMP DISCHARGE HEADER CROSSTIE VALVE	Core Cooling	42-C/a (B6203)	MCC	AUX	36'-6"	0.886	0.731	STARTER / CONTACTOR [1]	EPRI NP-5223-SLR1, GERS-MCC.9	1.200	Capacity meets or exceeds demand
4	2-MS-201	TDAFW STEAM SUPPLY VALVE FROM S/G NO. 1	Core Cooling	42-C/a (B5202)	MCC	AUX	38'-6"	0.886	0.731	STARTER / CONTACTOR [1]	EPRI NP-5223-SLR1, GERS-MCC.9	1.200	Capacity meets or exceeds demand

Notes:

1. Capacity data for starter/contactors from EPRI NP-5223-SLR1, GERS-MCC.9 is not model-specific.
2. Details of the methods and criteria used, and definitions of terms, are provided in Reference 5.

5.0 CONCLUSION

The FLEX strategies for MPS2 as described in the FIP are acceptable as specified and no further seismic evaluations are necessary.

6.0 REFERENCES

1. NEI 12-06, Revision 4, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, December 2016.

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

3. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – Seismic Hazard and Screening Report (CEUS Sites) for Recommendation 2.1," dated March 31, 2014. [ML14092A417]

4. NRC letter, "Millstone Power Station, Units 2 and 3 – 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 (TAC Nos. MF3968 and MF3969)," dated December 15, 2015.

5. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – High Frequency Equipment Functional Confirmation for Recommendation 2.1," dated December 22, 2016. [ML16365A036]

6. EPRI, "High Frequency Program Application Guidance for Functional Confirmation and Fragility Evaluation," Report Number 3002004396, Palo Alto, CA, July, 2015.

7. 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.

8. 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.

9. 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.

10. EPRI, "A Methodology for Assessment of Nuclear Plant Seismic Margin," Report Number NP-6041-SL, Revision 1, Palo Alto, CA, August, 1991 with October, 2015 errata.

11. Dominion Nuclear Connecticut, Inc. Letter, "Millstone Power Station Unit 2, Compliance Letter and Final Integrated Plan in Response to the March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated December 29, 2015. [ML16005A184]

12. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – Spent Fuel Pool Seismic Evaluation for Recommendation 2.1," dated December 21, 2016. [ML16365A032]

13. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – Supplemental Information Related to the Seismic Hazard and Screening Report for Recommendation 2.1," dated July 21, 2014. [ML14204A619]

14. NRC letter, "NRC Response to Licensees Regarding Notification of Regulatory Commitments Change Associated with Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident", dated December 15, 2014.

15. Millstone Power Station Unit 2 Final Safety Analysis Report

16. EPRI, "Guidelines for Determining Design Basis Ground Motions," Report Number TR-102293, Volume 1, Palo Alto, CA, November, 1993.

17. NUREG/CR-6728, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines", October 2001.

18. 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.

ATTACHMENT 2

MITIGATING STRATEGIES ASSESSMENT FOR MILLSTONE UNIT 3

MILLSTONE POWER STATION UNIT 3
DOMINION NUCLEAR CONNECTICUT, INC.

1.0 BACKGROUND

Millstone Power Station Unit 3 (MPS3) has completed a mitigating strategies assessment (MSA) to determine if the diverse and flexible (FLEX) mitigating strategies developed, implemented, and maintained for compliance with 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 NEI 12-06 (Reference 1), which was endorsed by the NRC (Reference 2).

The Mitigating Strategies Seismic Hazard Information (MSSHI) is the reevaluated seismic hazard information at Millstone Power Station (MPS) 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 MPS control point elevation. MPS3 submitted the reevaluated seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC (Reference 3). The NRC staff concluded that the GMRS that was submitted adequately characterizes the reevaluated seismic hazard for the MPS site (Reference 4). Section 6.1.2 of Reference 2 identifies the method described in Section H.4.3 of Reference 1 as applicable to MPS3. Section 6.1.1 of Reference 2 identifies that the method described in Section H.4.4 of Reference 1 is applicable to plants for which Section H.4.3 is applicable.

MPS3 performed the reevaluated seismic hazard screening based on the Individual Plant Examination of External Events (IPEEE) high confidence of a low probability of failure (HCLPF) spectrum (IHS) as described in Reference 3. Consistent with the guidance in Reference 1, Appendix H, Section H.4.3, the MSA evaluation follows Section H.4.4 guidance.

2.0 ASSESSMENT TO MSSHI

Consistent with Section H.4.4 (Path 4) of Reference 1, the MPS GMRS has spectral accelerations greater than the Safe Shutdown Earthquake (SSE) but no more than 2 times the SSE anywhere in the 1 to 10 Hz frequency range. As described in the Final Integrated Plan (FIP) (Reference 11), the plant equipment relied on for FLEX strategies are generally seismically robust to the SSE levels, with certain specified exceptions. The MPS3 MSA evaluation described in the following sections provides a confirmation that a minimum of one success path for each FLEX strategy relies on equipment that is seismically robust to the SSE levels. The evaluation further considers the adequacy of the equipment for the MSSHI seismic demand. 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 MPS3 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 expedited seismic evaluation process (ESEP) defined in EPRI 3002000704 (Reference 8). FLEX SSCs excluded from consideration in the ESEP described in Reference 8 were included in the MSA equipment scope. In addition, SSC failure modes not addressed in the ESEP that could potentially affect the FLEX strategies were included 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.

