Exelon Generation

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Limerick Generating Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Subject: Mitigating Strategies Assessment (MSA) Report for the Reevaluated Seismic Hazard Information – NEI 12-06, Appendix H, Revision 2, H.4.2 Path 2: GMRS < 2xSSE with High Frequency Exceedances

References:

1. NEI 12-06, Revision 2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, December 2015 (ML16005A625)
2. JLD-ISG-2012-01, Revision 1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, January 22, 2016 (ML15357A163)
3. Exelon Generation Company, LLC Letter to USNRC, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident – 1.5 Year Response for CEUS Sites, dated September 12, 2013 (ML13256A070)
4. Exelon Generation Company, LLC Letter to USNRC, Limerick Generating Station, Units 1 and 2 - Seismic Hazard and Screening Report (Central and Eastern United States (CEUS) Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 31, 2014 (ML14090A236)
5. NRC Letter to Exelon Generation Company, LLC, Limerick Generating Station, Units 1 and 2 – 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. MF3864 and MF3865), dated November 6, 2015 (ML15296A492)

6. Exelon Generation Company, LLC Letter to USNRC, Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2013 (RS-13-022) (ML13060A127)

The purpose of this letter is to provide the results of the assessment for Limerick Generating Station, Units 1 and 2 to demonstrate that the FLEX Mitigating Strategies developed, implemented and maintained in accordance with NRC Order EA-12-049, can be implemented considering the impacts of the reevaluated seismic hazard. The assessment was performed in accordance with the guidance provided in Appendix H of NEI 12-06, Revision 2 (Reference 1) which was endorsed by the NRC (Reference 2). The Limerick Generating Station, Units 1 and 2 FLEX Mitigating Strategies are described in Reference 6 and subsequent FLEX Mitigating Strategies Order 6-month update reports.

The Mitigating Strategies Seismic Hazard Information (MSSHI) is the licensee's reevaluated seismic hazard information at Limerick Generating Station, Units 1 and 2, developed using a Probabilistic Seismic Hazard Analysis (PSHA). The MSSHI includes a performance-based Ground Motion Response Spectrum (GMRS), Uniform Hazard Response Spectra (UHRS) at various annual probabilities of exceedance, and a family of seismic hazard curves at various frequencies and fractiles developed at the site control point elevation. Limerick Generating Station, Units 1 and 2 submitted the reevaluated seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC in References 3 and 4. The NRC staff concluded that the GMRS that was submitted adequately characterizes the reevaluated seismic hazard for the site (Reference 5).

Consistent with Section H.4.2 of Reference 1 and Reference 4, the Limerick Generating Station, Units 1 and 2 GMRS is bounded by the Safe Shutdown Earthquake (SSE) except at frequencies greater than 10Hz. Therefore, an evaluation was performed for equipment required to implement the Mitigation Strategies that may be sensitive to high frequency ground motions.

Based upon the Mitigating Strategies assessment provided in the enclosure to this letter, the mitigating strategies for Limerick Generating Station, Units 1 and 2 can be implemented as designed when considering the impacts of the reevaluated seismic hazard.

This letter contains no new regulatory commitments and no revision to existing regulatory commitments.

If you have any questions regarding this submittal, please contact Ron Gaston at (630) 657-3359.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 1st day of December 2016.

Respectfully submitted,

James Barstow
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure: Seismic Mitigating Strategies Assessment Report for Limerick Generating Station, Units 1 and 2

cc: NRC Regional Administrator - Region I
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Enclosure

Seismic Mitigating Strategies Assessment Report for Limerick Generating Station, Units 1 and 2

(20 pages)

SEISMIC MITIGATING STRATEGIES ASSESSMENT REPORT

IN RESPONSE TO REGULATORY GUIDE JLD-ISG-2012-01

for the

LIMERICK GENERATING STATION, UNITS 1 AND 2

3146 Sanatoga Rd, Pottstown, PA 19464
Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353
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Project Name: Limerick, Unit 1 and 2 High Frequency Confirmation
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Client: Exelon

This document has been prepared under the guidance of the S&A Quality Assurance Program Manual, Revision 18 and project requirements:

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Originated by: F. Ganatra [signature]	Date: 10/27/2016
Checked by: M. Delaney [signature]	Date: 10/27/2016
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ATTACHMENT

Exelon Generation Company, LLC (Exelon)

Limerick Generating Station, Units 1 & 2

NRC Docket Nos. 50-352 and 50-353

Facility Operating License Nos. NPF-39 and NPF-85

Seismic Mitigating Strategies Assessment for Limerick

1 INTRODUCTION

1.1 BACKGROUND

Limerick Generating Station, Units 1 and 2 (LIM) has completed a Mitigating Strategies Assessment (MSA) of the impacts of the reevaluated seismic hazard to determine if the mitigating (FLEX) strategies developed, implemented and maintained in accordance with NRC Order EA-12-049 can be implemented considering the impacts of the reevaluated seismic hazard. The MSA was performed in accordance with the guidance provided in Appendix H of NEI 12-06 Revision 2 [1] which was endorsed by the NRC [2]. The LIM FLEX Mitigating Strategies are described in Reference [3].

