Exelon Generation

RS-16-178

10 CFR 50.54(f)

November 2, 2016

U.S. Nuclear Regulatory Commission
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Nine Mile Point Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-63
NRC Docket No. 50-220

Subject: High Frequency Supplement to Seismic Hazard Screening Report, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident

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 (ML12053A340)
2. NRC Letter, Electric Power Research Institute Report 3002000704, "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," As An Acceptable Alternative to the March 12, 2012, Information Request for Seismic Reevaluations, dated May 7, 2013 (ML13106A331)
3. NEI Letter, Final Draft of Industry Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic (EPRI 1025287), dated November 27, 2012 (ML12333A168 and ML12333A170)
4. NRC Letter, Endorsement of Electric Power Research Institute Final Draft Report 1025287, "Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic", dated February 15, 2013 (ML12319A074)
5. Constellation Energy, LLC letter to NRC, Nine Mile Point Nuclear Station, Units 1 and 2 - Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10CFR50.54(f) Regarding Recommendation 2.1 of Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident, dated March 31, 2014 (ML14099A196)

6. NRC Letter, Screening and Prioritization Results Regarding Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Seismic Hazard Re-evaluations for Recommendation 2.1 of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated May 9, 2014 (ML14111A147)
7. NRC Memorandum, Support Document for Screening and Prioritization Results Regarding Seismic Hazard Re-Evaluation for Operating Reactors in the Central and Eastern United States, dated May 21, 2014 (ML14136A126)
8. NEI Letter, Request for NRC Endorsement of High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation (EPRI 3002004396), dated July 30, 2015 (ML15223A100/ML15223A102)
9. NRC Letter to NEI: Endorsement of Electric Power Research Institute Final Draft Report 3002004396: "High Frequency Program: Application Guidance for Functional Confirmation and Fragility," dated September 17, 2015 (ML15218A569)
10. NRC Letter, Final Determination of Licensee Seismic Probabilistic Risk Assessments Under the Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 2.1 "Seismic" of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident, dated October 27, 2015 (ML15194A015)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a Request for Information per 10 CFR 50.54(f) (Reference 1) to all power reactor licensees. The required response section of Enclosure 1 of Reference 1 indicated that licensees should provide a Seismic Hazard Evaluation and Screening Report within 1.5 years from the date of the letter for Central and Eastern United States (CEUS) nuclear power plants. By NRC letter dated May 7, 2013 (Reference 2), the date to submit the report was extended to March 31, 2014.

By letter dated May 9, 2014 (Reference 6), the NRC transmitted the results of the screening and prioritization review of the seismic hazards reevaluation report for Nine Mile Point Nuclear Station, Unit 1 submitted on March 31, 2014 (Reference 5). In accordance with the screening, prioritization, and implementation details report (SPID) (References 3 and 4), and Augmented Approach guidance (Reference 2), the reevaluated seismic hazard is used to determine if additional seismic risk evaluations are warranted for a plant. Specifically, the reevaluated horizontal ground motion response spectrum (GMRS) at the control point elevation is compared to the existing safe shutdown earthquake (SSE) or Individual Plant Examination for External Events (IPEEE) High Confidence of Low Probability of Failure (HCLPF) Spectrum (IHS) to determine if a plant is required to perform a high frequency confirmation evaluation. As noted in the May 9, 2014 letter from the NRC (Reference 6) on page 4 of Enclosure 2, Nine Mile Point Nuclear Station, Unit 1 is to conduct a limited scope High Frequency Evaluation (Confirmation).

Within the May 9, 2014 letter (Reference 6), the NRC acknowledged that these limited scope evaluations will require additional development of the assessment process. By Reference 8, the Nuclear Energy Institute (NEI) submitted an Electric Power Research Institute (EPRI) report entitled, High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation (EPRI 3002004396) for NRC review and endorsement. NRC endorsement was provided by Reference 9. Reference 10 provided the NRC final seismic hazard evaluation screening determination results and the associated schedules for submittal of the remaining seismic hazard evaluation activities.

The High Frequency Evaluation Confirmation Report for Nine Mile Point Nuclear Station, Unit 1, provided in the enclosure to this letter, shows that all high frequency susceptible equipment evaluated within the scoping requirements and using evaluation criteria of Reference 8 for seismic demands and capacities, are acceptable. Therefore, no additional modifications or evaluations are necessary.

This transmittal completes the scope of work described in Section 4.2 of Reference 5, for Nine Mile Point Nuclear Station, Unit 1. This letter closes the associated regulatory commitment contained in Reference 5 for Nine Mile Point Nuclear Station, Unit 1.

This letter contains no new regulatory commitments.

If you have any questions regarding this report, please contact Ronald Gaston at 630-657-3359.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 2nd day of November 2016.

Respectfully submitted,

James Barstow

James Barstow
Director - Licensing & Regulatory Affairs
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Enclosure: Nine Mile Point Nuclear Station, Unit 1 - Seismic High Frequency Evaluation Confirmation Report

cc: NRC Regional Administrator - Region I
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Enclosure

Nine Mile Point Nuclear Station, Unit 1

Seismic High Frequency Evaluation Confirmation Report

(55 pages)

HIGH FREQUENCY CONFIRMATION REPORT

IN RESPONSE TO NEAR TERM TASK FORCE (NTTF) 2.1 RECOMMENDATION

for the

NINE MILE POINT NUCLEAR STATION, UNIT 1
348 Lake Rd, Oswego, NY 13126
Facility Operating License No. DPR-63
NRC Docket No. 50-220
Correspondence No.: RS-16-178

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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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Executive Summary

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

Following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the Nuclear Regulatory Commission (NRC) established a Near Term Task Force (NTTF) to conduct a systematic review of NRC processes and regulations and to determine if the agency should make additional improvements to its regulatory system. The NTTF developed a set of recommendations [16] intended to clarify and strengthen the regulatory framework for protection against natural phenomena. Subsequently, the NRC issued a 50.54(f) letter on March 12, 2012 [1], requesting information to assure that these recommendations are addressed by all U.S. nuclear power plants. The 50.54(f) letter requests that licensees and holders of construction permits under 10 CFR Part 50 reevaluate the seismic hazards at their sites against present-day NRC requirements and guidance. Included in the 50.54(f) letter was a request that licensees perform a "confirmation, if necessary, that SSCs, which may be affected by high-frequency ground motion, will maintain their functions important to safety."

EPRI 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" [6] provided screening, prioritization, and implementation details to the U.S. nuclear utility industry for responding to the NRC 50.54(f) letter. This report was developed with NRC participation and was subsequently endorsed by the NRC. The SPID included guidance for determining which plants should perform a High Frequency Confirmation and identified the types of components that should be evaluated in the evaluation.

Subsequent guidance for performing a High Frequency Confirmation was provided in EPRI 3002004396, "High Frequency Program, Application Guidance for Functional Confirmation and Fragility Evaluation," [8] and was endorsed by the NRC in a letter dated September 17, 2015 [3]. Final screening identifying plants needing to perform a High Frequency Confirmation was provided by NRC in a letter dated October 27, 2015 [2].

This report describes the High Frequency Confirmation evaluation undertaken for Nine Mile Point Nuclear Station, Unit 1 (NMP1). The objective of this report is to provide summary information describing the High Frequency Confirmation evaluations and results. The level of detail provided in the report is intended to enable NRC to understand the inputs used, the evaluations performed, and the decisions made as a result of the evaluations.

EPRI 3002004396 [8] is used for the NMP1 engineering evaluations described in this report. In accordance with Reference [8], the following topics are addressed in the subsequent sections of this report:

- Process of selecting components and a list of specific components for high-frequency confirmation
- Estimation of a vertical ground motion response spectrum (GMRS)
- Estimation of in-cabinet seismic demand for subject components
- Estimation of in-cabinet seismic capacity for subject components
- Summary of subject components' high-frequency evaluations

1 Introduction

1.1 Purpose

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

1.2 Background

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

EPRI 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" [6] provided screening, prioritization, and implementation details to the U.S. nuclear utility industry for responding to the NRC 50.54(f) letter. This report was developed with NRC participation and is endorsed by the NRC. The SPID included guidance for determining which plants should perform a High Frequency Confirmation and identified the types of components that should be evaluated in the evaluation.

Subsequent guidance for performing a High Frequency Confirmation was provided in EPRI 3002004396, "High Frequency Program, Application Guidance for Functional Confirmation and Fragility Evaluation," [8] and was endorsed by the NRC in a letter dated September 17, 2015 [3]. Final screening identifying plants needing to perform a High Frequency Confirmation was provided by NRC in a letter dated October 27, 2015 [2].

On March 31, 2014, NMP1 (concurrently with Calvert Cliffs Nuclear Power Plant and R.E. Ginna Nuclear Plant) submitted a reevaluated seismic hazard to the NRC as a part of the Seismic Hazard and Screening Report [4]. By letter dated October 27, 2015 [2], the NRC transmitted the results of the screening and prioritization review of the seismic hazards reevaluation.

This report describes the High Frequency Confirmation evaluation undertaken for NMP1 using the methodologies in EPRI 3002004396, "High Frequency Program, Application Guidance for

Functional Confirmation and Fragility Evaluation," as endorsed by the NRC in a letter dated September 17, 2015 [3].

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

1.3 APPROACH

EPRI 3002004396 [8] is used for the NMP1 engineering evaluations described in this report. Section 4.1 of Reference [8] provided general steps to follow for the high frequency confirmation component evaluation. Accordingly, the following topics are addressed in the subsequent sections of this report:

- NMP1 SSE and GMRS Information
- Selection of components and a list of specific components for high-frequency confirmation
- Estimation of seismic demand for subject components
- Estimation of seismic capacity for subject components
- Summary of subject components' high-frequency evaluations
- Summary of Results

1.4 PLANT SCREENING

NMP1 submitted reevaluated seismic hazard information including GMRS and seismic hazard information to the NRC on March 31, 2014[4]. In a letter dated June 16, 2015, the NRC staff concluded that the submitted GMRS adequately characterizes the reevaluated seismic hazard for the NMP1 site [14].

The NRC final screening determination letter concluded [2] that the NMP1 GMRS to SSE comparison resulted in a need to perform a High Frequency Confirmation in accordance with the screening criteria in the SPID [6].

1.5 Report Documentation

Section 2 of this report describes the selection of devices. The identified devices are evaluated for the seismic demand specified in Section 3 of this report (see [15] for the evaluation) using the evaluation criteria discussed in Section 4 of this report. The overall conclusions are discussed in Section 5 of this report.

Table B-1 in Appendix B of this report lists the devices identified in Section 2 of this report and provides the results of the evaluations performed in accordance with Sections 3 and 4 of this report.

Table B-2 identifies the reactor coolant leak path valves that could potentially cause a loss-of-coolant accident (LOCA).

2 Selection of Components for High-Frequency Screening

The fundamental objective of the high frequency confirmation review is to determine whether the occurrence of a seismic event could cause credited equipment to fail to perform as necessary. An optimized evaluation process is applied that focuses on achieving a safe and stable plant state following a seismic event. As described in Reference [8], this state is achieved by confirming that key plant safety functions critical to immediate plant safety are preserved (reactor trip, reactor vessel inventory and pressure control, and core cooling) and that the plant operators have the necessary power available to achieve and maintain this state immediately following the seismic event (AC/DC power support systems).

Within the applicable functions, the components that would need a high frequency confirmation are contact control devices subject to intermittent states in seal-in or lockout circuits. Accordingly, the objective of the review as stated in Section 4.2.1 of Reference [8] is to determine if seismic induced high frequency relay chatter would prevent the completion of the following key functions.

2.1 Reactor Trip/SCRAM

The reactor trip/SCRAM function is identified as a key function in Reference [8] to be considered in the High Frequency Confirmation. The same report also states that "the design requirements preclude the application of seal-in or lockout circuits that prevent reactor trip/SCRAM functions" and that "No high-frequency review of the reactor trip/SCRAM systems is necessary."

2.2 Reactor Vessel Inventory Control

The concern regarding the reactor vessel inventory control function 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 Electromatic Relief Valves (ERV) as well as other Reactor Coolant System (RCS) valves listed in Attachment A of this report 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.

The EPRI High Frequency Confirmation guidance [8] assumes AC power is available, and thus control devices for AC powered valves are included. The discussion of DC powered valves in this section applies. This section describes the analysis of devices controlling the valves listed in Attachment B, Table B-2 of this report. Based on this analysis, there are no contact devices that meet the criteria for selection in this category.