2.2 STEP 2 – ESEP REVIEW

As described in a letter to the NRC dated July 21, 2014 (Reference 13), the review of a limited set of components (FLEX-credited equipment) to the reevaluated seismic hazard demand levels, in accordance with the Expedited Seismic Evaluation Process (ESEP) guidance (Reference 8), would not provide a significant increase in safety insight or indication of seismic margin for MPS3 beyond what was already provided by the IPEEE Program. Therefore, ESEP was not performed for MPS3. The NRC staff reviewed the information provided in the July 21, 2014 letter and concluded that the justification for not performing the ESEP was sufficient (Reference 14). The ESEP results were not submitted to NRC. However, an Expedited Seismic Equipment List (ESEL) was developed in accordance with the guidance in Reference 8 and this list included the ESEP equipment, which has been evaluated for the MSA as further described in Section 2.4.

2.3 STEP 3 – INHERENTLY / SUFFICIENTLY RUGGED EQUIPMENT

Consistent with the guidance in NEI 12-06, Section H.4.4, the assessment of certain SSCs was accomplished using (1) a qualitative screening of "inherently rugged" SSCs and (2) an evaluation of SSCs to determine if they are "sufficiently rugged." Reference 1 documents the process and the justification for this ruggedness assessment.

The following types of inherently rugged components have high seismic capacity and require no further evaluation for the MSA per Reference 1:

- Strainers and small line mounted tanks
- Welded and bolted piping
- Manual valves, check valves, and rupture discs
- Power operated valves (MOVs and AOVs) not required to change state

As documented in Reference 3, the MSSHI (i.e., GMRS) for MPS3 is less than twice the SSE in the 1 to 10 Hz range, and less than 0.8g peak spectral acceleration, such that the following types of SSCs have sufficiently high seismic capacities and are determined to be sufficiently rugged per Reference 1:

- Concrete containment and containment internal structures
- Shear walls, footings and containment shield walls
- Diaphragms (floors)
- Category I concrete frame structures
- Category I steel frame structures
- Raceways (Cable Trays and Conduit)
- NSSS components (piping and vessels)

2.4 STEP 4 – EVALUATIONS

This section provides the evaluation of MPS3 SSCs relied upon for implementation of FLEX strategies that were not determined to be inherently / sufficiently rugged as described in Section 2.3. As described in Section 2.2, MPS3 did not perform an ESEP. Therefore, the evaluation below includes the SSCs listed for evaluation in Reference 1, Section H.4.4 along with the ESEL SSCs. The portion of the MPS3 MSA described in this section includes the evaluation of the following SSCs:

1. ESEL SSCs that are not inherently / sufficiently rugged (as described in Section 2.3)
2. FLEX equipment storage building and Non-Seismic Category 1 Structures that could impact FLEX implementation
3. Operator Pathways credited in the FLEX Strategies
4. Tie down of FLEX portable equipment
5. Seismic Interactions that could affect FLEX strategies
6. Haul Paths

2.4.1 USE OF NEI 12-06, SECTION H.5 CRITERION FOR MPS3

The MSA evaluation for MPS3 SSCs was performed using the guidance in NEI 12-06 (Reference 1), Section H.5 Seismic Evaluation Criteria ($C_{10\%}$), to demonstrate adequate seismic ruggedness of the SSC for the MSSHI. As described in Reference 1, Section H.5, the FLEX strategies serve as a defense in depth to the existing safety systems and, as such, a 90% probability of success criterion is judged to be sufficient to verify adequate capacity for this beyond design basis seismic review. The basis for applying this criterion to the MSA is provided in Reference 1. For this evaluation, the MPS3 GMRS was set as the Review Level Earthquake (RLE).

Comparing the spectral ordinates of the MPS3 SSE and the GMRS in the 1 to10 Hz range from Reference 3, the maximum GMRS exceedance of the SSE occurs at 10 Hz. At this spectral frequency, GMRS amplitude equals 0.4036g and the SSE spectral amplitude equals 0.316g. The maximum exceedance ratio (GMRS/SSE) is 1.28.

In accordance with EPRI NP-6041 SL Revision 1 (Reference 10) [reference page 2-55], it is conservative to accept the SSE as the CDFM Seismic Margin Earthquake level (or HCLPF capacity or $C_{1\%}$ capacity). Therefore, for SSCs designed to SSE seismic demand levels, the design basis capacity of the SSC can conservatively be considered the $C_{1\%}$ capacity. Considering Section H.5 of Reference 1 for a realistic lower bound case, the ratio of $C_{10\%}$ to $C_{1\%}$ from Table H.1 is 1.36. Therefore, since the maximum GMRS-to-SSE exceedance ratio in the 1 to 10 Hz spectral frequency range is less than 1.36, it follows that SSCs designed to the SSE seismic demand level have lower bound $C_{10\%}$ capacities (i.e., $C_{1\%}$ times 1.36) exceeding the RLE (i.e., GMRS). For certain types of SSCs, the $C_{10\%}$ / $C_{1\%}$ ratio from Table H.1 could be higher, which results in a higher predicted $C_{10\%}$ capacity.