LIM submitted a reevaluated seismic hazard to the NRC [5]. By letter dated October 27, 2015 [6], the NRC transmitted the results of the screening and prioritization review of the seismic hazards reevaluation. Per the results of Reference [5] and Reference [6], the LIM GMRS exceeds the SSE only at frequencies greater than 10 Hz; therefore, the site falls under the guidance of Reference [1], Appendix H, Section H.4.2 (i.e., Path 2), which requires that high frequency sensitive plant equipment associated with the LIM mitigating strategies; namely, electrical contact devices, be evaluated for effects of the Mitigating Strategies Seismic Hazard Information (MSSHI).

This report describes the Mitigation Strategies Assessment undertaken for LIM, implemented using the methodologies in NEI 12-06 [1], Appendix H, which in turn specifies the methodologies from EPRI 3002004396, "High Frequency Program, Application Guidance for Functional Confirmation and Fragility Evaluation." [7]

The objective of this report is to provide summary information describing the assessment for LIM to demonstrate that the FLEX strategies developed, implemented and maintained in accordance with NRC Order EA-12-049 [8] can be implemented considering the impacts of the reevaluated seismic hazard. The plant equipment relied on for FLEX strategies that was specified in References [3, 3.1 – 3.7], have previously been evaluated as seismically robust to the SSE levels. The level of detail provided in the report is intended to enable NRC to understand the inputs used, the basis for the scope selection, the evaluations performed, and the decisions made as a result of the evaluations.

1.2 Approach

NEI 12-06 [1], Appendix H Section H.4.2 refers to EPRI 3002004396 [7] for the high-frequency contact device analysis approach. Reference [7] is the primary guidance document used for the LIM engineering evaluations described in this report. Acceptance criteria for the evaluations are found in Reference [1], Appendix H, Section H.5. In accordance with References [7] and [1], the following topics are addressed in the subsequent sections of this report:

- LIM SSE and GMRS/MMSHI Information
- Selection of components and a list of specific components for high-frequency confirmation
- Estimation of seismic demand for subject components
- Estimation of seismic capacity for subject components
- Summary of subject components' high-frequency evaluations
- Summary of Results

1.3 Plant Screening

The Mitigating Strategies Seismic Hazard Information (MSSHI) is the licensee's reevaluated seismic hazard information at LIM, developed using 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 LIM control point elevation. LIM submitted the reevaluated seismic hazard information including the UHRS, GMRS and the hazard curves to the NRC on March 31, 2014 [5]. The LIM Seismic Hazard and Screening NRC Staff Assessment Report confirmed the Limerick, Units 1 & 2 Seismic Hazard Reevaluation on November 6, 2015 [9]. The NRC summarized their screening evaluations in Letter to the Power Reactor Licensees on the Enclosed List. "Final Determination of Licensee Seismic Probabilistic Risk Assessments Under the Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 2.1 "Seismic" of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident" [6].

1.4 Report Documentation

Section 2 describes the selection of devices. The identified devices are evaluated in Reference [21] for the seismic demand specified in Section 3 using the evaluation criteria discussed in Section 4. The overall conclusion is discussed in Section 5.

Table A-1 lists the devices identified in Section 2 and provides the results of the evaluations performed in accordance with Section 3 and Section 4.

2 SELECTION OF COMPONENTS

The fundamental objective of the MSA evaluation is to determine whether the FLEX/mitigating strategies developed, implemented and maintained in accordance with NRC Order EA-12-049 [8] can be implemented considering the impacts of the reevaluated seismic hazard. Within the applicable functions identified in Section H.4.2 (Path 2) [1], the components that require a high frequency evaluation are contact control devices subject to intermittent states in seal-in or lockout (SILO) circuits. Plants in Path 2 are required to evaluate SILO devices in the control systems of four specific categories: (1) Reactor Trip/Scram, (2) Reactor Vessel Coolant Inventory leakage pathways, (3) FLEX Phase 1 Components, and (4) Automatically Operated FLEX Phase 2 Components evaluated to ensure their functions perform as necessary for the FLEX/mitigating strategies. The equipment selection process for each of those categories is described below.