Main Steam System Valves

Electromatic Relief Valves PSV-01-102A/B/C/D/E/F

Electrical control for the solenoid-operated pilot valves is via relays controlled by reactor pressure and the Auto Depressurization Logic [22, 23, 24, 25, 26, 27]. There is no seal-in of the reactor pressure portion of the circuit. Seal-in of the Auto Depressurization Logic [28, 29] is prevented by the Low-Low-Low Water Level signal [30, 31].

Reactor Vessel Head Safety Valves PSV-01-119A/B/C/D/F/G/H/J/M

Per the UFSAR, these valves are spring-loaded, pop-open type safety valves [19, pp. V-8]. As such they have no electric control and thus are not considered for high frequency effects.

Reactor Vent Valves BV-37-01, BV-37-02, BV-37-06

BV-37-01 is closed and depowered under normal operation [32]. In this condition BV-37-01 can be credited to remain closed following a seismic event, and misalignment of the downstream valves BV-37-02 and BV-37-06 would not lead to a LOCA. For this reason, devices controlling these valves are not considered for high frequency effects.

Drywell and Torus Isolation Valves

Main Steam Isolation Valves IV-01-01, IV-01-02, IV-01-03, IV-01-04

Seal-in of the opening contactor controlling normally open motorized valves IV-01-01 and IV-01-02 is blocked by rugged limit switches [33, 34]. Chatter in the control circuits for the solenoid-operated pilot valves of normally-open IV-01-03 and IV-01-04 would have the beneficial effect of closing the valves; and thus no devices in these circuits meet the selection criteria [35]. No SILO will block valve closure of any of these valves upon an isolation signal.

Reactor Shutdown Cooling Isolation Valves IV-38-01, IV-38-13

These valves are closed and depowered under normal operation [36, p. 82]. Chatter in the control circuits of these depowered valves has no effect on valve position and thus these valves can be credited to remain closed following a seismic event. For this reason, devices controlling these valves are not considered for high frequency effects.

Reactor Recirculation Sample Isolation Valve IV-110-127

Coincident chatter in the 42-O contactor auxiliary contact and 4-11D or 4-12D may open the valve, however the valve would reclose immediately due to the normally closed contacts of 4-11D and 4-12D in the closing circuit [37].

Feedwater Isolation Valves 31-07, 31-08; Clean-up Return Isolation Valve IV-33-01R; Clean-up Supply Isolation Valves IV-33-02R, IV-33-04

These valves are normally open and controlled by non-vulnerable hand switches. Seal-in of the opening contactor via its auxiliary contact is prevented by rugged limit and torque switches which are open when the valve is open [33, 38, 34, 39].

Reactor Drain Valves BV-37-08R, BV-37-09R

Valve BV-37-09R is closed and depowered under normal operation [40, p. 168]. Because it is depowered, chatter in its control circuit has no effect on this valve and it will remain closed following the seismic event. Valve BV-37-08R is in series with BV-37-09R and because BV-37-09R can be credited to remain closed following a seismic event, chatter in the control circuit of BV-37-08R would not lead to a LOCA.

Core Spray Isolation Valves

Core Spray Vent Isolation Valves IV-40-30, IV-40-31; Core Spray Test Isolation Valves IV-40-05, IV-40-06

These valves are closed and depowered under normal operation [41 and 42, pp. 65 - 66]. Because they are depowered, chatter in their control circuits has no effect on these valves and they will remain closed following a seismic event. For this reason, devices controlling these valves are not considered for high frequency effects.

Core Spray Discharge Isolation Valves IV-40-01, IV-40-09, IV-40-10, IV-40-11

All four of these normally-closed valves have similar control circuits which contain potentially vulnerable devices capable of causing the valve to open. Due to check valves and the closed and depowered Core Spray Vent and Test Isolation Valves (described above), no leak path would be created should these valves open due to chatter in their control circuits [41]. For this reason, potentially vulnerable devices in the control circuits of these valves do not meet the selection criteria.

Containment Spray Valves

Containment Spray Test to Torus Flow Control Valve FCV-80-118

Chatter in the opening circuit for this valve is blocked by a normally-open and rugged hand switch [43] and for this reason no devices in this valve's control circuit meet the selection criteria.

2.3 Reactor Vessel Pressure Control

The reactor vessel pressure control function is identified as a key function in Reference [8] to be considered in the High Frequency Confirmation. The same report also states that "required post event pressure control is typically provided by passive devices" and that "no specific high frequency component chatter review is required for this function."

2.4 Core Cooling

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

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

The emergency condenser is placed into operation by opening the condensate outlet isolation valves [19, pp. V-18] via by initiation relays 11K61A, 11K61X, 11K62A, and 11K62X [20] in Channel 11 and 12K61A, 12K61X, 12K62A, and 12K62X in Channel 12 [21]. These relays are normally energized and must de-energize to initiate the condenser. Chatter in the initiation circuit would tend to open these valves and this beneficial effect eliminates these relays and their input devices from consideration.

Chatter in the Auto Close circuit could lead to an undesired isolation of the Emergency Condenser, which would place it out of operation. Chatter in the normally de-energized isolation signal output relays 4-11A/B or 4-12A/B; or their input devices K17A/B/C/D and 36-06A-M/B-M/C-M/D-M could tend to seal-in the isolation relays [20, 21]. Chatter in normally-energized confirmatory logic relays 36A/B/C/D could break their seal-in. The potential effect of chatter in these devices meets the selection criteria and thus they must be considered for this program. Chatter in the remote isolation bypass circuit (R38A/B/C/D or their input devices) would have no effect on the condenser control when it is available or operating. The remaining devices are slave relays to those listed and do not lead to SILO on their own.

2.5 AC/DC Power Support Systems

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

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

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

In order to ensure contact chatter cannot compromise the emergency power system, control circuits were analyzed for the Emergency Diesel Generators (EDG), Battery Chargers, Vital AC Inverters, and Switchgear/Load Centers/MCCs as necessary to distribute power from the EDGs to the Battery Chargers and EDG Ancillary Systems. General information on the arrangement of safety-related AC and DC systems, as well as operation of the EDGs, was obtained from the NMP1 UFSAR. Nine Mile Point has two (2) EDGs which provide emergency power to two (2) divisions of Class 1E loads, with one EDG for each division [19, pp. IX-10]. The overall emergency power distribution, both AC and DC, is shown on the C19950C One-Line Diagrams [44, 45].

The analysis necessary to identify contact devices in this category relies on conservative worse-case initial conditions and presumptions regarding event progression. The analysis considers the reactor is operating at power with no equipment failures or LOCA prior to the seismic event. The Emergency Diesel Generators are not operating but are available. The seismic event is presumed to cause a Loss of Offsite Power (LOOP) and a normal reactor SCRAM.

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

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

Emergency Diesel Generators

The analysis of the Emergency Diesel Generators, 102 and 103, is divided into two sections, generator protective relaying and diesel engine control. General descriptions of these systems and controls appear in the UFSAR [19, pp. IX-17].

Generator Protective Relaying

The control circuits for the 102 DG circuit breaker R1022 include DG lockout relay 86DG-2/HR and R1012 feeder breaker lockout relay 86/ER [46]. If either of these lockout relays are tripped the EDG breaker will not close automatically during the LOOP. The Diesel Generator Lockout Relay 86DG-2/HR may be tripped by chatter in the three 87DG-2 Phase Differential Relays or the 67NI Directional Overcurrent Relay [46]. Feeder Lockout Relay 86/ER may be tripped by chatter in the three 50/51 Phase Overcurrent Relays and 50G/51G Ground Overcurrent Protective Relay associated with Auxiliary Feeder 102 [47]. In addition to the lockout relays, the R1022 circuit breaker could be tripped by chatter in the three 51V Phase Time Overcurrent Relays [46].

The control circuits for the 103 DG circuit breaker R1032 is identical in design and sensitive to chatter in its equivalent devices: 86DG-3/HR, 86/ER @ R1013, 87DG-3, 67NI @ R1032, 50/51 @ R1013, 50G/51G @ R1013, and 51V @ R1032 [48, 47].

Diesel Engine Control

Chatter analysis for the diesel engine control was performed on the starting and control circuits of each EDG [49]. The 86DG-2/HR DG Lockout Relay (already covered) is the only SILO device which may prevent EDG Start. Chatter in the other devices in the start circuit would only have a temporary effect on EDG start during the period of strong shaking. The EDG Start Signal energizes engine Shutdown Relay 5D, which de-energizes the Governor Shutdown Solenoid 65. Any chatter in the shutdown circuit which may energize the shutdown solenoid after EDG start may cause the EDG to shut down. The shutdown solenoid is controlled via two contacts of the Governor Shutdown Auxiliary Time Delay Relay 65X-1, the normally closed instantaneous contact and the normally open time delay dropout (TDDO). When energized via the shutdown relay the instantaneous contacts open and the TDDO contacts close. When 65X-1 is de-energized the contact configuration functions to energize the shutdown relay for 50 seconds. This mean that any chatter which de-energizes the solenoid of 65X-1 would block EDG restart for 50 seconds.

Due to relay contact construction, for any given relay with both open and closed contacts, the closed contacts will chatter open before the open contacts chatter closed. This means chatter in 65X-1 would not cause the shutdown solenoid to energize. Chatter in Shutdown Relay 5D or Fast

Shutdown Relay 5DE could de-energize 65X-1, energizing the shutdown solenoid. Also chatter in any device which affect 5D or 5DE may cause shutdown: Start Relay 2-2X, Overcrank Time Delay Relay 2-3, Overspeed Relay 12X, Main Bearing Relay 38D-X, and Restart/No Start Relay 48. Other devices in this circuit do not meet the selection criteria due to their being non-vulnerable, chatter having no effect, or chatter having beneficial effect.

Battery Chargers

The Control Circuits for Battery Charger 161A/B [50, 51, 52, 53, 54] and 171A/B [55, 56, 57, 58, 59] contain a high voltage shutdown circuit which is intended to protect the batteries and DC loads from output overvoltage due to charger failure. The high voltage shutdown circuit has an output relay X308, which shunt-trips the AC input circuit breaker, shutting the charger down [52, 54, 57, 59]. Chatter in the contacts of these output relays may disable the battery chargers, and for this reason meet the selection criteria.

Uninterruptible Power Supplies

Analysis of schematics for the Uninterruptable Power Supplies (UPS) 162A/B [60, 61, 62, 63, 64, 65] and 172A/B [66, 67, 68, 69, 70, 71] revealed the output is controlled by an overvoltage lockout via electrical contractors. Chatter in the 86-1 Lockout Relay or the two Overvoltage Relays feeding it, 59-1 and 59-2, may de-energize the output contactors and disable the UPS [61, 67]. The DC supply was credited as the UPS power source because it uses rugged fuses.

EDG Ancillary Systems

In order to start and operate the Emergency Diesel Generators require a number of components and systems. For the purpose of identifying electrical contact devices, only systems and components which are electrically controlled are analyzed. Information in the UFSAR [19] was used as appropriate for this analysis.

Starting Air

Based on Diesel Generator availability as an initial condition the passive air reservoirs are presumed pressurized and the only active components in this system required to operate are the air start solenoids [72, 73], which are covered under the EDG engine control analysis as discussed above.

Combustion Air Intake and Exhaust

The combustion air intake and exhaust for the Diesel Generators are passive systems [72, 73] which do not rely on electrical control.

Lube Oil

The Diesel Generators utilize engine-driven mechanical lubrication oil pumps [72, 73] which do not rely on electrical control.

Fuel Oil

The Diesel Generators utilize engine shaft-driven mechanical pumps and motor-driven electric pumps to supply fuel oil to the engines from the day tanks [72, 73]. The day tanks are re-supplied using AC-powered Diesel Oil Transfer Pumps [74]. Chatter analysis of the control circuits for the electrically-powered fuel oil and fuel oil transfer pumps [49] concluded they do not include SILO devices. The mechanical pumps do not rely on electrical control.

Cooling Water

The Diesel Generator Cooling Water System consists of two cooling loops, jacket water and raw water. Engine driven pumps are credited for jacket water when the engine is operating. These mechanical pumps do not rely on electrical control. Raw water flow is provided by the Emergency Diesel Generator Cooling Raw Water Pump [72, 73]. This pump is controlled by the EDG start circuit via the governor solenoid auxiliary relay [75, 76]. This control circuit is covered in Section 6.5.1 above. No electrically operated valves are used to establish flow in either cooling loop [72, 73].