2.4.2 SSC EVALUATIONS

2.4.2.1 ESEL SSCs

As indicated in Section 2.2, a MPS3 Expedited Seismic Equipment List (ESEL) was developed in accordance with the guidance in Reference 8. This list defined the single train/single channel set of FLEX-credited permanent plant equipment relied upon for successful implementation of FLEX strategies supporting the core cooling, reactor coolant system inventory, and containment functions, including key parameter instrumentation, during Phase 1 and Phase 2 of the plant response to an extended loss of all AC power (ELAP) concurrent with a loss of access to the ultimate heat sink (LUHS).

NEI 12-06 (Reference 1) provides guidance for addressing seismic design of SSCs that support FLEX strategies as equivalent to the design basis, and for consideration of beyond design basis seismic events, in Section 5. The guidance also generally provides that FLEX-credited SSCs should be robust with respect to external hazards, including seismic events, for implementation of FLEX strategies. NEI 12-06 defines robust in Appendix A, Glossary of Terms, as:

> *Robust (designs): the design of an SSC either meets the current plant design basis for the applicable external hazards or has been shown by analysis or test to meet or exceed the current design basis.*

The FIP (Reference 11) describes water sources, FLEX connections, system flow paths, and electrical power sources as meeting the MPS3 seismic design basis. However, although the intent of the development of FLEX strategies was to include at least one path that meets seismic design basis requirements, the level of detail for the credited plant equipment in a success path has not been addressed at the level of detail that exists on the ESEL. For the purposes of this evaluation, the seismic design of equipment on the ESEL has been confirmed by the review of the safety classification and seismic design information for each applicable SSC using the MPS3 Safety Classification and Seismic indicators in the equipment database. The MPS3 Final Safety Analysis Report (Reference 15), Sections 2.5.4.9, Earthquake Design Basis, and 3.1.2.2, Design Bases for Protection against Natural Phenomena (Criterion 2), confirm that SSCs classified as safety-related are designed to the SSE seismic demand.

The review concluded that the SSCs on the ESEL were designed or otherwise evaluated for the design basis SSE loading conditions. Therefore, using the approach described in Section 2.4.1, the ESEL SSCs have been demonstrated to have adequate seismic ruggedness for the MPS3 MSSHI and will support implementation of the MPS3 FLEX strategies in the event of a beyond design basis earthquake.

2.4.2.2 FLEX EQUIPMENT STORAGE BUILDING AND NON-SEISMIC CATEGORY I STRUCTURES

The FLEX portable equipment and accessories that support implementation of FLEX strategies for MPS2 and MPS3 are stored in the BDB Storage Building.

2.4.2.2.1 BDB STORAGE BUILDING EVALUATION

The MPS BDB Storage Building, which stores the portable FLEX equipment and accessories, is a reinforced concrete dome-shaped structure. The structure is designed to meet the plant's design basis for earthquake ground motions, tornado missiles, and severe weather events.

The structure is located on the plant site north of the protected area of the station, and founded on an approximately 37 ft thickness soil overburden at elevation 33 ft. The structure is 120 feet in diameter and 38 feet tall with 24 inch shell thickness, and includes two large equipment entries and two personnel entries each with steel closure doors. The structure foundation is a conventionally reinforced cast-in-place shallow ring-beam concrete foundation five feet wide by four feet depth. The floor slab is 8 inch thick reinforced concrete slab-on-grade designed to support the FLEX equipment loading.

The seismic design of the BDB Storage Building was based on the rock-based MPS Unit 3 SSE amplified to account for the location of the building relative to the SSE control point. The SSE was amplified to represent the ground motion input at the building foundation due to the soil profile at the building location, which was estimated as 40 feet deep at the time of the building design. The amplified 5% damping SSE spectrum was developed using the relationships between soil and rock ground motions and the methods described in EPRI TR-102293 (Reference 16).

The BDB Storage Building was evaluated to demonstrate adequate seismic ruggedness with respect to the MSSHI using the guidance in NEI 12-06 (Reference 1), Section H.5 Seismic Evaluation Criteria ($C_{10\%}$). The following steps were applied to evaluate the building:

1. Determine the MSSHI input motion at the BDB Storage Building foundation (amplified GMRS)
2. Determine the $C_{1\%}$ capacity of the BDB Storage Building

3. Determine the $C_{10\%}$ capacity of the building and compare to the amplified GMRS demand

The MSSHI demand at the structure foundation was determined consistent with the original design methods (based on Reference 16) relative to the GMRS control point elevation of +15 ft from Reference 3. The 37 foot deep soil profile beneath the building foundation to bedrock was used to determine soil amplification factors from Reference 16. The amplified horizontal GMRS was calculated by multiplying the horizontal control point GMRS from Reference 3 by the appropriate frequency-based amplification factors. The corresponding amplified vertical GMRS was determined from the amplified horizontal GMRS using Table 4-5 of NUREG/CR-6728 (Reference 17).

Consistent with the methods described in Section 2.4.1, the $C_{1\%}$ capacity of the building was conservatively taken as the amplified SSE demand level based on the original seismic design analysis of the BDB Storage Building described above. Based on the original design dynamic analysis, the structure fundamental response modes are at 5.5 Hz horizontal and at 9.75 Hz vertical. The amplified SSE spectral accelerations at these frequencies are 1.393g and 0.667g, respectively.

The $C_{10\%}$ capacity for the structure is based on Reference 1, Section H.5, Table H.1, for item "Structures and Major Passive Mechanical Components on Ground or Low Elevation Within Structures." The corresponding $C_{10\%}$ / $C_{1\%}$ Ratio of 1.44 was used to determine the $C_{10\%}$ capacity for the storage building.