2.1 REACTOR TRIP/SCRAM

Section H.4.2 of NEI 12-06 Appendix H [1] identifies the Reactor Trip/SCRAM function as a function to be considered in the high frequency evaluation. The EPRI guidance for High Frequency Confirmation [7] notes that "the design requirements preclude the application of seal-in or lockout circuits that prevent reactor trip/SCRAM functions" and that "No high-frequency review of the reactor trip/SCRAM systems is necessary." Therefore, no additional evaluations are necessary for the reactor trip/SCRAM function.

2.2 REACTOR VESSEL INVENTORY CONTROL

This category of components is shared between NEI 12-06 Appendix H [1] and EPRI 3002004396 [7]. The concern for both these programs is the actuation of valves that have the potential to cause a loss-of-coolant accident (LOCA). A LOCA following a seismic event could provide a challenge to the mitigation strategies and lead to core damage. Control circuits for the Safety Relief Valves (SRV) as well as other Reactor Coolant System (RCS) valves listed in Attachment 9.3 of Ref. [16] were analyzed. In this case, the "undesirable state" criterion for selection of devices was any device that could lead to a listed valve opening and remaining open after the period of strong shaking. Loss of AC power is a basic premise of NEI 12-06, thus control devices for AC-powered valves are not included in the NEI 12-06 Appendix H selection. No devices in this category met all criteria for selection. The valves covered in this category are a subset of those covered in the RCS/Reactor Vessel Inventory Control category of EPRI 3002004396 and for that reason specific discussion of the selection of devices for this category is contained in Section 6.2 of Ref. [16].

2.3 FLEX PHASE 1

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

FLEX Strategies specific to a seismic event response or common to all external event responses were examined to identify flow paths, electrical distribution and instrumentation relied upon to accomplish the reactor and containment safety functions identified in NEI 12-06 [1], omitting response strategies only valid in an outage. The selected equipment is a subset of equipment relied upon to establish the credited flow paths, electrical distribution, and instrumentation identified in the FLEX responses examined. Permanent plant equipment required for implementation of Phase 1 of the FLEX Strategy was identified by reviewing the FLEX Strategy, FLEX support documents, and associated flow path Piping and Instrumentation Diagrams (P&IDs), instrument elementary diagrams, and electrical distribution one-line diagrams.

The following key functions were reviewed:

- Piping Flow Paths
- Equipment/Room Cooling
- Key Parameter Instrumentation
- Diesel Fuel Oil Supply
- Instrument Air Distribution
- Electrical Power Distribution
- Control Systems

Piping Flow Paths

Once the FLEX Strategy and FLEX support documents (flow diagrams) were reviewed, P&IDs were examined to identify the primary Phase 1 flow paths credited for seismic response and pressure boundaries necessary to establish those flow paths. In accordance with NEI 12-06, not all success paths need to be evaluated for all hazards; therefore, only a single success path needs to be reviewed for cooling or make-up functions. All components within these identified flow paths and pressure boundaries were screened utilizing the evaluation guidance [7] to exclude components having the following criteria:

- Non-power operated valves (manual valves, check valves, rupture disks) excluding pressure relief valves and manual valves with reach-rods
- Power operated valves, pressure relief valves, and manual valves with reach rods not required to change state to establish identified flow paths
- Sub-components mounted within equipment already included on the list
- In-line pipe-supported components
- Pumps and small heat exchangers within piping pressure boundaries but not in the flow path
- Instrumentation not relied upon for the FLEX response
- Components expected to operate during the initial reactor transient (as described in NEI 12-06, Section 3.2.1.4 [1])
- Containment isolation valves not required to change state following the initial containment isolation action (as described in NEI 12-06, Section 3.2.1.11 [1])

The remaining components not screened out are included in the equipment list. Of these components, pumps needed to operate, power-operated valves needed to change state to establish the identified flow paths and pressure boundaries, as well as instruments that are essential to FLEX Strategy within these paths were singled out for identification of necessary motive and control sources.

For the Phase 1 FLEX response, Limerick credits their steam turbine-driven Reactor Core Isolation Cooling (RCIC) Pump to provide core decay-heat cooling. For this effort, the flow paths credited include: (1) Steam from the reactor pressure vessel to the RCIC turbine and exhausted to the suppression pool; (2) Coolant from the suppression pool to the reactor via the RCIC pump; and (3) Steam from the reactor pressure vessel vented to the suppression pool via the Safety Relief Valves (SRVs).

Equipment/Room Cooling

Cooling for rooms is normally provided by AC power, and thus components associated with fans, dampers, compressors or other systems relied upon to provide ventilation or cooling to these rooms were not considered as these would not be Phase 1 systems.