Ventilation

Ventilation for each EDG room is achieved via two exhaust fans and a roll-up door. These components are controlled by room temperature [75, 76]. Strong shaking may temporarily prevent fan operation. It also may cause the roll-up door closing contactor to seal-in, however this would only lead to a temporary closing of the door because the high room temperature signal would command the door to reopen should this occur. Because the effect of strong shaking on this system is temporary, no devices in this system meet the selection criteria.

Switchgear, Load Centers, and MCCs

Power distribution from the EDGs to the necessary electrical loads (Battery Chargers, Inverters, Fuel Oil Pumps, and EDG Ventilation Fans, etc.) was traced to identify any SILO devices which could lead to a circuit breaker trip and interruption in power. This effort excluded the EDG output circuit breakers, which are covered above, as well as component-specific contactors and their control devices, which are covered in the analysis for each component above. Those medium- and low-voltage circuit breakers in 4160V Busses and 600V AC Load Centers supplying power to loads noted in this section (battery chargers, EDG ancillary systems, etc.) have been identified for evaluation: R1022/571, R1021/171, R1043/603, 52 @ PB16 Cubicle 10B, 52 @ PB16 Cubicle 12C, R1032/581, R1031/181, R1053/613, 52 @ PB17 Cubicle 5B 52 @ PB17 Cubicle 3C [77, 78, 79]. DC Distribution uses four low voltage circuit breakers, 52 @ BB11 Unit E02, 52 @ BB11 Unit F03, 52 @ BB12 Unit F02, 52 @ BB12 Unit G03, for the battery charger DC outputs and the batteries to the battery boards [80]. The DC distribution to the UPS uses fuses which do not have moving contacts. MCCBs in low voltage Motor Control Center Buckets were considered rugged. The only circuit breakers affected by protective relaying (not already covered) were those that distribute power from the 4160V Busses to the 4160/600V step-down transformers. An analysis of the control circuits for these circuit breakers, R1021 and R1031, indicates that chatter in the three 50/51 Phase Overcurrent Relays or the 50G Ground Overcurrent Relay in the trip circuits of these breakers could cause circuit breaker tripping [46, 48].

2.6 SUMMARY OF SELECTED COMPONENTS

The investigation of high-frequency contact devices as described above was performed in Ref. [81]. A list of the contact devices requiring a high frequency confirmation is provided in Appendix B, Table B-1 of this report. The identified devices are evaluated in [15] per the methodology and description of Sections 3 and 4 of this report. Results are presented in Section 5 and Table B-1 of this report.

3 Seismic Evaluation

3.1 Horizontal Seismic Demand

Per Reference [8], Sect. 4.3, the basis for calculating high-frequency seismic demand on the subject components in the horizontal direction is the NMP1 horizontal ground motion response spectrum (GMRS), which was generated as part of the NMP1 Seismic Hazard and Screening Report [4] submitted to the NRC on March 31, 2014, and accepted by the NRC on June 10, 2016 [14].

It is noted in Reference [8] that a Foundation Input Response Spectrum (FIRS) may be necessary to evaluate buildings whose foundations are supported at elevations different than the Control Point elevation. However, for sites founded on rock, per Ref. [8], "The Control Point GMRS developed for these rock sites are typically appropriate for all rock-founded structures and additional FIRS estimates are not deemed necessary for the high frequency confirmation effort." For sites founded on soil, the soil layers will shift the frequency range of seismic input towards the lower frequency range of the response spectrum by engineering judgment. Therefore, for purposes of high-frequency evaluations in this report, the GMRS is an adequate substitute for the FIRS for sites founded on soil.

The applicable buildings at NMP1 are founded on rock; therefore, the Control Point GMRS is representative of the input at the building foundation.

The horizontal GMRS values are provided in Table 3-2.

3.2 Vertical Seismic Demand

As described in Section 3.2 of Reference. [8], the horizontal GMRS and site soil conditions are used to calculate the vertical GMRS (VGMRS), which is the basis for calculating high-frequency seismic demand on the subject components in the vertical direction.

The site's soil mean shear wave velocity vs. depth profile is provided in Reference. [4], Table 2.3.2-1 and reproduced below in Table 3-1.

Table 3-1: Soil Mean Shear Wave Velocity Vs. Depth Profile

Layer	Depth (ft)	Depth (m)	Thickness, d_i (ft)	Vs_i (ft/sec)	d_i / Vs_i	Σ [d_i / Vs_i]	Vs30 (ft/s)
1	10	3.05	10	6,000	1.67E-03	1.67E-03	7161
2	20	6.10	10	6,000	1.67E-03	3.33E-03	
3	35	10.7	15	6,500	2.31E-03	5.64E-03	
4	51.2	15.6	16.2	8,000	2.03E-03	7.67E-03	
5	67.4	20.5	16.2	8,000	2.03E-03	9.69E-03	
6	83.6	25.5	16.2	8,000	2.03E-03	1.17E-02	
7	99.8	30.4	16.2	8,000	2.03E-03	1.37E-02	

Using the shear wave velocity vs. depth profile, the velocity of a shear wave traveling from a depth of 30m (98.43ft) to the surface of the site (Vs30) is calculated per the methodology of Reference [8], Section 3.5.

- The time for a shear wave to travel through each soil layer is calculated by dividing the layer depth (d_i) by the shear wave velocity of the layer (Vs_i).
- The total time for a wave to travel from a depth of 30m to the surface is calculated by adding the travel time through each layer from depths of 0m to 30m ($\Sigma[d_i/Vs_i]$).
- The velocity of a shear wave traveling from a depth of 30m to the surface is therefore the total distance (30m) divided by the total time; i.e., $Vs30 = (30m)/\Sigma[d_i/Vs_i]$.
- Note: The shear wave velocity is calculated based on time it takes for the shear wave to travel 30.4m (99.8ft) instead of 30m (98.43ft). This small change in travel distance will have no impact on identifying soil class type.

The site's soil class is determined by using the site's shear wave velocity (Vs30) and the peak ground acceleration (PGA) of the GMRS and comparing them to the values within Reference [8], Table 3-1. Based on the PGA of 0.122g and the shear wave velocity of 7161ft/s, the site soil class is B-Hard.

Once a site soil class is determined, the mean vertical vs. horizontal GMRS ratios (V/H) at each frequency are determined by using the site soil class and its associated V/H values in Reference [8], Table 3-2.

The vertical GMRS is then calculated by multiplying the mean V/H ratio at each frequency by the horizontal GMRS acceleration at the corresponding frequency. It is noted that Reference [8], Table 3-2 values are constant between 0.1Hz and 15Hz.

The V/H ratios and VGMRS values are provided in Table 3-2 of this report.

Figure 3-1 below provides a plot of the horizontal GMRS, V/H ratios, and vertical GMRS for NMP1.

Table 3-2: Horizontal and Vertical Ground Motions Response Spectra

Frequency (Hz)	HGMRS (g)	V/H Ratio	VGMRS (g)
100	0.122	0.8	0.098
90	0.123	0.82	0.101
80	0.123	0.87	0.107
70	0.125	0.91	0.114
60	0.130	0.92	0.120
50	0.144	0.9	0.130
45	0.157	0.89	0.140
40	0.170	0.86	0.146
35	0.186	0.81	0.151
30	0.202	0.75	0.152
25	0.221	0.7	0.155
20	0.236	0.68	0.160
15	0.245	0.68	0.167
12.5	0.241	0.68	0.164
10	0.236	0.68	0.160
9	0.219	0.68	0.149
8	0.206	0.68	0.140
7	0.201	0.68	0.137
6	0.196	0.68	0.133
5	0.172	0.68	0.117
4	0.142	0.68	0.097
3.5	0.129	0.68	0.088
3	0.116	0.68	0.079
2.5	0.100	0.68	0.068
2	0.093	0.68	0.064
1.5	0.081	0.68	0.055
1.25	0.075	0.68	0.051
1	0.059	0.68	0.040
0.9	0.052	0.68	0.035
0.8	0.047	0.68	0.032
0.7	0.042	0.68	0.029
0.6	0.038	0.68	0.026
0.5	0.033	0.68	0.023
0.4	0.027	0.68	0.018
0.35	0.023	0.68	0.016
0.3	0.020	0.68	0.014
0.25	0.017	0.68	0.011
0.2	0.013	0.68	0.009
0.15	0.010	0.68	0.007
0.125	0.008	0.68	0.006
0.1	0.007	0.68	0.005

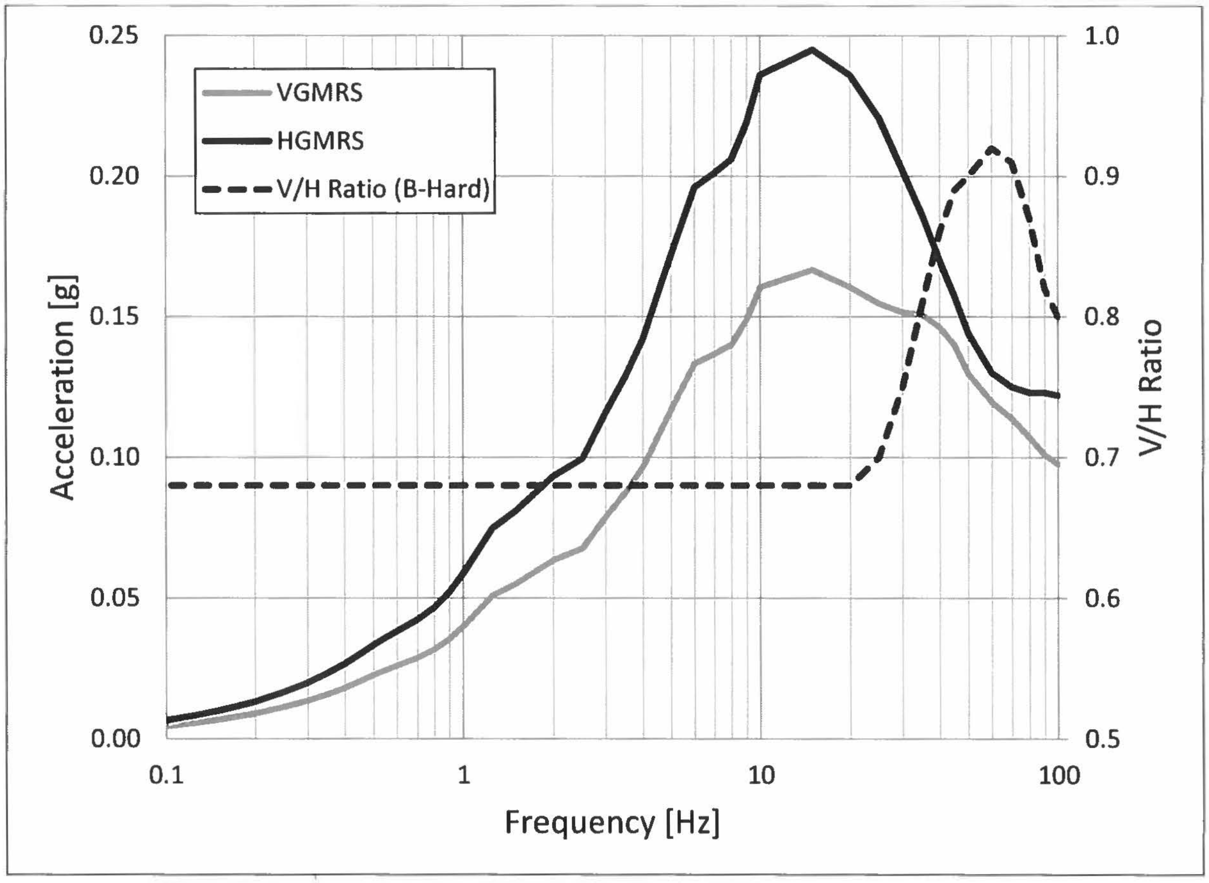

Figure 3-1

Plot of the NMP1 Horizontal Ground Motion Response Spectra (HGMRS), Vertical Ground Motion Response Spectra (VGMRS), and V/H Ratios for a B-Hard Soil Site

3.3 COMPONENT HORIZONTAL SEISMIC DEMAND

Per Reference [8], the peak horizontal acceleration is amplified using the following two factors to determine the horizontal in-cabinet response spectrum:

- Horizontal in-structure amplification factor AF_{SH} to account for seismic amplification at floor elevations above the host building's foundation
- Horizontal in-cabinet amplification factor AF_c to account for seismic amplification within the host equipment (cabinet, switchgear, motor control center, etc.)