The results of the evaluation of the BDB Storage Building are summarized below and demonstrate that the structure has adequate seismic ruggedness with respect to the MSSHI.

Fundamental Mode	Frequency	SSE Acceleration (Amplified) [$C_{1\%}$ Capacity]	$C_{10\%}$ Capacity		GMRS Acceleration (Amplified)	Conclusion
Horizontal	5.5 Hz	1.393g	2.01g	>	0.57g	Acceptable
Vertical	9.75 Hz	0.667g	0.96g	>	0.63g	Acceptable

2.4.2.2.2 NON-SEISMIC CATEGORY I STRUCTURES

As described in the FIP (Reference 11), FLEX mechanical and electrical connections, and access to the connections and other areas requiring operator action, are located in seismically designed structures / areas of the plant. These structures are considered sufficiently rugged as described in Section 2.3.

There are various non-Seismic Category I structures/equipment located along the FLEX equipment deployment haul paths, such as light poles, electrical transmission poles and towers, fencing, security towers, etc. The failure of these non-seismically designed SSCs was evaluated. As a result, the preferred haul paths minimize travel through areas with trees, power lines, narrow passages, etc., to the extent practical. The FIP includes multiple haul path routings and other pre-planned options, including assessment of de-energization of downed power lines and clearing of debris using FLEX-dedicated heavy equipment stored in the BDB Storage Building, to ensure success of FLEX strategy implementation.

Therefore, no further evaluation of non-Seismic Category I structures is necessary to support the MSA.

2.4.2.3 Operator Pathways

As described in the FIP, operator pathways to access FLEX mechanical and electrical connections, and to perform required local operator actions, do not require access through non-seismically designed structures. Operator pathways were further reviewed during a plant walkdown for the MSA, including pathways near internal masonry block walls, and no spatial interaction concerns were identified that could prevent implementation of the FLEX strategies. Additional information related to the masonry block wall review is included in Section 2.4.2.5.

2.4.2.4 Tie Down of FLEX Portable Equipment

FLEX portable equipment and associated accessories are stored in the BDB Storage Building described in Section 2.4.2.2.1. The stored portable equipment and accessories are described in the FIP. The stability of the stored equipment has been evaluated considering the MSSHI.

The stored FLEX portable equipment, including miscellaneous support equipment stored on shelving units within the BDB Storage Building, was evaluated using a static coefficient analysis. The equipment was evaluated for stability against overturning, resistance to sliding, and the potential for adverse interaction. The horizontal and vertical amplified GMRS accelerations developed as described in Section 2.4.2.2.1 were used as input to the evaluation. The vertical acceleration was increased to the peak spectral value (0.67g) for the portable equipment and shelving stability evaluations to ensure the minimum factors of safety for overturning were evaluated.

The evaluation was performed by identifying the dimensions, weight, and location of the center of gravity for each stored piece of portable equipment and for the shelving units. Each item was evaluated for overturning using a factor of safety (FS) criterion of 1.0, which is appropriate based on the low probability of a GMRS magnitude seismic event and that overturning would require significant additional energy input beyond this point to actually overturn the equipment since FS=1.0 simply indicates the point of uplift. Similarly, since the initiation of sliding results in significant energy dissipation in friction, sliding was evaluated for equipment and shelving using an FS of 1.0. For equipment or shelving that indicates an overturning FS</=1.0, factors of safety for overturning and sliding were compared to determine if sliding occurred first, thereby limiting overturning. If sliding was predicted, the potential for interaction with nearby equipment was evaluated.

The evaluation concluded that the portable equipment stored in the BDB Storage Building is stable against overturning and sliding considering the MSSHI. Storage shelving units are stable against overturning, however the potential for sliding was identified. The potential for interaction with stored equipment was evaluated and it was determined that no adverse interaction was feasible based on the minimal expected lateral displacement of the shelving units and the open floor area between shelving units and stored equipment necessary to allow for access to the equipment stored on the shelves.

2.4.2.5 ADDITIONAL SEISMIC INTERACTIONS

Seismic interactions that could potentially affect the implementation of FLEX strategies were reviewed for the MPS3 MSA. Seismic interactions that were reviewed included failure of masonry block walls near FLEX-credited equipment or operator pathways, failure of piping attached to tanks, flooding from non-seismically robust tanks, interactions to distributed systems (raceways and piping) associated with FLEX-credited equipment, and general area reviews of interactions with FLEX-credited equipment.

2.4.2.5.1 MASONRY BLOCK WALL REVIEW

The potential for failure of masonry block walls in the vicinity of FLEX-credited equipment or operator pathways was evaluated considering the MSSHI.

Seismic analyses of masonry block walls in areas housing safety-related equipment were performed considering loads from the SSE prior to initial plant operation. The analyses included walls in the vicinity of FLEX-credited equipment or operator pathways. The analyses concluded that the walls were acceptable to meet SSE demand and other applicable loading conditions.

The masonry block walls in the vicinity of FLEX-credited equipment or operator pathways were evaluated for the MSA to demonstrate adequate seismic ruggedness using the approach from Reference 1, Section H.5 as described in Section 2.4.1. The $C_{10\%}$ capacity for the walls was determined based on a $C_{10\%}$ / $C_{1\%}$ ratio of 1.36 from Reference 1, Section H.5, Table H.1, and a conservative $C_{1\%}$ capacity equal to the SSE demand. Consistent with the discussion in Section 2.4.1, the $C_{10\%}$ capacities for the walls were determined to exceed the GMRS demand, and adequate seismic ruggedness was demonstrated.