Key Parameter Instrumentation

Instruments identified to monitor parameters critical to control of elements of the Phase 1 FLEX Strategy are included in the equipment list. For each of the included instruments, flow diagrams were reviewed as applicable to confirm the transmitter is within an established FLEX flow path. Elementary diagrams were reviewed to establish the signal path between the instrument transmitter and the credited indicator. The transmitter, indicator and any signal conditioning components, as well as power supplies used to power all the components necessary to the signal path were identified. For each of these items either the component itself or the instrumentation cabinet containing it (per rule-of-the-box (ROB)) was included in the equipment list.

Diesel Fuel Oil Supply

Diesel Fuel Oil is not necessary for Limerick's Phase 1 response and is thus not considered for the Phase 1.

Instrument Air Distribution

Instrument air P&IDs were reviewed along with the OIP and FLEX Support Guides to determine if any tanks, accumulators, pressure regulating valves, or any power operated valves are required to provide Instrument Air (IA) to air-operated valves necessary to establish FLEX Phase 1 flow paths. In general, normal instrument air (IA) is non-safety related. Any valves credited to establish Limerick's FLEX Phase 1 flow paths which use normal instrument air as a motive source either fail to their required state or will be manually overridden. Air-operated valves which rely on pneumatic pressure for motive force and are required to operate to support the FLEX mitigation strategy have backup accumulators and associated control valves which are on the Phase 1 equipment list. These instrument gas control valves are mechanically operated from air pressure and thus no electrical relays or switches are needed to provide the air supply required for any valve.

Electrical Power Distribution

The Phase 1 response relies on station batteries for electrical power (motive force), one-line drawings were reviewed and the batteries, inverters, and electrical distribution between the batteries and the required DC Panels and vital instrumentation power supplies were included on the equipment list.

Control Systems

For every FLEX Phase 1 item on the equipment list requiring control, the associated control diagrams were reviewed and the control cabinets or panels critical to the item's control were included on the equipment list. Power sources for the required control circuits were traced and any power distribution component necessary for the control circuits (and not already identified) was added as well. Relay control logic was analyzed and relays or switches that could cause seal-in or lockout and leave the circuit in a state other than what would be desired for FLEX response were identified and added to the equipment list. The criteria for determining if a component needed to be evaluated are provided below. A component must meet all three of the following criteria to be selected.

(Criterion 1)

The Phase 1 FLEX Strategy for Limerick, as described in the Overall Integrated Plan [3] and its updates [3.1 through 3.7], relies on permanent plant equipment in the steam turbine-driven RCIC and SRV systems. Control elementary diagrams, piping and instrumentation diagrams, and system technical manuals were reviewed as necessary to determine which relays and switches have an impact on the operation of these systems. Any impact to AC powered valves in these systems was ignored as loss of AC power is a requirement for entry into FLEX.

(Criterion 2)

Before entry into FLEX a site must first (in this case) experience a beyond design-basis seismic event coupled with an Extended Loss of AC Power (ELAP) and Loss of Ultimate Heat Sink (LUHS). In this event scenario the site would need time to assess plant conditions before it would declare itself in an ELAP/LUHS condition. By the time this condition is declared it is expected the period of strong shaking would be over and thus any temporary effect of relay chatter would be cleared before entry into FLEX. In some control circuits, however, contacts are fed back into the control to electrically seal-in and cause a sustained change of state in the control circuit. This circuit seal-in may cause valves to change position, pumps to change state, or controls to lock-out operation of systems or components. Control elementary diagrams, piping and instrumentation diagrams, and system technical manuals were reviewed as necessary to determine the potential of chatter (in the relays and switches identified by Criterion 1) to cause a seal-in or lock-out. Only those relays and switches with the potential to cause seal-in or lock-out were screened-in for evaluation, relays and switches with only the potential to cause temporary conditions that clear on their own before entry into FLEX were screened out.

(Criterion 3)

In some cases, spurious chatter leads to a circuit seal-in or lock-out that either has no effect on the FLEX Response, or has a beneficial effect on the FLEX Response (for example the unintentional change of state in a valve that aids in aligning a credited flow path). Contact chatter having no system effect or beneficial system effects allow a relay or switch to be functionally screened out of consideration for this category. Control elementary diagrams, piping and instrumentation diagrams, and system technical manuals were reviewed as necessary to determine the potential impact of chatter (in the relays and switches identified by Criterion 2) on the operation of the Phase 1 systems. Only those relays and switches which could cause an undesirable effect on these systems were screened-in.