The in-structure amplification factor AF_{SH} is derived from Figure 4-3 in Reference [8]. The in-cabinet horizontal amplification factor, AF_c is associated with a given type of cabinet construction. The three general cabinet types are identified in Reference [8] and Appendix I of EPRI NP-7148 [13] assuming 5% in-cabinet response spectrum damping. EPRI NP-7148 [13] classified the cabinet types as high amplification structures such as switchgear panels and other similar large flexible panels, medium amplification structures such as control panels and control room benchboard panels and low amplification structures such as motor control centers.

All of the electrical cabinets containing the components subject to high frequency confirmation (see Table B-1 in Appendix B) can be categorized into one of the in-cabinet amplification categories in Reference [8] as follows:

- NMP1 Motor Control Centers are typical motor control center cabinets consisting of a lineup of several interconnected sections. Each section is a relatively narrow cabinet structure with height-to-depth ratios of about 4.5 that allow the cabinet framing to be efficiently used in flexure for the dynamic response loading, primarily in the front-to-back direction. This results in higher frame stresses and hence more damping which lowers the cabinet response. In addition, the subject components are not located on large unstiffened panels that could exhibit high local amplifications. These cabinets qualify as low amplification cabinets.
- NMP1 Switchgear cabinets are large cabinets consisting of a lineup of several interconnected sections typical of the high amplification cabinet category. Each section is a wide box-type structure with height-to-depth ratios of about 1.5 and may include wide stiffened panels. This results in lower stresses and hence less damping which increases the enclosure response. Components can be mounted on the wide panels, which results in the higher in-cabinet amplification factors.
- NMP1 Control cabinets are in a lineup of several interconnected sections with moderate width. Each section consists of structures with height-to-depth ratios of about 3 which results in moderate frame stresses and damping. The response levels are mid-range between MCCs and switchgear and therefore these cabinets can be considered in the medium amplification category.

3.4 COMPONENT VERTICAL SEISMIC DEMAND

The component vertical demand is determined using the peak acceleration of the VGMRS between 15 Hz and 40 Hz and amplifying it using the following two factors:

- Vertical in-structure amplification factor AF_{SV} to account for seismic amplification at floor elevations above the host building's foundation
- Vertical in-cabinet amplification factor AF_c to account for seismic amplification within the host equipment (cabinet, switchgear, motor control center, etc.)

The in-structure amplification factor AF_{SV} is derived from Figure 4-4 in Reference [8]. The in-cabinet vertical amplification factor, AF_c is derived in Reference [8] and is 4.7 for all cabinet types.

4 Contact Device Evaluations

Per Reference [8], seismic capacities (the highest seismic test level reached by the contact device without chatter or other malfunction) for each subject contact device are determined by the following procedures:

(1) If a contact device was tested as part of the EPRI High Frequency Testing program [7], then the component seismic capacity from this program is used.

(2) If a contact device was not tested as part of [7], then one or more of the following means to determine the component capacity were used:

   (a) Device-specific seismic test reports (either from the station or from the SQURTS testing program).

   (b) Generic Equipment Ruggedness Spectra (GERS) capacities per [9], [**Error! Reference source not found.**], [11], and [12].

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

   (d) Station A-46 program reports.

The high-frequency capacity of each device was evaluated (see [15]) with the component mounting point demand from Section 3 using the criteria in Section 4.5 of Reference [8].

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

5 Conclusions

5.1 General Conclusions

NMP1 has performed a High Frequency Confirmation evaluation in response to the NRC's 50.54(f) letter [1] using the methods in EPRI report 3002004396 [8].

The evaluation identified a total of 88 components that required seismic high frequency evaluation. As summarized in Table B-1 in Appendix B, 80 of the devices have adequate seismic capacity. The remaining 8 devices are adequate despite their seismic capacities' being less than seismic demand because any chatter in these 8 devices can be resolved by NMP1 operator actions.

5.2 Identification of Follow-up Actions

No follow-up actions are required.

6 References

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

2 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

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

4 Calvert Cliffs Nuclear Power Plant, Units 1 and 2; R.E. Ginna Nuclear Power Plant; and Nine Mile Point Nuclear Station, Units 1 and 2. "Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident." March 31, 2014. ADAMS Accession Number ML14099A196-1.

5 Not used.

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

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

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

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

10 Not used.

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

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

13 EPRI NP-7148, "Procedure for Evaluating Nuclear Power Plant Relay Seismic Functionality", 1990

14 NRC (F. Vega) Letter to Nine Mile Point Nuclear Station (P. Orphanos). "Nine Mile Point Nuclear 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. MF3973 and MF3974)." June 16, 2015., ADAMS Accession Number ML15153A660

15 15C4344-CAL-001, Rev. 2, "High Frequency Functional Confirmation and Fragility Evaluation of Relays"

16 NRC (C. Miller et al.) Report, "Recommendations for Enhancing Reactor Safety in the 21st Century: The Near-Term Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, ADAMS Accession Number ML111861807

17 NEI 12-06, Rev. 2. "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"

18 Not used.

19 NMP Report, "Final Safety Analysis Report (Updated)," Rev. 24, October 2015

20 NMP Drawing C19859C-008 Rev. 51, "Elementary Wiring Diagram Reactor Protection System (Emergency Cooling Channel #11)"

21 NMP Drawing C19859C-008A Rev. 24, "Elementary Wiring Diagram Reactor Protection System (Emergency Cooling Channel #12)"

22 NMP Drawing C19859C-024 Rev. 10, "Elementary Wiring Diagram Reactor Protection System (Ch. 11 Automatic Depressurization - Core Spray) ERV Valve #111"

23 NMP Drawing C19859C-024A Rev. 7, "Elementary Wiring Diagram Reactor Protection System (Channel #12 Automatic Depressurization-Core Spray) ERV Valve #121"

24 NMP Drawing C19859C-025 Rev. 9, "Elementary Wiring Diagram Reactor Protection System (Ch. 11 Automatic Depressurization - Core Spray) ERV Valve #112"

25 NMP Drawing C19859C-025A Rev. 9, "Elementary Wiring Diagram Reactor Protection System (Channel #12 Automatic Depressurization-Core Spray) ERV Valve #122"

26 NMP Drawing C19859C-026 Rev. 9, "Elementary Wiring Diagram Reactor Protection System (Ch. 11 Auto Depressurization - Core Spray) ERV Valve #113"

27 NMP Drawing C19859C-026A Rev. 8, "Elementary Wiring Diagram Reactor Protection System (Channel #12 Automatic Depressurization-Core Spray) ERV Valve #123"

28 NMP Drawing C19859C-018 Rev. 25, "Elementary Wiring Diagram Reactor Protection System Auto Depressurization - Core Spray"

29 NMP Drawing C19859C-018A Rev. 16, "Elementary Wiring Diagram Reactor Protection System Auto Depressurization - Core Spray"

30 NMP Drawing C19859C-002 Rev. 50, "Elementary Wiring Diagram Reactor Protection System (Channel 11 Coincident Logic)"

31 NMP Drawing C19859C-005 Rev. 43, "Elementary Wiring Diagram Reactor Protection System (Channel 12 Coincident Logic)"

32 NMP Drawing C18002C-001 Rev. 49, "P&ID Steam Flow Main Steam & High Pressure Turbine"

33 NMP Drawing C19437C-007 Rev. 31, "Elementary Wiring Diagram 600V Power Board 161A and 161B Control Circuits"

34 NMP Drawing C19440C-007 Rev. 32, "Elementary Wiring Diagram 600V Power Board 171B Control Circuits"

35 NMP Drawing C19859C-011 Rev. 32, "Elementary Wiring Diagram Reactor Protection System Vessel Isolation"

36 NMP Procedure N1-OP-43A Rev. 03900, "Nine Mile Point Nuclear Station Unit 1 Operating Procedure, Plant Startup"

37 NMP Drawing C19438C-008 Rev. 11, "Elementary Wiring Diagram 600V Power Board 167 Control Circuits"

38 NMP Drawing C19437C-005 Rev. 25, "Elementary Wiring Diagram 600V Power Board 161B Control Circuits"

39 NMP Drawing C19440C-005 Rev. 23, "Elementary Wiring Diagram 600V Power Board 171B Control Circuits"

40 NMP Procedure N1-OP-3 Rev. 04200, "Nine Mile Point Nuclear Station Unit 1 Operating Procedure, Reactor Cleanup System"

41 NMP Drawing C18007C-001 Rev. 59, "P&ID Reactor Core Spray"

42 NMP Procedure N1-OP-2 Rev. 03501, "Nine Mile Point Nuclear Station Unit 1 Operating Procedure, Core Spray System"

43 NMP Drawing C19438C-009 Rev. 6, "Elementary Wiring Diagram 600V Power Board 167 Control Circuits"

44 NMP Drawing C19950C-001 Rev. 29, "One Line Diagram Plant Control and Instrumentation Power Distribution"

45 NMP Drawing C19950C-002 Rev. 20, "One Line Diagram Plant Control and Instrumentation Power Distribution"

46 NMP Drawing C19410C-003 Rev. 31, "Elementary Wiring Diagram 4.16KV Emergency Power Board & Diesel Generator (#102 Control Circuits)"

47 NMP Drawing C19409C-002 Rev. 34, "One Line Diagram Auxiliary System 4160 Volt Power Boards 11 12 & 101"

48 NMP Drawing C19410C-005 Rev. 33, "Elementary Wiring Diagram 4.16KV Emergency Power Board & Diesel Generator (#103 Control Circuits)"

49 NMP Drawing C19410C-010 Rev. 44, "Elementary Wiring Diagram 4.16KV Emergency Power Board & Diesel Generator (#102 & 103 Control Circuits)"

50 NMP Drawing C19436C-006 Rev. 18, "Elementary Wiring Diagram, 600 Volt Power Board 16 Static Battery Charger 161A & 161B Control Circuits"

51 NMP Drawing C19436C-006A Rev. 12, "Elementary Wiring Diagram, 600 Volt Power Board 16 (Battery Charger 161B)"

52 NMP Drawing C19436C-006B Rev. 4, "Elementary Wiring Diagram, 600 Volt Power Board 16 (Battery Charger 161B)"

53 NMP Drawing C19436C-006C Rev. 3, “Elementary Wiring Diagram, 600 Volt Power Board 16 (Battery Charger 161A)”

54 NMP Drawing C19436C-006D Rev. 3, “Elementary Wiring Diagram, 600 Volt Power Board 16 (Battery Charger 161A)”

55 NMP Drawing C19439C-006 Rev. 20, “Elementary Wiring Diagram, 600 Volt Power Board 17 Static Battery Charger 171A & 171B Control Circuits”

56 NMP Drawing C19439C-006A Rev. 13, “Elementary Wiring Diagram, 600 Volt Power Board 17 (Battery Charger 171B)”

57 NMP Drawing C19439C-006B Rev. 5, “Elementary Wiring Diagram, 600 Volt Power Board 17 (Battery Charger 171B)”

58 NMP Drawing C19439C-006C Rev. 3, “Elementary Wiring Diagram, 600 Volt Power Board 17 (Battery Charger 171A)”

59 NMP Drawing C19439C-006D Rev. 3, “Elementary Wiring Diagram, 600 Volt Power Board 17 (Battery Charger 171A)”

60 NMP Drawing C19436C-005 Rev. 20, “Elementary Wiring Diagram, 600 Volt Power Board 16 Control Circuits (UPS 162A & 162B)”

61 NMP Drawing C19436C-005A Rev. 13, “Elementary Wiring Diagram, 600 Volt Power Board 16 Control Circuits (UPS 162A & 162B)”

62 NMP Drawing C19436C-005B Rev. 10, “Elementary Wiring Diagram, 600 Volt Power Board 16 Control Circuits (UPS 162A & 162B)”

63 NMP Drawing C19436C-005C Rev. 1, “Elementary Wiring Diagram, 600 Volt Power Board 16 Control Circuits (UPS 162A & 162B)”

64 NMP Drawing C19436C-005D Rev. 1, “Elementary Wiring Diagram, 600 Volt Power Board 16 Control Circuits (UPS 162A & 162B)”

65 NMP Drawing C19436C-005E Rev. 1, “Elementary Wiring Diagram, 600 Volt Power Board 16 Control Circuits (UPS 162A & 162B)”

66 NMP Drawing C19439C-005 Rev. 22, “Elementary Wiring Diagram, 600 Volt Power Board 17 Control Circuits (UPS 172A & 172B)”

67 NMP Drawing C19439C-005A Rev. 11, “Elementary Wiring Diagram, 600 Volt Power Board 17 Control Circuits (UPS 172A & 172B)”