Therefore, MPS3 masonry block walls in the vicinity of FLEX-credited equipment or operator pathways are adequate considering the MSSHI.

2.4.2.5.2 <u>Review of Piping Attached to Tanks</u>

Piping attached to tanks credited for implementation of FLEX strategies was reviewed to evaluate the possibility of failures due to differential displacements. The Demineralized Water Storage Tank (DWST) and Refueling Water Storage Tank (RWST) are credited as water sources for the FLEX strategy implementation and are founded on grade in the MPS3 Yard Area. The tanks are seismically-designed for the SSE seismic loading conditions. There are no buried tanks relied upon for the implementation of MPS3 FLEX strategies.

The DWST and RWST were determined to be robustly anchored to the tank foundation such that no significant displacement of the tanks is expected. Based on the robustness of the tanks and anchorage, the tanks and attached piping would not be subject to significant differential displacement and are acceptable for the MSSHI seismic demand.

2.4.2.5.3 <u>Flooding from Non-Seismically Robust Tanks</u>

Large, non-seismically designed tanks located in the plant Yard Area were evaluated as potential sources of flooding due to seismic failure. Flooding originating from non-seismic sources within the MPS3 buildings was evaluated as described in the FIP and this evaluation remains valid for the MSSHI.

The evaluation of the potential for flooding from non-seismic sources in the Yard Area considered the flood volume from non-seismic tanks that do not include external containment systems (e.g., berms, dikes, etc.), the surface area available for flood water to disperse, and the slope of the ground in the vicinity of the tanks and plant structures. Potential impacts of flooding considered FLEX equipment staging areas in the yard and flooding of MPS3 buildings.

A conservative assessment assuming the total volume of all of the non-seismic flood sources and the yard area available for dispersion of flood liquid concluded that only a few inches of flood water would accumulate that would not inhibit FLEX strategy implementation. Realistically, only a portion of the total volume of the tanks would contribute to the flooding, and the slope of the ground surface would generally direct water away from the plant. Considering the timeline for deployment of FLEX equipment and implementation of strategies described in the FIP (Reference 11), there is more than adequate time for flood water to drain away from staging areas and plant buildings.

Therefore, flooding from non-seismic tanks would not affect implementation of MPS3 FLEX strategies considering the MSSHI.

2.4.2.5.4 INTERACTIONS TO DISTRIBUTED SYSTEMS

The potential for adverse equipment interactions to distributed systems (i.e., piping and electrical raceways) due to a MSSHI seismic event was evaluated by walkdown inspections of a sample of distributed system SSCs relied on for FLEX strategy implementation, consistent with the guidance in Reference 1, Section H.4.4.

The inspection sample included conduit and cable tray near electrical cabinets and devices credited for FLEX strategy implementation and in the general area of these components. The conduit and raceway was well supported such that displacement was limited and no potential for interaction with structure or nearby equipment was identified. Cable trays were observed to be lightly loaded. Adequate cable flexibility was observed in the inspection sample. No instances were observed where seismic excitation could interfere with the distributed system function.

The sample also included piping systems, including FLEX connections, associated with FLEX strategy implementation. The piping was well supported and displacement would be limited in a seismic event. No close-proximity structure or equipment was identified that could interact adversely with the piping.

Therefore, no credible interactions with distributed systems that would affect the implementation of FLEX strategies were identified considering the MSSHI.

2.4.2.5.5 GENERAL AREA REVIEW OF INTERACTIONS

General areas in the vicinity of a sample of FLEX equipment were also walked down to identify potential seismic interaction concerns. The review identified overhead lighting, stored mobile carts, work desks, and non-permanent / transient items in the areas. The failure of overhead lighting (bulbs, diffusers) near electrical cabinets was determined not to represent a significant interaction hazard due to its lightweight in relation to target components. The carts, desk, and transient items were stored and secured in accordance with the station seismic housekeeping program and did not constitute an interaction hazard.

Therefore, no credible seismic interactions with FLEX equipment that would affect the implementation of MPS3 FLEX strategies were identified considering the MSSHI.

2.4.2.6 HAUL PATH

The deployment of FLEX equipment from the BDB Storage Building (described in Section 2.4.2.2.1) to staging locations on the plant site requires availability of equipment haul routes / paths. MPS3 FLEX strategies include the use of primary and alternate routes / haul paths to ensure accessibility following extreme external events, including earthquakes. The haul paths are described in the FIP (Reference 11). The haul paths were evaluated for seismic induced liquefaction and interaction issues (failure of non-seismic SSCs along the haul route) and the results of the evaluation are summarized in the FIP. The conclusions of the FIP evaluation related to interactions of non-seismic SSCs impact on haul path availability remain valid for the MSSHI. The potential for liquefaction at the BDB Storage Building and along the haul paths was reevaluated considering the MSSHI to support the MSA.