The selection of contact devices for the Safety Relief Valves (SRVs) overlaps with the RCS/Reactor Vessel Inventory Control Category. Refer to Section 6.2.1 of Ref. [16] for more information on the analysis of contact devices for these valves.

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

The largest vulnerability to RCIC operation following a seismic event is contact chatter leading to a false RCIC Isolation Signal or false Turbine Trip. A false steam line break trip has the potential to delay RCIC operation while confirmatory inspections are being made. Chatter in the contacts of RCIC Isolation Signal Relay E51A-K31A or Steam Line High Differential Pressure Time Delay Relay E51A-K15A; or coincident chatter in the Turbine Exhaust Diaphragm High Pressure Relays E51A-K11A and E51A-K12A, or Reactor Pressure Relays E51A-K16A and E51A-K17A; may lead to a RCIC Isolation Signal and seal-in of E51A-K31A [17]. This would cause the RCIC Isolation Valves to close and the RCIC Trip and Throttle Valve to trip. Similar chatter in the contact devices that drive those relays could also lead to seal-in: PIS-050-1N655A, PIS-050-1N655E, PIS-049-1N658A, and PIS-049-1N658E [18]. (The three-second time delay associated with E51A-K15A will mask any chatter on PDIS-049-1N657A and PDS-049-1N660A, so they are excluded.) The same rationale applies to the identical Division 3 devices: E51A-K31C, E51A-K15C, E51A-K11C, E51A-K12C, E51A-K16C, E51A-K17C, PIS-050-1N655C, PIS-050-1N655G, PIS-049-1N658C, and PIS-049-1N658G [19, 20].

Any chatter that may lead to the energization of the Trip and Throttle Valve Remote Trip Circuit is considered as SILO as it will close the valve and require a manual reset prior to restoration of the RCIC system. Chatter in Turbine Trip Auxiliary Relay E51A-K28, or in the devices which control this relay; the Turbine Exhaust High Pressure Relays E51A-K13 and E51A-K14, the Pump Suction Low Pressure Relay E51A-K10, and the Isolation Signal Relays E51A-K30A, and E51A-K67C [17]. Similar chatter in the contact devices that drive those relays (and not already covered in the RCIC Isolation Signal analysis) could also lead to a turbine trip: E51A-K30C, PIS-050-1N653, PIS-050-1N656A, and PIS-050-1N656E [18, 19].

Refer to Attachments 9.1 (Unit 1) and 9.2 (Unit 2) of Ref. [16] for Limerick's Phase 1 specific ESEL. The contact devices selected as part of this effort appear in Table 7-1 of Ref. [16].

2.4 FLEX Phase 2 Automatic Operation

NEI 12-06 Appendix H [1] requires the inclusion of SILO relays and contactors that could impede FLEX capabilities for mitigation of seismic events in permanently installed Phase 2 SSCs that have the capability to begin operation without operator manual actions. With the loss of AC power, the Phase 2 SSCs would be limited to any permanently installed FLEX generator and, if allowed to automatically start, any electrical components powered by the FLEX generator and relied upon for Phase 2 of the FLEX Strategy. Limerick credits a portable FLEX generator for their Phase 2 response, and the operator action to install and connect that generator eliminates any devices from being identified in this category.

2.5 Summary of Selected Components

The investigation of high-frequency contact devices as described above was performed in Ref. [16]. A list of the contact devices requiring a high frequency evaluation is provided in Appendix A, Table A-1. The identified devices are evaluated in Ref. [21] per the methodology/description of Section 3 and 4. Results are presented in Section 5 and Table A-1.

3 SEISMIC EVALUATION

3.1 HORIZONTAL SEISMIC DEMAND

LIM performed a High Frequency Confirmation using the criteria in Reference [7], which is the same criteria specified for the MSA Path 2 evaluation [1]. The horizontal ground motion applicable to the MSA Path 2 evaluation is the same horizontal ground motion identified in LIM submittal [10].

3.2 VERTICAL SEISMIC DEMAND

LIM performed a High Frequency Confirmation using the criteria in Reference [7], which is the same criteria specified for the MSA Path 2 evaluation [1]. The vertical ground motion applicable to the MSA Path 2 evaluation is the same vertical ground motion identified in LIM submittal [10].

3.3 COMPONENT HORIZONTAL SEISMIC DEMAND

The components identified in Section 2 are the same components previously evaluated in the LIM High Frequency Confirmation [10]. Therefore, the component horizontal seismic demands for the MSA are the same as the demands applied in the High Frequency Confirmation.

3.4 COMPONENT VERTICAL SEISMIC DEMAND

The components identified in Section 2 are the same components previously evaluated in the LIM High Frequency Confirmation [10]. Therefore, the component vertical seismic demands for the MSA are the same as the demands applied in the High Frequency Confirmation.