68 NMP Drawing C19439C-005B Rev. 10, “Elementary Wiring Diagram, 600 Volt Power Board 17 Control Circuits (UPS 172A & 172B)”

69 NMP Drawing C19439C-005C Rev. 1, “Elementary Wiring Diagram, 600 Volt Power Board 17 Control Circuits (UPS 172A & 172B)”

70 NMP Drawing C19439C-005D Rev. 1, “Elementary Wiring Diagram, 600 Volt Power Board 17 Control Circuits (UPS 172A & 172B)”

71 NMP Drawing C19439C-005E Rev. 1, “Elementary Wiring Diagram, 600 Volt Power Board 17 Control Circuits (UPS 172A & 172B)”

72 NMP Drawing C18026C-001 Rev. 26, "P&ID Emergency Diesel Generator #102 Starting Air, Cooling Water, Lube Oil, and Fuel"

73 NMP Drawing C18026C-002 Rev. 29, "P&ID Emergency Diesel Generator #103 Starting Air, Cooling Water, Lube Oil, and Fuel"

74 NMP Drawing C19410C-001 Rev. 31, "Elementary Wiring Diagram 4.16KV Emergency Power Boards and Diesel Generators (#102 & #103 Power Circuits)"

75 NMP Drawing C19437C-008 Rev. 18, "Elementary Wiring Diagram 600V Power Board 161B Control Circuits"

76 NMP Drawing C19440C-008 Rev. 20, Elementary Wiring Diagram 600V Power Board 171B Control Circuits.

77 NMP Drawing C19409C-001 Rev. 14, "One Line Diagram Auxiliary System (Power Boards)"

78 NMP Drawing C19409C-008 Rev. 53, "One Line Diagram Auxiliary System 600 Volt Power Board 16, 161A & 161B"

79 NMP Drawing C19409C-009 Rev. 47, "One Line Diagram Auxiliary System 600 Volt Power Board 17, 171A & 171B"

80 NMP Drawing C19839C-001 Rev. 17, "One Line Diagram 125V DC Control Bus."

81 15C4344-RPT-001, Rev. 2. "Selection of Relays and Switches for High Frequency Seismic Evaluation."

A Representative Sample Component Evaluations

The following sample calculation is extracted from Reference [15].

Notes:

1. Reference citations within the sample calculation are per the Ref. [15] reference section shown on the following page.
2. This sample calculation contains evaluations of sample high-frequency-sensitive components per the methodologies of both the EPRI high-frequency guidance [8] and the flexible coping strategies guidance document NEI 12-06 [17].

6 REFERENCES

1. Codes, Guidance, and Standards
   1.1. EPRI 3002004396. "High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation." July 2015.
   1.2. EPRI 3002002997. "High Frequency Program: High Frequency Testing Summary." September 2014.
   1.3. EPRI NP-6041-SL. "A Methodology for Assessment of Nuclear Power Plant Seismic Margin (Revision 1)." August 1991.
   1.4. NEI 12-06, Rev. 2. "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide."
   1.5. EPRI NP-7147-SL, Volume 2, Addendum 2, "Seismic Ruggedness of Relays." April 1995.
   1.6. SQUG Advisory Memorandum 2004-02. "Relay GERS Corrections." September 7, 2004.
   1.7. ABS Consulting et al. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment." Rev. 3A.
   1.8. IEEE Standard 344-1975. "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."
   1.9. SANDIA Report SAND92-0140, Part I. "Use of Seismic Experience and Test Data to Show Ruggedness of Equipment in Nuclear Power Plants." Senior Seismic Review and Advisory Panel (SSRAP). February 28, 1991.
   1.10. IEEE Standard C37.98-1987. "IEEE Standard Seismic Testing of Relays."
   1.11. EPRI NP-7147-SL. "Seismic Ruggedness of Relays." August 1991.

2. Documents with Nuclear Regulatory Commission (NRC) Accession Numbers
   2.1. ML14099A196. Calvert Cliffs Nuclear Power Plant, Units 1 and 2, Renewed Facility Operating License Nos. DPR-53 and DPR-69; R.E. Ginna Nuclear Power Plant, Renewed Facility Operating License No. DPR-18, Docket No. 50-244; and Nine Mile Point Nuclear Station, Units 1 & 2, Renewed Facility Operating License Nos. DPR-63 and NPF-69, Docket Nos. 50-220 and 50-410. "Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident."
   2.2. ML12053A340. Letter to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status. "Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident." March 12, 2012.
   2.3. ML12054A735. Order EA-12-049 to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status. "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." March 12, 2012.

3. Station Documents

3.1. UFSAR

3.1.1. Nine Mile Point UFSAR, Rev. 23.

3.2. Reports

3.2.1. Nine Mile Point IPEEE (SAS-I3U1-1) Rev. 0, "Identification of Structures, Systems, & Components."
3.2.2. Nine Mile Point Report 1EQDP-PNL003, Rev. 3.
3.2.3. NER-1S-013, Rev. 1. "USI A-46 Relay Evaluation Path - Nine Mile Point Unit 1."
3.2.4. NER-1S-018, Rev. 0. "Results of BWR Trial Plant Review - Nine Mile Point Unit 1 (SQUG)."
3.2.5. SAS-I3U1-4, Rev. 0. "Seismic Analysis – A46 Relay Outliers – Functional Evaluation."

3.3. Drawings

3.3.1. C19184C-001, Rev. 4. "Diesel Gen. & Control Room – Walls & Piers below EL. 261'-0" & Slab at EL. 250'-0" – Reinforcing Details."
3.3.2. C19453C-003, Rev. 21. "Conduit Detail – Turbine Bldg. EL. 277'-0" – (Control Room)."
3.3.3. C19794C-001, Rev. 10. "4160 Volt Power Board 101 – Plan & Front View."
3.3.4. C19794C-002, Rev. 10. "4160 Volt Power Board 101 – Plan & Front View."
3.3.5. C19795C-003, Rev. 3. "4160 Volt Power Boards – 11 - 12 - 101 – Summary Sheets."
3.3.6. C19798C-001, Rev. 10. "4160 Volt Power Board #102 – Plan & Front View."
3.3.7. C19798C-002, Rev. 4. "4160 Volt Power Board #102 – Plan & Front View – (Details & Sections)."
3.3.8. C19799C-001, Rev. 11. "4160 Volt Power Board #103 – Plan & Front View."
3.3.9. C19799C-002, Rev. 4. "4160 Volt Power Board #103 – Plan & Front View – (Details & Sections)."
3.3.10. C18805C-001, Rev. 30. "Turbine Building – Turbine Generator Area – Floor Plan at EL. 277'-0"."
3.3.11. C22238C-001B, Rev. 3. "Control Board – Panels 3A and 4A – Front View & Sections."
3.3.12. C22391C-001, Rev. 4. "Diesel Control Panels 1T & 2T – Front View & Sections."
3.3.13. C22449C-001, Rev. 11. "Floor Plan, Front View & Sections – Diesel Generators #102 & #103 – Control Cabinets."
3.3.14. C22449C-002, Rev. 1. "Front View – Details – Diesel Generators #102 & #103 – Control Cabinets."
3.3.15. C22238C-001C, Rev. 2. "Control Board – Panels 5A and 6A – Front View & Sections."

3.4. Other Station Documents

3.4.1. Exelon Nuclear Issue 02608956. "Motor Starters for MOT-40-30 not in FCMS." January 7, 2016. (See Attachment D, pp. D-10 and D-11 of this calculation.)

4. S&A Documents
   4.1. 15C4344-RPT-001, Rev. 2, "Selection of Relays and Switches for High Frequency Seismic Evaluation."
   4.2. 15C4344-LRC-001. "NMP1: Request for site-specific EDG relay qualification information." February 16, 2016. (See Attachment F of this calculation.)
   4.3. 15C4344-LRC-002. "Nine Mile Diesel Relays." January 29, 2016. (See Attachment G of this calculation.)
   4.4. 15C4344-LRC-003. "NMP1 Relays Whose Schematic IDs Do Not Match Station IDs." (See Attachment J of this calculation.)

5. Other Documents
   5.1. TE Connectivity Qualification Test Report 501-529, Rev. E, "Nuclear Environmental Qualification Test Report on Agastat EGP, EML and ETR Control Relays by Control Products Division, Amerace Corporation."
   5.2. General Electric Report GE-101, Rev. 1, "GE Dynamic Qualification Report for Class 1E Control Room Panels." (Note: GE-101 was originally supplied for Limerick Generating Station)
   5.3. Farwell & Hendricks, Inc., Report No. 61409, Rev. 0. "Nuclear Environmental Qualification Report for Various Components – Prepared for the Virginia Electric & Power Company – Reference P.O. #SNS 411321."
   5.4. Trentec Report No. T8357.0, Rev. 0. "Seismic Test Report for Allen Bradley P/N: 700DC-R440-Z1 w/ Allen Bradley Surge Suppressor P/N: 199-FSMA10."
   5.5. Not used.
   5.6. ABB Addendum to IB 7.4.1.7-7 Issue E, Rev. 1, "Type 27N High Accuracy Undervoltage Relay & Type 59N High Accuracy Overvoltage Relay." (See Attachment H of this calculation.)
   5.7. General Electric Report RN-150. "Nuclear Qualified Devices – Relays, Control Switches, & Accessories." January 25, 1990.
   5.8. General Electric Instruction Manual GEH-1753E. "Time Overcurrent Relays."
   5.9. Wyle Test Report No. 41070-1. "Seismic Simulation Test Program on a 500-Ampere Battery Charger." February 20, 1991.

7 INPUTS

Inputs are provided as necessary within Section 8 of this calculation.

8 ANALYSIS

A detailed example analysis of two relays is provided within this section. This example is intended to illustrate each step of the high frequency analysis methodology given in Section 2. A complete analysis of all subject relays is shown in tabular form in Attachment A.

8.1 Equipment Scope

The list of essential relays at NMP1 are per Ref. 4.1, Table 7-1, and can be found in Attachment A, Table A-1 of this calculation.

8 ANALYSIS (cont'd)

8.2 High-Frequency Seismic Demand

Calculate the high-frequency seismic demand on the relays per the methodology from Ref. 1.1.

Sample calculations for the high-frequency seismic demand of components K17A and R36A are presented below. A table that calculates the high-frequency seismic demand for all of the subject relays listed in Attachment A, Table A-1 of this calculation is provided in Attachment A, Table A-2 of this calculation.

8.2.1 Horizontal Seismic Demand

The horizontal site-specific GMRS for NMP1 is per Ref. 2.1. GMRS data can be found in Attachment B of this calculation.

Determine the peak acceleration of the horizontal GMRS between 15 Hz and 40 Hz.

Peak acceleration of horizontal GMRS between 15 Hz and 40 Hz (Ref. 2.1; see Attachment B of this calculation): $SA_{GMRS} := 0.245g$ (at 15 Hz)

Calculate the horizontal in-structure amplification factor based on the distance between the plant foundation elevation and the subject floor elevation.

Foundation Elevation (Reactor Building): (Ref. 3.1) $El_{found} := 198ft$

Relay floor elevation (See Table 1-1): $EL_{relay} := 281ft$

Relay components K17A and R36A are both located in the Reactor Building at elevation 281'.

Distance between relay floor and foundation: $h_{relay} := EL_{relay} - El_{found} = 83.00 \cdot ft$

8 ANALYSIS (cont'd)

8.2 High-Frequency Seismic Demand (cont'd)

8.2.1 Horizontal Seismic Demand (cont'd)

Work the distance between the relay floor and foundation with Ref. 1.1, Fig. 4-3 to calculate the horizontal in-structure amplification factor.

Slope of amplification factor line, $0ft < h_{relay} < 40ft$

$$m_h := \frac{2.1 - 1.2}{40ft - 0ft} = 0.0225 \cdot \frac{1}{ft}$$

Intercept of amplification factor line, $0ft < h_{relay} < 40ft$

$$b_h := 1.2$$

Horizontal in-structure amplification factor:

$$AF_{SH}(h_{relay}) := \begin{vmatrix} (m_h \cdot h_{relay} + b_h) & \text{if} \quad h_{relay} \le 40ft \\ 2.1 & \text{otherwise} \end{vmatrix}$$

$$AF_{SH}(h_{relay}) = 2.10$$

Calculate the horizontal in-cabinet amplification factor based on the type of cabinet that contains the subject relay.