As part of the geotechnical investigation for the BDB Storage Building and haul paths, two geophysical studies utilizing in-situ shear wave velocity data acquired with the multi-channel analysis of surface waves (MASW) method were performed in the area of the building and along the haul paths. For limited locations within the total area investigated in the vicinity of the building site, lenses about 7 to 8 feet below the surface were encountered in which the in-situ shear wave velocity was below approximately 600 feet per second. In haul path areas along the southern extremity of the MPS Protected Area (PA), low shear wave velocity layers were encountered at depth ranges varying from 6 feet to 13 feet, to as deep as 19 feet to 27 feet, below the surface. These subgrade layers near the BDB Storage Building and along the haul paths were considered potentially liquefiable with respect to the MSSHI ground accelerations and were further evaluated in a liquefaction study.

The study used the GMRS-equivalent PGA at the subgrade layer locations as the seismic source and determined the factor of safety (FS) against liquefaction. If the FS was equal to or less than 1.1, the study estimated the amount of potential settlement associated with the liquefied zone. Two methods were employed to estimate settlement: the first method estimates the settlement directly from the calculated FS and relative density derived with the measured shear wave velocity and the second method estimates the settlement from the calculated shear strains and relative density. The two methods provided a range of expected deformation in the ground surface, which was averaged to provide the estimated settlement.

The liquefaction study estimated that liquefaction could result in building settlements of approximately 0.1 inch, which was determined to have negligible impact on the function of the BDB Storage Building or the ability to access and remove FLEX portable equipment from the building for implementation of FLEX strategies. The study of the haul paths estimated a maximum potential settlement of the limited path area subject to liquefaction of approximately 5 inches. This was also determined to have a negligible impact on FLEX strategy implementation based on the heavy duty nature of the haul and clearing equipment available onsite and stored in the BDB Storage Building, which have significantly greater ground clearance than the potential ground surface settlements.

Therefore, MPS3 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

The FLEX mitigating strategy for maintaining the spent fuel pool (SFP) cooling function is described in the FIP (Reference 11) and consists of actions to maintain normal SFP water level to keep the stored spent fuel adequately cooled following an ELAP causing loss of the normal SFP cooling system.

The Phase 1 coping strategy is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051. The Phase 2 strategy is to initiate SFP makeup within 24 hours using a portable FLEX pump discharging through flexible hose to the FLEX SFP makeup connection located in the MPS3 Fuel Building. The strategy provides sufficient makeup water to the SFP to maintain the normal SFP level. The FLEX SFP makeup connection piping is seismically designed in accordance with the plant design basis and is protected from missiles in all directions. The SFP makeup connection piping ties into an existing SFP makeup line, which discharges directly into the SFP. Makeup water is provided from the RWST.

The SFP level instrumentation relied upon for the FLEX strategy is designed and installed to the SSE loading conditions. The instrumentation was evaluated for the MSA to demonstrate adequate seismic ruggedness using the approach from Reference 1, Section H.5 as described in Section 2.4.1. The $C_{10\%}$ capacity for the instrumentation was determined based on a $C_{10\%}$ / $C_{1\%}$ ratio of 1.36 from Reference 1, Section H.5, Table H.1, and a conservative $C_{1\%}$ capacity equal to the SSE demand. Consistent with the discussion in Section 2.4.1, the $C_{10\%}$ capacity for the instrumentation was determined to exceed the GMRS demand, and adequate seismic ruggedness was demonstrated.

The piping associated with the FLEX SFP makeup connection and makeup flowpath is inherently rugged as discussed in Section 2.3. The portable FLEX equipment relied upon for the SFP Cooling mitigating strategy is stored in the BDB Storage Building, which was evaluated considering the MSSHI and found acceptable in Sections 2.4.2.2.1 and 2.4.2.4, and is deployed along the haul paths evaluated in Section 2.4.2.6.

The spent fuel pool integrity evaluation described in Reference 12 demonstrated inherent margins of the spent fuel pool structure and interfacing plant equipment above the SSE to a peak spectral acceleration of 0.8g, which exceeds the MSSHI (GMRS) peak spectral acceleration of 0.42g (Reference 3).

Therefore, the MPS3 FLEX mitigating strategy to provide SFP cooling has been evaluated considering the MSSHI and demonstrated to be acceptable.

4.0 HIGH FREQUENCY REVIEW

The MPS3 MSSHI (GMRS) includes accelerations that exceed the SSE spectrum in the high frequency (i.e., greater than 10Hz) range as described in Reference 3. As described in NEI 12-06 (Reference 1), Section H.4.4, an evaluation of high frequency (HF) sensitive equipment relied on for FLEX strategy implementation is to be conducted for the MSA in accordance with the methodology in Reference 1, Section H.4.2.

In accordance with Reference 1, Section H.4.2, the HF evaluation is to be performed using the methods described in EPRI 3002004396 (Reference 6), Sections 3 and 4. The HF evaluation scope includes contact control devices subject to intermittent states (e.g., relays and contactors that could chatter) in seal-in and lockout circuits for plant equipment relied on for Phase 1 FLEX strategy implementation (and permanently installed FLEX Phase 2 equipment with automatic start capability for which there are none relied on for MPS3 FLEX strategies). Per Reference 1, Section H.4.2, the evaluation focus is on the following systems and equipment:

- *Relays and contactors whose chatter could cause malfunction of a reactor SCRAM.*
- *Relays and contactors in seal-in or lockout circuits whose chatter could cause a reactor coolant system (RCS) leakage pathway that was not considered in the FLEX strategies.*
- *Relays and contactors that may lead to circuit seal-ins or lockouts that could impede the Phase 1 FLEX capabilities, including buses fed by station batteries through inverters.*
- *Relays and contactors that may lead to circuit seal-ins or lockouts 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.* [None for MPS3]

MPS3 performed a HF sensitive equipment evaluation in accordance with the guidance in Reference 6 to support the response to NRC 10CFR50.54(f) Request for Information letter (Reference 18) for NTTF Recommendation 2.1: Seismic and provided the results in Reference 5. The HF review documented in Reference 5 envelops the scope of the HF evaluation required for the MSA and was performed using the GMRS seismic demand. The HF sensitive components evaluated for the MSA that could result in control circuit seal-in or lockout for equipment relied on in the FLEX strategies are provided in Table 4.0-1: High Frequency Evaluation for Mitigating Strategies Assessment along with the results of the HF evaluation for these components from Reference 5. Details of the methods and criteria used are described in Reference 5.