4 CONTACT DEVICES EVALUATION

Per Reference [7], seismic capacities (the highest seismic test level reached by the contact device without chatter or other malfunction) of each subject contact device are determined by the following procedures:

(1) If a contact device was tested as part of the EPRI High Frequency Testing program [11], then the component seismic capacity from this program is used.

(2) If a contact device was not tested as part of Reference [11], then one or more of the following means to determine the component capacity were used:

  (a) Device-specific seismic test reports (either from the station or from the Seismic Qualification Reporting and Testing Standardization (SQURTS) testing program).

  (b) Generic Equipment Ruggedness Spectra (GERS) capacities per References [12, 13, 14, 15].

  (c) Assembly (e.g. electrical cabinet) tests where the component functional performance was monitored.

The high-frequency capacity of each device was evaluated with the component mounting point demand from Section 3 using the criteria in Section 4.5 of Reference [7] and the acceptance criteria in Section H.5 of [1].

A summary of the high-frequency evaluation results is provided in Appendix A, Table A-1 of this report.

5 Conclusions

5.1 General Conclusions

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

5.2 Identification of Follow-up Actions

No follow-up actions were identified.

6 References

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

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

3. Limerick (M. Jesse) Letter to NRC. "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." February 28, 2013, ADAMS Accession Number ML13060A127

   3.1. Limerick (J. Barstow) Letter to NRC. "First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." August 28, 2013, ADAMS Accession Number ML13240A266

   3.2. Limerick (D. Helker) Letter to NRC. "Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." February 28, 2014, ADAMS Accession Number ML14059A219

   3.3. Limerick (J. Barstow) Letter to NRC. "Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." August 28, 2014, ADAMS Accession Number ML14241A285

   3.4. Limerick (J. Barstow) Letter to NRC. "Fourth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." February 27, 2015, ADAMS Accession Number ML15058A261

   3.5. Limerick (J. Barstow) Letter to NRC. "Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." August 28, 2015, ADAMS Accession Number ML15243A081

   3.6. Limerick (D. Helker) Letter to NRC. "Sixth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." February 26, 2016, ADAMS Accession Number ML16057A006

3.7. Limerick (J. Barstow) Letter to NRC. "Seventh Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)." August 26, 2016, ADAMS Accession Number ML16239A033

4. Not Used

5. Limerick (J. Barstow) Letter to NRC. "Exelon Generation Company, LLC, Seismic Hazard and Screening Report (Central and Eastern United States (CEUS) Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insight from the Fukushima Dai-ichi Accident." March 31, 2014, ADAMS Accession Number ML14090A236

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

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

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

9. NRC (F. Vega) Letter to Exelon Generation Company, LLC (B. Hanson). "Limerick Generating Station, Unit 1 and 2 – 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 NO. MF3864 and MF3865)." November 6, 2015, ADAMS Accession Number ML15296A492

10. 15C4345-RPT-002, Rev. 0, "High Frequency Confirmation Report for Limerick Generating Station, Unit 1 and 2 in Response to Near Term Task Force (NTTF) 2.1 Recommendation"

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

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

13. EPRI NP-7147-SLV2, Addendum 1, "Seismic Ruggedness of Relays", September 1993

14. EPRI NP-7147-SLV2, Addendum 2, "Seismic Ruggedness of Relays", April 1995

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

16. 15C4345-RPT-001, Rev. 3, "Selection of Relays and Switches for High Frequency Seismic Evaluation"

17. Limerick Drawing E51-1040-E-003 Rev. 32, *Elementary Diagram Reactor Core Isolation*

18. Limerick Drawing E51-1040-E-013 Rev. 16, *Elementary Diagram RCIC System Sheet 3A*

19. Limerick Drawing E51-1040-E-004 Rev. 30, *Elementary Diagram Reactor Core Isolation*

20. Limerick Drawing E51-1040-E-014 Rev. 16, *Elementary Diagram RCIC System Sheet 3A*

21. 15C4345-CAL-001, Rev. 2, "High Frequency Functional Confirmation and Fragility Evaluation of Components"