Type of cabinet (per Ref. 3.2) (enter "MCC", "Switchgear", "Control Cabinet", or "Rigid"):

cab := "Switchgear"

Horizontal in-cabinet amplification factor (Ref. 1.1, p. 4-13):

$$AF_{c.h}(cab) := \begin{vmatrix} 3.6 & \text{if} & cab = \text{"MCC"} \\ 7.2 & \text{if} & cab = \text{"Switchgear"} \\ 4.5 & \text{if} & cab = \text{"Control Cabinet"} \\ 1.0 & \text{if} & cab = \text{"Rigid"} \end{vmatrix}$$

$$AF_{c.h}(cab) = 7.2$$

Multiply the peak horizontal GMRS acceleration between by the horizontal in-structure and in-cabinet amplification factors to determine the in-cabinet response spectrum demand on the relays.

Horizontal in-cabinet response spectrum (Ref. 1.1, p. 4-12, Eq. 4-1a):

$$ICRS_{c.h} := AF_{SH}(h_{relay}) \cdot AF_{c.h}(cab) \cdot SA_{GMRS} = 3.704 \cdot g$$

Note that the horizontal seismic demand is the same for both relay components K17A and R36A.

8 ANALYSIS (cont'd)

8.2 High-Frequency Seismic Demand (cont'd)

8.2.2 Vertical Seismic Demand

Determine the peak acceleration of the horizontal GMRS between 15 Hz and 40 Hz.

Peak acceleration of horizontal GMRS between 15 Hz and 40 Hz (see Sect. 8.2.1 of this calculation) $SA_{GMRS} = 0.245 \cdot g$ (at 15 Hz)

Obtain the peak ground acceleration (PGA) of the horizontal GMRS from Ref. 2.1 (see Attachment B of this calculation).

$$PGA_{GMRS} := 0.122g$$

Calculate the shear wave velocity traveling from a depth of 30m to the surface of the site (V_{s30}) from Ref. 1.1 and Attachment C.

Shear Wave Velocity:

$$V_{s30} = \frac{(30m)}{\Sigma\left(\frac{d_i}{V_{si}}\right)}$$

where,
d_i: Thickness of the layer (ft)
V_{si}: Shear wave velocity of the layer (ft/s)

Per Attachment C, the sum of thickness of the layer over shear wave velocity of the layer is 0.01374 sec.

Shear Wave Velocity:

$$V_{s30} := \frac{30m}{0.01374sec} = 7163 \cdot \frac{ft}{sec}$$

8 ANALYSIS (cont'd)

8.2 High-Frequency Seismic Demand (cont'd)

8.2.2 Vertical Seismic Demand (cont'd)

Work the PGA and shear wave velocity with Ref. 1.1, Table 3-1 to determine the soil class of the site. Based on the PGA of 0.122g and shear wave velocity of 7163ft/sec at NMP1, the site soil class is B-Hard.

Work the site soil class with Ref. 1.1, Table 3-2 to determine the mean vertical vs. horizontal GMRS ratios (V/H) at each spectral frequency. Multiply the V/H ratio at each frequency between 15Hz and 40Hz by the corresponding horizontal GMRS acceleration at each frequency between 15Hz and 40Hz to calculate the vertical GMRS.

See Attachment B for a table that calculates the vertical GMRS (equal to (V/H) x horizontal GMRS) between 15Hz and 40Hz.

Determine the peak acceleration of the vertical GMRS (SA_{VGMRS}) between frequencies of 15Hz and 40Hz. (By inspection of Attachment B, the SA_{VGMRS} occurs at 15Hz.)

V/H ratio at 15Hz (See Attachment B of this calculation):	$VH := 0.68$
Horizontal GMRS at frequency of peak vertical GMRS (at 15Hz) (See Attachment B of this calculation):	$HGMRS := 0.245g$
Peak acceleration of vertical GMRS between 15 Hz and 40 Hz:	$SA_{VGMRS} := VH \cdot HGMRS = 0.167 \cdot g$ (at 15 Hz)

A plot of horizontal and vertical GMRS is provided in Attachment B of this calculation.

8 ANALYSIS (cont'd)

8.2 High-Frequency Seismic Demand (cont'd)

8.2.2 Vertical Seismic Demand (cont'd)

Calculate the vertical in-structure amplification factor based on the distance between the plant foundation elevation and the subject floor elevation.

Distance between relay floor and foundation (see Sect. 8.2.1 of this calculation): $h_{relay} = 83.00 \cdot ft$

Work the distance between the relay floor and foundation with Ref. 1.1, Fig. 4-4 to calculate the vertical in-structure amplification factor.

Slope of amplification factor line: $m_v := \frac{2.7 - 1.0}{100ft - 0ft} = 0.017 \cdot \frac{1}{ft}$

Intercept of amplification factor line: $b_v := 1.0$

Vertical in-structure amplification factor: $AF_{SV} := m_v \cdot h_{relay} + b_v = 2.411$

Per Ref. 1.1, the vertical in-cabinet amplification factor is 4.7 regardless of cabinet type.

Vertical in-cabinet amplification factor: $AF_{c.v} := 4.7$

Multiply the peak vertical GMRS acceleration between by the vertical in-structure and in-cabinet amplification factors to determine the in-cabinet response spectrum demand on the relay.

Vertical in-cabinet response spectrum (Ref. 1.1, p. 4-12, Eq. 4-1b):

$$ICRS_{c.v} := AF_{SV} \cdot AF_{c.v} \cdot SA_{VGMRS} = 1.89 \cdot g$$

Note that the vertical seismic demand is same for both relay components K17A and R36A.

8 ANALYSIS (cont'd)

8.3 High-Frequency Seismic Capacity

A sample calculation for the high-frequency seismic capacity of components K17A and R36A are presented here. A table that calculates the high-frequency seismic capacities for all of the subject relays listed in Attachment A, Table A-1 of this calculation is provided in Attachment A, Table A-2 of this calculation.

8.3.1 Seismic Test Capacity

The high frequency seismic capacity of a relay can be determined from the EPRI High Frequency Testing Program (Ref. 1.2) or other broad banded low frequency capacity data such as the Generic Equipment Ruggedness Spectra (GERS) or vendor qualification reports. Per Ref. 1.1, Sect. 4.5.2, a conservative estimate of the high-frequency (i.e., 20Hz to 40Hz) capacity can be made by extending the low frequency GERS capacity into the high frequency range to a roll off frequency of about 40Hz. Therefore, if the high frequency capacity was not available for a component, a SA_T value equal to the GERS spectral acceleration from 4 to 16 Hz could be used.

The relay model for component K17A, an Agastat EGPB004 per Table 1-1, was not tested as part of the Ref. 1.2 high-frequency testing program. However, a capacity of 5.2g was obtained from TE Qualification Report 501-529 (Ref. 5.1).

The relay model for component R36A, an ASEA RXMA1 per Table 1-1, was also not tested as part of the Ref. 1.2 high-frequency testing program, but it was included in the EPRI (GERS) report NP-7147-SL Volume 2 Addendum 2 (Ref. 1.5). Since this relay is energized (operate) per Ref. 4.1, a capacity of 10.0g is selected from NP-7147-SL.

Seismic test capacity (SA*):

$$SA' := \begin{pmatrix} 5.2 \\ 10.0 \end{pmatrix} g \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

8.3.2 Effective Spectral Test Capacity

Since neither K17A nor R36A has a capacity derived from the Ref. 1.2 high frequency test program, there are no spectral acceleration increases for either relay; therefore, the effective spectral test capacity is equal to the seismic test capacity.

Effective spectral test capacity (Ref. 1.1, p. 4-16):

$$SA_T := \begin{pmatrix} SA'_1 \\ SA'_2 \end{pmatrix} = \begin{pmatrix} 5.20 \\ 10.00 \end{pmatrix} \cdot g \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

8 ANALYSIS (cont'd)

8.3 High-Frequency Seismic Capacity (cont'd)

8.3.3 Seismic Capacity Knockdown Factor

Determine the seismic capacity knockdown factor for the subject relay based on the type of testing used to determine the seismic capacity of the relay.

Using Table 4-2 of Ref. 1.1 and the capacity sources from Section 8.3.1 above (i.e., K17A's capacity is per an IEEE-344 test, while R36A's capacity is per a GERS test), the knockdown factors are chosen as:

Seismic capacity knockdown factor: $F_k := \begin{pmatrix} 1.20 \\ 1.50 \end{pmatrix} \qquad \begin{pmatrix} \text{K17A} \\ \text{R36A} \end{pmatrix}$

8.3.4 Seismic Testing Single-Axis Correction Factor

Determine the seismic testing single-axis correction factor of the subject relay, which is based on whether the equipment housing to which the relay is mounted has well-separated horizontal and vertical motion or not.

Per Ref. 1.1, pp. 4-18, conservatively take the F_{MS} value as 1.0 for both K17A and R36A.

Single-axis correction factor (Ref. 1.1, pp. 4-17 to 4-18): $F_{MS} := 1.0$

8 ANALYSIS (cont'd)

8.3 High-Frequency Seismic Capacity for Ref. 1.1 Relays (cont'd)

8.3.5 Effective Wide-Band Component Capacity Acceleration

Calculate the effective wide-band component capacity acceleration per Ref. 1.1, Eq. 4-5.

Effective wide-band component capacity acceleration (Ref. 1.1, Eq. 4-5)

$$TRS := \left(\frac{SA_T}{F_k}\right) \cdot F_{MS} = \begin{pmatrix} 4.333 \\ 6.667 \end{pmatrix} \cdot g \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

8.4 High-Frequency Seismic Capacity for Ref. 1.4, Appendix H Relays

8.4.1 Effective Wide-Band Component Capacity Acceleration

Per a review of the capacity generation methodologies of Ref. 1.1 and Ref. 1.4, App. H, Section H.5, the capacity of a Ref. 1.4 relay is equal to the Ref. 1.1 effective wide-band component capacity multiplied by a factor accounting for the difference between a 1% probability of failure ($C_{1\%}$, Ref. 1.1) and a 10% probability of failure ($C_{10\%}$, Ref. 1.4).

Per Ref. 1.4, App. H, Table H.1, use the $C_{10\%}$ vs. $C_{1\%}$ ratio from the Realistic Lower Bound Case for relays.

$C_{10\%}$ vs. $C_{1\%}$ ratio (i.e., $C_{10\%}/C_{1\%}$) $\qquad C_{10} := 1.36$

Effective wide-band component capacity acceleration (Ref. 1.4, App. H, Sect. H.5)

$$TRS_{1.4} := TRS \cdot C_{10} = \begin{pmatrix} 5.893 \\ 9.067 \end{pmatrix} \cdot g \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

8 ANALYSIS (cont'd)

8.5 Relay (Ref. 1.1) High-Frequency Margin

Calculate the high-frequency seismic margin for relays per Ref. 1.1, Eq. 4-6.

A sample calculation for the high-frequency seismic demand of relay components K17A and R36A is presented here. A table that calculates the high-frequency seismic margin for all of the subject relays listed in Attachment A, Table A-1 of this calculation is provided in Attachment A, Table A-2 of this calculation.

Horizontal seismic demand (see Section 8.2.1 of this calculation):

$$ICRS_{c.h} = 3.70 \cdot g$$

Vertical seismic demand (see Section 8.2.2 of this calculation):

$$ICRS_{c.v} = 1.89 \cdot g$$

Ref. 1.1 component capacity acceleration (see Section 8.3.5 of this calculation):

$$TRS = \begin{pmatrix} 4.333 \\ 6.667 \end{pmatrix} \cdot g \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

Horizontal seismic margin (Ref. 1.1, Eq. 4-6):

$$\frac{TRS}{ICRS_{c.h}} = \begin{pmatrix} 1.170 \\ 1.800 \end{pmatrix} \quad \begin{matrix} \mathbf{> 1.0,\ O.K.} \\ \mathbf{> 1.0,\ O.K.} \end{matrix} \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

Vertical seismic margin (Ref. 1.1, Eq. 4-6):

$$\frac{TRS}{ICRS_{c.v}} = \begin{pmatrix} 2.295 \\ 3.531 \end{pmatrix} \quad \begin{matrix} \mathbf{> 1.0,\ O.K.} \\ \mathbf{> 1.0,\ O.K.} \end{matrix} \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

Both the horizontal and vertical seismic margins for K17A and R36A are greater than 1.00; indicating that these components are adequate for high frequency seismic spectral ground motion for its Ref. 1.1 functions.

8 ANALYSIS (cont'd)

8.6 Relay (Ref. 1.4) High-Frequency Margin

Calculate the high-frequency seismic margin for Ref. 1.4 relays per Ref. 1.1, Eq. 4-6.