As indicated in Table 4.0-1, the HF sensitive components evaluated were found to have adequate capacity against high frequency effects when considering the MSSHI seismic demand. Therefore, no adverse effects on MPS3 FLEX strategy implementation were identified due to HF seismic ground motions associated with the MSSHI.

Table 4.0-1: High Frequency Evaluation for Mitigating Strategies Assessment

High-frequency Review Equipment List								Seismic Demand [3]		Seismic Capacity [3]			
Item No.	Equipment ID	Equipment Description	Key Safety Function	Relay ID(s)	Cabinet Type	Bldg	Elev	$ICRS_{cH}$	$ICRS_{cV}$	Relay Mfg. & Model	Seismic Capacity Source Document	TRS	Evaluation Result
1	3MSS*MOV17A (V12)	TDAFW STEAM SUPPLY VALVE FROM S/G A MOV	CORE COOLING	42C	MCC	ESF BLDG.	36'-6"	0.886	0.677	[2]	EPRI NP-5223-SLR1, GERS-MCC.9	1.200	Capacity meets or exceeds demand
2	3MSS*MOV17B (V37)	TDAFW STEAM SUPPLY VALVE FROM S/G B MOV	CORE COOLING	42C	MCC	ESF BLDG.	36'-6"	0.886	0.677	[2]	EPRI NP-5223-SLR1, GERS-MCC.9	1.200	Capacity meets or exceeds demand
3	3MSS*MOV17D (V38)	TDAFW STEAM SUPPLY VALVE FROM S/G D MOV	CORE COOLING	42C	MCC	ESF BLDG.	36'-6"	0.886	0.677	[2]	EPRI NP-5223-SLR1, GERS-MCC.9	1.200	Capacity meets or exceeds demand
4	3MSS*MSV5	TURBINE DRIVEN AUXILIARY FEEDWATER PUMP - TURBINE ISOLATION VALVE (INCLUSIVE OF TURBINE OVERSPEED TRIP SOLENOID 3FWL*SOV104 SOV)	CORE COOLING	1CON	Control Cabinet	ESF BLDG.	21'-6"	3.987	2.820	N/A	[1]	[1]	Capacity meets or exceeds demand [1]
5	3MSS*MSV5	TURBINE DRIVEN AUXILIARY FEEDWATER PUMP - TURBINE ISOLATION VALVE (INCLUSIVE OF TURBINE OVERSPEED TRIP SOLENOID 3FWL*SOV104 SOV)	CORE COOLING	3CR	Control Cabinet	ESF BLDG.	21'-6"	3.987	2.820	GE CR120BD03041	EPRI NP-7147-SL, GERS-RLY-AI1.4 (increased by EPRI TR-105988-V2 [SQURTS], Table 3-1)	5.667	Capacity meets or exceeds demand
6	3MSS*MSV5	TURBINE DRIVEN AUXILIARY FEEDWATER PUMP - TURBINE ISOLATION VALVE (INCLUSIVE OF TURBINE OVERSPEED TRIP SOLENOID 3FWL*SOV104 SOV)	CORE COOLING	K2	Control Cabinet	ESF BLDG.	21'-6"	3.987	2.820	N/A	[1]	[1]	Capacity meets or exceeds demand [1]
7	3MSS*PV20A (V48)	S/G A MAIN STEAM PRESSURE RELIEVING VALVE	CORE COOLING	PSCB/K627 (SLI)	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-4076 (LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3 (increased by EPRI TR-105988-V2 [SQURTS], Table 3-1)	9.533	Capacity meets or exceeds demand
8	3MSS*PV20B (V55)	S/G B MAIN STEAM PRESSURE RELIEVING VALVE	CORE COOLING	PSCA/K627 (SLI)	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-4076 (LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3 (increased by EPRI TR-105988-V2 [SQURTS], Table 3-1)	9.533	Capacity meets or exceeds demand
9	3MSS*PV20C (V62)	S/G C MAIN STEAM PRESSURE RELIEVING VALVE	CORE COOLING	PSCB/K627 (SLI)	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-4076 (LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3 (increased by EPRI TR-105988-V2 [SQURTS], Table 3-1)	9.533	Capacity meets or exceeds demand
10	3MSS*PV20D (V69)	S/G D MAIN STEAM PRESSURE RELIEVING VALVE	CORE COOLING	PSCA/K627 (SLI)	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-4076 (LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3 (increased by EPRI TR-105988-V2 [SQURTS], Table 3-1)	9.533	Capacity meets or exceeds demand
11	3RCS*PCV455A (V168)	PRESSURE OPERATED RELIEF VALVE SOV	RCS INVENTORY CONTROL	PSCA1/K628	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-134-1 (NON-LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3	6.667	Capacity meets or exceeds demand