A Components Identified for High Frequency Evaluation

Table A-1: Components Identified for High Frequency Evaluation

No.	Unit	Component				Enclosure Type	Building	Component Evaluation Result
		ID	Type	System	Function			
1	1	PIS-049-1N658A	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
2	1	PIS-049-1N658C	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
3	1	PIS-049-1N658E	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
4	1	PIS-049-1N658G	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
5	1	PIS-050-1N653	Control Relay	FLEX Phase 1	RCIC Pump Suction Header	Control Cab.	Control Enclosure	Cap > Dem
6	1	PIS-050-1N655A	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
7	1	PIS-050-1N655C	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
8	1	PIS-050-1N655E	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
9	1	PIS-050-1N655G	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
10	1	PIS-050-1N656A	Control Relay	FLEX Phase 1	RCIC Pump Turbine Exhaust	Control Cab.	Control Enclosure	Cap > Dem
11	1	PIS-050-1N656E	Control Relay	FLEX Phase 1	RCIC Pump Turbine Exhaust	Control Cab.	Control Enclosure	Cap > Dem
12	2	PIS-049-2N658A	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
13	2	PIS-049-2N658C	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
14	2	PIS-049-2N658E	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
15	2	PIS-049-2N658G	Control Relay	FLEX Phase 1	RCIC Steam Pressure Indicating Switch	Control Cab.	Control Enclosure	Cap > Dem
16	2	PIS-050-2N653	Control Relay	FLEX Phase 1	RCIC Pump Suction Header	Control Cab.	Control Enclosure	Cap > Dem
17	2	PIS-050-2N655A	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
18	2	PIS-050-2N655C	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
19	2	PIS-050-2N655E	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
20	2	PIS-050-2N655G	Control Relay	FLEX Phase 1	RCIC Turbine Exhaust Line Vent	Control Cab.	Control Enclosure	Cap > Dem
21	2	PIS-050-2N656A	Control Relay	FLEX Phase 1	RCIC Pump Turbine Exhaust	Control Cab.	Control Enclosure	Cap > Dem
22	2	PIS-050-2N656E	Control Relay	FLEX Phase 1	RCIC Pump Turbine Exhaust	Control Cab.	Control Enclosure	Cap > Dem

Table A-1: Components Identified for High Frequency Evaluation

No.	Unit	Component				Enclosure Type	Building	Component Evaluation Result
		ID	Type	System	Function			
23	1	E51A-K10	Control Relay	FLEX Phase 1	RCIC Pump Suction Pressure Relay Energize on Pressure On Vacuum Less than Set-point	Control Cab.	Control Enclosure	Cap > Dem
24	1	E51A-K11A	Control Relay	FLEX Phase 1	RCIC Relay – Energize on Turbine Diaphragm Exhaust Pressure Above Set-point	Control Cab.	Control Enclosure	Cap > Dem
25	1	E51A-K11C	Control Relay	FLEX Phase 1	RCIC Relay - Energize On Turbine Diaphragm Exhaust Pressure Above Set-Point	Control Cab.	Control Enclosure	Cap > Dem
26	1	E51A-K12A	Control Relay	FLEX Phase 1	RCIC RELAY - Energize on Turbine Diaphragm Exhaust Pressure Above Set-point	Control Cab.	Control Enclosure	Cap > Dem
27	1	E51A-K12C	Control Relay	FLEX Phase 1	RCIC Relay – Energize on Turbine Diaphragm Exhaust Pressure Above Set-Point	Control Cab.	Control Enclosure	Cap > Dem
28	1	E51A-K13	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Turbine Exhaust Pressure Above Set-point	Control Cab.	Control Enclosure	Cap > Dem
29	1	E51A-K14	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Turbine Exhaust Pressure Above Set-Point	Control Cab.	Control Enclosure	Cap > Dem
30	1	E51A-K16A	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-point	Control Cab.	Control Enclosure	Cap > Dem
31	1	E51A-K16C	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-Point	Control Cab.	Control Enclosure	Cap > Dem
32	1	E51A-K17A	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-point	Control Cab.	Control Enclosure	Cap > Dem
33	1	E51A-K17C	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-Point	Control Cab.	Control Enclosure	Cap > Dem
34	1	E51A-K28	Control Relay	FLEX Phase 1	RCIC Turbine Trip Auxiliary Relay	Control Cab.	Control Enclosure	Cap > Dem
35	1	E51A-K30A	Control Relay	FLEX Phase 1	Steam Leak Detection Relay (RCIC Isolation Signal Manual Isolation Relay - Valve E51-F008)	Control Cab.	Control Enclosure	Cap > Dem
36	1	E51A-K30C	Control Relay	FLEX Phase 1	RCIC DIV 3 Isolation Signal and Steam Line Detection Relay (E51-F007)	Control Cab.	Control Enclosure	Cap > Dem