A sample calculation for the high-frequency seismic demand of relay components K17A and R36A is presented here. A table that calculates the high-frequency seismic margin for all of the subject relays listed in Attachment A, Table A-1 of this calculation is provided in Attachment A, Table A-2 of this calculation.

Horizontal seismic demand (see Section 8.2.1 of this calculation):

$$ICRS_{c.h} = 3.70 \cdot g$$

Vertical seismic demand (see Section 8.2.2 of this calculation):

$$ICRS_{c.v} = 1.89 \cdot g$$

Ref. 1.4 component capacity acceleration (see Section 8.4.1 of this calculation):

$$TRS_{1.4} = \begin{pmatrix} 5.893 \\ 9.067 \end{pmatrix} \cdot g \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

Horizontal seismic margin (Ref. 1.1, Eq. 4-6):

$$\frac{TRS_{1.4}}{ICRS_{c.h}} = \begin{pmatrix} 1.591 \\ 2.448 \end{pmatrix} \quad \begin{matrix} > 1.0, \text{ O.K.} \\ > 1.0, \text{ O.K.} \end{matrix} \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

Vertical seismic margin (Ref. 1.1, Eq. 4-6):

$$\frac{TRS_{1.4}}{ICRS_{c.v}} = \begin{pmatrix} 3.122 \\ 4.803 \end{pmatrix} \quad \begin{matrix} > 1.0, \text{ O.K.} \\ > 1.0, \text{ O.K.} \end{matrix} \qquad \begin{pmatrix} K17A \\ R36A \end{pmatrix}$$

Both the horizontal and vertical seismic margins for K17A and R36A are greater than 1.00; therefore, these components are adequate for high-frequency seismic spectral ground motion for its Ref. 1.4 functions.

B Components Identified for High Frequency Confirmation

Table B-1: Components Identified for High Frequency Confirmation

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
1	1	36-06A-M	Trip Unit	Core Cooling	EMERGENCY CONDENSER STEAM FLOW TRIP UNIT	Rosemount, Inc.	510DU137020A005	A.T.S. CAB A	Switchgear	Reactor	281	Qualification Test	Cap > Dem
2	1	36-06B-M	Trip Unit	Core Cooling	EMERGENCY CONDENSER STEAM FLOW TRIP UNIT	Rosemount, Inc.	510DU137020A005	A.T.S. CAB B	Switchgear	Reactor	281	Qualification Test	Cap > Dem
3	1	36-06C-M	Trip Unit	Core Cooling	EMERGENCY CONDENSER STEAM FLOW TRIP UNIT	Rosemount, Inc.	510DU137020A005	A.T.S. CAB C	Switchgear	Reactor	281	Qualification Test	Cap > Dem
4	1	36-06D-M	Trip Unit	Core Cooling	EMERGENCY CONDENSER STEAM FLOW TRIP UNIT	Rosemount, Inc.	NUS-710DU0TT37020	A.T.S. CAB D	Switchgear	Reactor	281	Qualification Test	Cap > Dem
5	1	4-11A	Auxiliary Relay	Core Cooling	EMERGENCY CONDENSER RELAY	General Electric	12HFA151A2F	1S75	Switchgear	Turbine	261	High Freq. Test Program	Cap > Dem
6	1	4-11B	Auxiliary Relay	Core Cooling	EMERGENCY CONDENSER RELAY	General Electric	12HFA151A2F	1S65	Switchgear	Turbine	261	High Freq. Test Program	Cap > Dem
7	1	4-12A	Auxiliary Relay	Core Cooling	EMERGENCY CONDENSER RELAY	General Electric	12HFA151A2F	1S65	Switchgear	Turbine	261	High Freq. Test Program	Cap > Dem
8	1	4-12B	Auxiliary Relay	Core Cooling	EMERGENCY CONDENSER RELAY	General Electric	12HFA151A2F	1S75	Switchgear	Turbine	261	High Freq. Test Program	Cap > Dem
9	1	K17A	Control Relay	Core Cooling	EMERGENCY CONDENSER STEAM FLOW RELAY	Amerace / Agastat	EGPB004	A.T.S. CAB A	Switchgear	Reactor	281	Qualification Test	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
10	1	K17B	Control Relay	Core Cooling	EMERGENCY CONDENSER STEAM FLOW RELAY	Amerace / Agastat	EGPB004	A.T.S. CAB B	Switchgear	Reactor	281	Qualification Test	Cap > Dem
11	1	K17C	Control Relay	Core Cooling	EMERGENCY CONDENSER STEAM FLOW RELAY	Amerace / Agastat	EGPB004	A.T.S. CAB C	Switchgear	Reactor	281	Qualification Test	Cap > Dem
12	1	K17D	Control Relay	Core Cooling	EMERGENCY CONDENSER STEAM FLOW RELAY	Amerace / Agastat	EGPB004	A.T.S. CAB D	Switchgear	Reactor	281	Qualification Test	Cap > Dem
13	1	R36A	Output Relay	Core Cooling	EMERGENCY CONDENSER AUTO CLOSE RELAY	ASEA	RXMA1	SSC1	Switchgear	Reactor	281	GERS	Cap > Dem
14	1	R36B	Output Relay	Core Cooling	EMERGENCY CONDENSER AUTO CLOSE RELAY	ASEA	RXMA1	SSC1	Switchgear	Reactor	281	GERS	Cap > Dem
15	1	R36C	Output Relay	Core Cooling	EMERGENCY CONDENSER AUTO CLOSE RELAY	ASEA	RXMA1	SSC2	Switchgear	Reactor	281	GERS	Cap > Dem
16	1	R36D	Output Relay	Core Cooling	EMERGENCY CONDENSER AUTO CLOSE RELAY	ASEA	RXMA1	SSC2	Switchgear	Reactor	281	GERS	Cap > Dem
17	1	RLY-(PRC162)59-1	Overvoltage Relay	AC/DC Power Support Systems	UPS 162 OVERVOLTAGE RELAY	ABB	59N,411U4175-HF-L	PNL-PRC162	Switchgear	Turbine	277	GERS	Cap > Dem
18	1	RLY-(PRC162)59-2	Overvoltage Relay	AC/DC Power Support Systems	UPS 162 OVERVOLTAGE RELAY	ABB	59N,411U4175-HF-L	PNL-PRC162	Switchgear	Turbine	277	GERS	Cap > Dem
19	1	RLY-(PRC172)59-1	Overvoltage Relay	AC/DC Power Support Systems	UPS 162 OVERVOLTAGE RELAY	ABB	59N,411U4175-HF-L	PNL-PRC172	Switchgear	Turbine	277	GERS	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
20	1	RLY-(PRC172)59-2	Overvoltage Relay	AC/DC Power Support Systems	UPS 162 OVERVOLTAGE RELAY	ABB	59N,411U4175-HF-L	PNL-PRC172	Switchgear	Turbine	277	GERS	Cap > Dem
21	1	67NI; RLY-(1S3)67NI	Overcurrent Relay	AC/DC Power Support Systems	DIRECTIONAL OVERCURRENT RELAY - EDG102 RELAYING CIRCUIT AND LOCKOUT RELAY 86DG-2	General Electric	12CJCG15E21A	1T (aka 1S3)	Switchgear	Turbine	261	N/A	Operator Action
22	1	67NI; RLY-(1S4)67NI	Overcurrent Relay	AC/DC Power Support Systems	DIRECTIONAL OVERCURRENT RELAY - EDG103 RELAYING CIRCUIT AND LOCKOUT RELAY 86DG-3	General Electric	12CJCG15E21A	2T (aka 1S4)	Switchgear	Turbine	261	N/A	Operator Action
23	1	86DG-2/HR; RLY-(4A)86DG-2	Auxiliary Relay	AC/DC Power Support Systems	DG #102 LOCKOUT RELAY	General Electric	12HEA61B237	4A	Control Cabinet	Turbine	277	GERS	Cap > Dem
24	1	RLY-(5A)86DG-3	Auxiliary Relay	AC/DC Power Support Systems	DG #103 LOCKOUT RELAY	General Electric	12HEA61B237	5A	Control Cabinet	Turbine	277	GERS	Cap > Dem
25	1	51-A; RLY-(102)50/51-1	Overcurrent Relay	AC/DC Power Support Systems	R1021 A PHASE TIME OVERCURRENT RELAY	General Electric	12IAC51A101AAH	PB 102	Switchgear	Turbine	261	GERS	Cap > Dem
26	1	51-B; RLY-(102)50/51-2	Overcurrent Relay	AC/DC Power Support Systems	R1021 B PHASE TIME OVERCURRENT RELAY	General Electric	12IAC51A101AAH	PB 102	Switchgear	Turbine	261	GERS	Cap > Dem
27	1	51-C; RLY-(102)50/51-3	Overcurrent Relay	AC/DC Power Support Systems	R1021 C PHASE TIME OVERCURRENT RELAY	General Electric	12IAC51A101AAH	PB 102	Switchgear	Turbine	261	GERS	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
28	1	51-A; RLY-(103)50/51-1	Overcurrent Relay	AC/DC Power Support Systems	R1031 A PHASE TIME OVERCURRENT RELAY AUX FEEDER 17B INST OC RELAY PH1	General Electric	12IAC51A101AAH	PB 103	Switchgear	Turbine	261	GERS	Cap > Dem
29	1	51-B; RLY-(103)50/51-2	Overcurrent Relay	AC/DC Power Support Systems	R1031 B PHASE TIME OVERCURRENT RELAY AUX FEEDER 17B INST OC RELAY PH2	General Electric	12IAC51A101AAH	PB 103	Switchgear	Turbine	261	GERS	Cap > Dem
30	1	51-C; RLY-(103)50/51-3	Overcurrent Relay	AC/DC Power Support Systems	R1031 C PHASE TIME OVERCURRENT RELAY AUX FEEDER 17B INST OC RELAY PH3	General Electric	12IAC51A101AAH	PB 103	Switchgear	Turbine	261	GERS	Cap > Dem
31	1	RLY-(101/2B-1)51/50-1	Overcurrent Relay	AC/DC Power Support Systems	R1012 A PHASE OVERCURRENT RELAY	General Electric	12IAC51B806A	PB 101	Switchgear	Turbine	277	GERS	Cap > Dem
32	1	RLY-(101/2B-1)51/50-2	Overcurrent Relay	AC/DC Power Support Systems	R1012 B PHASE OVERCURRENT RELAY	General Electric	12IAC51B806A	PB 101	Switchgear	Turbine	277	GERS	Cap > Dem
33	1	RLY-(101/2B-1)51/50-3	Overcurrent Relay	AC/DC Power Support Systems	R1012 C PHASE OVERCURRENT RELAY	General Electric	12IAC51B806A	PB 101	Switchgear	Turbine	277	GERS	Cap > Dem
34	1	51V-A: RLY-(102/2-2)51V-1	Overcurrent Relay	AC/DC Power Support Systems	EDG102 OVERCURRENT RELAY PH1 - R1022/571	General Electric	12IJCV51A13A	PB 102	Switchgear	Turbine	261	GERS	Cap > Dem
35	1	51V-B; RLY-(102/2-2)51V-2	Overcurrent Relay	AC/DC Power Support Systems	EDG102 OVERCURRENT RELAY PH2 - R1022/571	General Electric	12IJCV51A13A	PB 102	Switchgear	Turbine	261	GERS	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
36	1	51V-C; RLY-(102/2-2)51V-3	Overcurrent Relay	AC/DC Power Support Systems	EDG102 OVERCURRENT RELAY PH3 - R1022/571	General Electric	12IJCV51A13A	PB 102	Switchgear	Turbine	261	GERS	Cap > Dem
37	1	51V-B; RLY-(103/1-2)51V-2	Overcurrent Relay	AC/DC Power Support Systems	EDG103 OVERCURRENT RELAY PH2 - R1032/581	General Electric	12IJCV51A13A	PB 103	Switchgear	Turbine	261	GERS	Cap > Dem
38	1	51V-A; RLY-(103/1-2)51V-1	Overcurrent Relay	AC/DC Power Support Systems	EDG103 OVERCURRENT RELAY PH1 - R1032/581	General Electric	12IJCV51A13A	PB 103	Switchgear	Turbine	261	GERS	Cap > Dem
39	1	51V-C: RLY-(103/1-2)51V-3	Overcurrent Relay	AC/DC Power Support Systems	EDG103 OVERCURRENT RELAY PH3 - R1032/581	General Electric	12IJCV51A13A	PB 103	Switchgear	Turbine	261	GERS	Cap > Dem
40	1	2-2X; RLY-(DC102)2-2X	Control Relay	AC/DC Power Support Systems	DG-102 AUXILIARY RELAY, 2-2X	Allen-Bradley	700DC-R440Z1	PNL-DC 102	Switchgear	Turbine	261	Qualification Test	Cap > Dem
41	1	2-2X; RLY-(DC103)2-2X	Control Relay	AC/DC Power Support Systems	DG-103 AUXILIARY RELAY, 2-2X	Allen-Bradley	700DC-R440Z1	PNL-DC 103	Switchgear	Turbine	261	Qualification Test	Cap > Dem
42	1	2-3: RLY-(DC102)2-3	Timing Relay	AC/DC Power Support Systems	DG-102 TIME DELAY RELAY, 2-3	Allen-Bradley	700-RTC1111OU1	PNL-DC 102	Switchgear	Turbine	261	Qualification Test	Cap > Dem
43	1	2-3: RLY-(DC103)2-3	Timing Relay	AC/DC Power Support Systems	DG-103 TIME DELAY RELAY, 2-3	Allen-Bradley	700-RTC1111OU1	PNL-DC 103	Switchgear	Turbine	261	Qualification Test	Cap > Dem
44	1	12X; RLY-(DE102)12X	Overspeed Relay	AC/DC Power Support Systems	DG-102 OVERSPEED RELAY, 12X	EMD - General Motors	CLASS7001PO-53	DG-102 PNL DE	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem
45	1	38D-X: RLY-(DE102)38D-X	Overspeed Relay	AC/DC Power Support Systems	DG-102 MAIN BEARING RELAY, 38D-X	EMD - General Motors	CLASS7001PO-53	DG-102 PNL DE	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
46	1	38D-X; RLY-(DE103)38D-X	Overspeed Relay	AC/DC Power Support Systems	DG-103 MAIN BEARING RELAY, 38D-X	EMD - General Motors	CLASS7001PO-53	DG-103 PNL DE	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem
47	1	12X: RLY-(DE103)12X	Overspeed Relay	AC/DC Power Support Systems	DG-103 OVERSPEED RELAY, 12X	EMD - General Motors	CLASS7001PO-53	DG-103 PNL DE	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem
48	1	RLY-(DE103)5D	Overspeed Relay	AC/DC Power Support Systems	DG-103 SHUTDOWN RELAY	EMD - General Motors	CLASS 7001 PO-52	PNL-DE 103	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem
49	1	RLY-(DE102)5D	Overspeed Relay	AC/DC Power Support Systems	DG-102 SHUTDOWN RELAY	EMD - General Motors	CLASS 7001 PO-53	PNL-DE 102	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem
50	1	RLY-(DE102)5DE	Overspeed Relay	AC/DC Power Support Systems	DG-102 FAST STOP RELAY	EMD - General Motors	CLASS 7001 PO-53	PNL-DE 102	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem
51	1	RLY-(DE103)5DE	Overspeed Relay	AC/DC Power Support Systems	DG-103 FAST STOP RELAY	EMD - General Motors	CLASS 7001 PO-53	PNL-DE 103	Mounted to EDG Skid	Turbine	261	Bounding Spectrum	Cap > Dem
52	1	87DG-2/A; RLY-(1S3)87DG-2-1	Differential Relay	AC/DC Power Support Systems	BUS 102 PHASE DIFFERENTIAL RELAY PHASE 1	General Electric	12IJD52A11A	1T (aka 1S3)	Switchgear	Turbine	261	GERS	Operator Action
53	1	87DG-2/B; RLY-(1S3)87DG-2-2	Differential Relay	AC/DC Power Support Systems	BUS 102 PHASE DIFFERENTIAL RELAY PHASE 2	General Electric	12IJD52A11A	1T (aka 1S3)	Switchgear	Turbine	261	GERS	Operator Action
54	1	87DG-2/C; RLY-(1S3)87DG-2-3	Differential Relay	AC/DC Power Support Systems	BUS 102 PHASE DIFFERENTIAL RELAY PHASE 3	General Electric	12IJD52A11A	1T (aka 1S3)	Switchgear	Turbine	261	GERS	Operator Action
55	1	87DG-3/A; RLY-(1S4)87DG-3-1	Differential Relay	AC/DC Power Support Systems	BUS 103 PHASE DIFFERENTIAL RELAY PHASE 1	General Electric	12IJD52A11A	2T (aka 1S4)	Switchgear	Turbine	261	GERS	Operator Action