Table 4.0-1: High Frequency Evaluation for Mitigating Strategies Assessment

High-frequency Review Equipment List								Seismic Demand [3]		Seismic Capacity [3]			
Item No.	Equipment ID	Equipment Description	Key Safety Function	Relay ID(s)	Cabinet Type	Bldg	Elev	$ICRS_{cH}$	$ICRS_{cV}$	Relay Mfg. & Model	Seismic Capacity Source Document	TRS	Evaluation Result
12	3RCS*PCV455A (V168)	PRESSURE OPERATED RELIEF VALVE SOV	RCS INVENTORY CONTROL	PSCA2/K743	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-134-1 (NON-LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3	6.667	Capacity meets or exceeds demand
13	3RCS*PCV456 (V170)	PRESSURE OPERATED RELIEF VALVE SOV	RCS INVENTORY CONTROL	PSCB1/K628	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-134-1 (NON-LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3	6.667	Capacity meets or exceeds demand
14	3RCS*PCV456 (V170)	PRESSURE OPERATED RELIEF VALVE SOV	RCS INVENTORY CONTROL	PSCB2/K743	Control Cabinet	CNTL BLDG	47'-6"	3.987	2.491	POTTER & BRUMFIELD MDR-134-1 (NON-LATCHING)	EPRI NP-7147-SL, GERS-RLY-ARR.3	6.667	Capacity meets or exceeds demand
15	3VBA*INV1	120VAC VITAL INVERTER INV-1	AC/DC POWER AND SUPPORT SYSTEMS	Static Switch Relays	Control Cabinet	CNTL BLDG	4'-6"	0.506	0.309	AMETEK Solidstate Controls Model 85-VC0250-29	[1]	[1]	Capacity meets or exceeds demand [1]
16	3VBA*INV2	120VAC VITAL INVERTER INV-2	AC/DC POWER AND SUPPORT SYSTEMS	Static Switch Relays	Control Cabinet	CNTL BLDG	4'-6"	0.506	0.309	AMETEK Solidstate Controls Model 85-VC0250-29	[1]	[1]	Capacity meets or exceeds demand [1]
17	3VBA*INV3	120VAC VITAL INVERTER INV-3	AC/DC POWER AND SUPPORT SYSTEMS	Static Switch Relays	Control Cabinet	CNTL BLDG	4'-6"	0.506	0.309	AMETEK Solidstate Controls Model 85-VC0250-29	[1]	[1]	Capacity meets or exceeds demand [1]
18	3VBA*INV4	120VAC VITAL INVERTER INV-4	AC/DC POWER AND SUPPORT SYSTEMS	Static Switch Relays	Control Cabinet	CNTL BLDG	4'-6"	0.506	0.309	AMETEK Solidstate Controls Model 85-VC0250-29	[1]	[1]	Capacity meets or exceeds demand [1]

Notes:

1. Acceptable margin to contact chatter is based on the MPS3 design basis seismic qualification of components as described in Reference 5.
2. Capacity data for starter/contactors from EPRI NP-5223-SLR1, GERS-MCC.9 is not model-specific.
3. Details of the methods and criteria used, and definitions of terms, are provided in Reference 5.

5.0 CONCLUSION

The FLEX strategies for MPS3 as described in the FIP are acceptable as specified and no further seismic evaluations are necessary.

6.0 REFERENCES

1. NEI 12-06, Revision 4, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, December 2016.
2. JLD-ISG-2012-01, Revision 2, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events.
3. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – Seismic Hazard and Screening Report (CEUS Sites) for Recommendation 2.1," dated March 31, 2014. [ML14092A417]
4. NRC letter, "Millstone Power Station, Units 2 and 3 – 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 (TAC Nos. MF3968 and MF3969)," dated December 15, 2015.
5. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – High Frequency Equipment Functional Confirmation for Recommendation 2.1," dated December 22, 2016. [ML16365A036]
6. EPRI, "High Frequency Program Application Guidance for Functional Confirmation and Fragility Evaluation," Report Number 3002004396, Palo Alto, CA, July, 2015.
7. 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.
8. 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.
9. 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.
10. EPRI, "A Methodology for Assessment of Nuclear Plant Seismic Margin," Report Number NP-6041-SL, Revision 1, Palo Alto, CA, August, 1991 with October, 2015 errata.
11. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Unit 3, Compliance Letter and Final Integrated Plan in Response to the March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-

Design-Basis External Events (Order Number EA-12-049)," dated June 23, 2015. [ML15182A012]

12. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – Spent Fuel Pool Seismic Evaluation for Recommendation 2.1," dated December 21, 2016. [ML16365A032]
13. Dominion Nuclear Connecticut, Inc. letter, "Millstone Power Station Units 2 and 3, Response to March 12, 2012 Information Request – Supplemental Information Related to the Seismic Hazard and Screening Report for Recommendation 2.1," dated July 21, 2014. [ML14204A619]
14. NRC letter, "NRC Response to Licensees Regarding Notification of Regulatory Commitments Change Associated with Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident", dated December 15, 2014.
15. Millstone Power Station Unit 3 Final Safety Analysis Report
16. EPRI, "Guidelines for Determining Design Basis Ground Motions," Report Number TR-102293, Volume 1, Palo Alto, CA, November, 1993.
17. NUREG/CR-6728, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines", October 2001.
18. 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.