Table A-1: Components Identified for High Frequency Evaluation

No.	Unit	Component				Enclosure Type	Building	Component Evaluation Result
		ID	Type	System	Function			
37	1	E51A-K31A	Control Relay	FLEX Phase 1	RCIC Isolation Signal Manual Isolation Relay - Valve E51-F008	Control Cab.	Control Enclosure	Cap > Dem
38	1	E51A-K31C	Control Relay	FLEX Phase 1	RCIC Isolation Signal Manual Isolation Relay - Valve E51-F008	Control Cab.	Control Enclosure	Cap > Dem
39	1	E51A-K67C	Control Relay	FLEX Phase 1	RCIC DIV 3 Isolation Signal Relay	Control Cab.	Control Enclosure	Cap > Dem
40	2	E51A-K10	Control Relay	FLEX Phase 1	RCIC Pump Suction Pressure Relay Energize on Pressure On Vacuum Less than Set-point	Control Cab.	Control Enclosure	Cap > Dem
41	2	E51A-K11A	Control Relay	FLEX Phase 1	RCIC Relay – Energize on Turbine Diaphragm Exhaust Pressure Above Set-point	Control Cab.	Control Enclosure	Cap > Dem
42	2	E51A-K11C	Control Relay	FLEX Phase 1	RCIC Relay - Energize On Turbine Diaphragm Exhaust Pressure Above Set-Point	Control Cab.	Control Enclosure	Cap > Dem
43	2	E51A-K12A	Control Relay	FLEX Phase 1	RCIC RELAY - Energize on Turbine Diaphragm Exhaust Pressure Above Set-point	Control Cab.	Control Enclosure	Cap > Dem
44	2	E51A-K12C	Control Relay	FLEX Phase 1	RCIC Relay – Energize on Turbine Diaphragm Exhaust Pressure Above Set-Point	Control Cab.	Control Enclosure	Cap > Dem
45	2	E51A-K13	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Turbine Exhaust Pressure Above Set-point	Control Cab.	Control Enclosure	Cap > Dem
46	2	E51A-K14	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Turbine Exhaust Pressure Above Set-Point	Control Cab.	Control Enclosure	Cap > Dem
47	2	E51A-K16A	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-point	Control Cab.	Control Enclosure	Cap > Dem
48	2	E51A-K16C	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-Point	Control Cab.	Control Enclosure	Cap > Dem
49	2	E51A-K17A	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-point	Control Cab.	Control Enclosure	Cap > Dem
50	2	E51A-K17C	Control Relay	FLEX Phase 1	RCIC Relay - Energizes On Steam Line Pressure Below Set-Point	Control Cab.	Control Enclosure	Cap > Dem
51	2	E51A-K28	Control Relay	FLEX Phase 1	RCIC Turbine Trip Auxiliary Relay	Control Cab.	Control Enclosure	Cap > Dem

Table A-1: Components Identified for High Frequency Evaluation

No.	Unit	Component				Enclosure Type	Building	Component Evaluation Result
		ID	Type	System	Function			
52	2	E51A-K30A	Control Relay	FLEX Phase 1	Steam Leak Detection Relay (RCIC Isolation Signal Manual Isolation Relay - Valve E51-F008)	Control Cab.	Control Enclosure	Cap > Dem
53	2	E51A-K30C	Control Relay	FLEX Phase 1	RCIC DIV 3 Isolation Signal and Steam Line Detection Relay (E51-F007)	Control Cab.	Control Enclosure	Cap > Dem
54	2	E51A-K31A	Control Relay	FLEX Phase 1	RCIC Isolation Signal Manual Isolation Relay - Valve E51-F008	Control Cab.	Control Enclosure	Cap > Dem
55	2	E51A-K31C	Control Relay	FLEX Phase 1	RCIC Isolation Signal Manual Isolation Relay - Valve E51-F008	Control Cab.	Control Enclosure	Cap > Dem
56	2	E51A-K67C	Control Relay	FLEX Phase 1	RCIC DIV 3 Isolation Signal Relay	Control Cab.	Control Enclosure	Cap > Dem
57	1	E51A-K15A	Control Relay	FLEX Phase 1	RCIC System Steam Flow Above Set-point Time Delay Relay	Control Cab.	Control Enclosure	Cap > Dem
58	1	E51A-K15C	Control Relay	FLEX Phase 1	RCIC System Steam Flow Above Set-Point Time Delay Relay	Control Cab.	Control Enclosure	Cap > Dem
59	2	E51A-K15A	Control Relay	FLEX Phase 1	RCIC System Steam Flow Above Set-point Time Delay Relay	Control Cab.	Control Enclosure	Cap > Dem
60	2	E51A-K15C	Control Relay	FLEX Phase 1	RCIC System Steam Flow Above Set-Point Time Delay Relay	Control Cab.	Control Enclosure	Cap > Dem