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
56	1	87DG-3/B; RLY-(1S4)87DG-3-2	Differential Relay	AC/DC Power Support Systems	BUS 103 PHASE DIFFERENTIAL RELAY PHASE 2	General Electric	12IJD52A11A	2T (aka 1S4)	Switchgear	Turbine	261	GERS	Operator Action
57	1	87DG-3/C; RLY-(1S4)87DG-3-3	Differential Relay	AC/DC Power Support Systems	BUS 103 PHASE DIFFERENTIAL RELAY PHASE 3	General Electric	12IJD52A11A	2T (aka 1S4)	Switchgear	Turbine	261	GERS	Operator Action
58	1	RLY-(101/2B-1)86	Auxiliary Relay	AC/DC Power Support Systems	AUXILIARY FEEDER 102 LOCKOUT RELAY	General Electric	12HFA154E26F	PB-101	Switchgear	Turbine	277	GERS	Cap > Dem
59	1	RLY-(101/2A-1)86	Auxiliary Relay	AC/DC Power Support Systems	AUXILIARY FEEDER 103 LOCKOUT RELAY	General Electric	12HFA154E26F	PB-101	Switchgear	Turbine	277	GERS	Cap > Dem
60	1	RLY-(DC102)48	Auxiliary Relay	AC/DC Power Support Systems	DG-102 RESTART RELAY	General Electric	12HMA11 DC	PNL-DC 102	Switchgear	Turbine	261	GERS	Cap > Dem
61	1	RLY-(DC103)48	Auxiliary Relay	AC/DC Power Support Systems	DG-103 RESTART RELAY	General Electric	12HMA11 DC	PNL-DC 103	Switchgear	Turbine	261	GERS	Cap > Dem
62	1	RLY-UPS162/86-1	Auxiliary Relay	AC/DC Power Support Systems	UPS 162 LOCKOUT RELAY	General Electric	HEA61	PNL-PRC162	Switchgear	Turbine	277	GERS	Cap > Dem
63	1	RLY-UPS172/86-1	Auxiliary Relay	AC/DC Power Support Systems	UPS 172 LOCKOUT RELAY	General Electric	HEA61	PNL-PRC172	Switchgear	Turbine	277	GERS	Cap > Dem
64	1	BKR-SBC161/72	Circuit Breaker	AC/DC Power Support Systems	BATTERY CHARGER 161A, 161B DC CIRCUIT BREAKER	General Electric	AK-25-400	BB 11	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem
65	1	BKR-SBC171/72	Circuit Breaker	AC/DC Power Support Systems	BATTERY CHARGER 171A, 171B DC CIRCUIT BREAKER	General Electric	AK-25-400	BB 12	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
66	1	BKR-(16B/010B)52	Circuit Breaker	AC/DC Power Support Systems	POWER BOARD 161B FEEDER BREAKER	General Electric	AK-2A-25-1	PB-16B	Switchgear	Reactor	281	Bounding Spectrum	Cap > Dem
67	1	BKR-(16B/012C)52	Circuit Breaker	AC/DC Power Support Systems	BATTERY CHARGER 161A, 161B AC CIRCUIT BREAKER	General Electric	AK-2A-25-1	PB-16B	Switchgear	Reactor	281	Bounding Spectrum	Cap > Dem
68	1	BKR-(17B/005B)52	Circuit Breaker	AC/DC Power Support Systems	POWER BOARD 171B FEEDER BREAKER	General Electric	AK-2A-25-1	PB-17B	Switchgear	Reactor	281	Bounding Spectrum	Cap > Dem
69	1	BKR-(17B/003C)52	Circuit Breaker	AC/DC Power Support Systems	BATTERY CHARGER 171A, 171B CIRCUIT BREAKER	General Electric	AK-2A-25-1	PB-17B	Switchgear	Reactor	281	Bounding Spectrum	Cap > Dem
70	1	BKR-(16B/013B) R1043/603	Circuit Breaker	AC/DC Power Support Systems	POWER BOARD 16 FEEDER BREAKER	General Electric	AK-2A-50	PB-16B	Switchgear	Reactor	281	Bounding Spectrum	Cap > Dem
71	1	BKR-(17B/002B) R1053/613	Circuit Breaker	AC/DC Power Support Systems	POWER BOARD 17 FEEDER BREAKER	General Electric	AK-2A-50	PB-17B	Switchgear	Reactor	281	Bounding Spectrum	Cap > Dem
72	1	BKR-B11/72-M	Circuit Breaker	AC/DC Power Support Systems	BATTERY 11 CIRCUIT BREAKER	General Electric	AK-2A-50	BB 11	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem
73	1	BKR-B12/72-M	Circuit Breaker	AC/DC Power Support Systems	BATTERY 12 CIRCUIT BREAKER	General Electric	AK-2A-50	BB 12	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem
74	1	BKR-(102/2-1)R1022/571)	Circuit Breaker	AC/DC Power Support Systems	DG #102 CIRCUIT BREAKER	General Electric	AM-4.16-350-1H	PB-102	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem
75	1	BKR-(102/2-9)R1021/171	Circuit Breaker	AC/DC Power Support Systems	AUXILIARY FEEDER 16B CIRCUIT BREAKER	General Electric	AM-4.16-350-1H	PB-102	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
76	1	BKR-(103/1-1)R1032/581	Circuit Breaker	AC/DC Power Support Systems	DG #103 CIRCUIT BREAKER	General Electric	AM-4.16-350-1H	PB-103	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem
77	1	BKR-(103/1-9)R1031/181	Circuit Breaker	AC/DC Power Support Systems	AUXILIARY FEEDER 17B CIRCUIT BREAKER	General Electric	AM-4.16-350-1H	PB-103	Switchgear	Turbine	261	Bounding Spectrum	Cap > Dem
78	1	RLY-(101/2A-1)51/50-1	Overcurrent Relay	AC/DC Power Support Systems	R1013 A PHASE OVERCURRENT RELAY	General Electric	IAC51	PB-101	Switchgear	Turbine	277	GERS	Cap > Dem
79	1	RLY-(101/2A-1)51/50-2	Overcurrent Relay	AC/DC Power Support Systems	R1013 B PHASE OVERCURRENT RELAY	General Electric	IAC51	PB-101	Switchgear	Turbine	277	GERS	Cap > Dem
80	1	RLY-(101/2A-1)51/50-3	Overcurrent Relay	AC/DC Power Support Systems	R1013 C PHASE OVERCURRENT RELAY	General Electric	IAC51	PB-101	Switchgear	Turbine	277	GERS	Cap > Dem
81	1	RLY-(101/2A-1)51G/50G	Overcurrent Relay	AC/DC Power Support Systems	R1013 GROUND OVERCURRENT RELAY	General Electric	IAC51	PB-101	Switchgear	Turbine	277	GERS	Cap > Dem
82	1	RLY-(101/2B-1)51G/50G	Overcurrent Relay	AC/DC Power Support Systems	R1012 GROUND OVERCURRENT RELAY	General Electric	IAC51	PB-101	Switchgear	Turbine	277	GERS	Cap > Dem
83	1	X308	Overvoltage Relay	AC/DC Power Support Systems	BATTERY CHARGER 161A OVERVOLTAGE RELAY	Relay is part of a Solidstate No. 85-CC5000-03 battery charger.		SBC161A	Switchgear	Turbine	261	Qualification Test	Cap > Dem
84	1	X308	Overvoltage Relay	AC/DC Power Support Systems	BATTERY CHARGER 161B OVERVOLTAGE RELAY	Relay is part of a Solidstate No. 85-CC5000-03 battery charger.		SBC161B	Switchgear	Turbine	261	Qualification Test	Cap > Dem
85	1	X308	Overvoltage Relay	AC/DC Power Support Systems	BATTERY CHARGER 171A OVERVOLTAGE RELAY	Relay is part of a Solidstate No. 85-CC5000-03 battery charger.		SBC171A	Switchgear	Turbine	261	Qualification Test	Cap > Dem

No.	Unit	Component						Enclosure		Building	Floor Elev. (ft)	Component Evaluation	
		ID	Type	System	Function	Manufacturer	Model No.	ID	Type			Basis for Capacity	Evaluation Result
86	1	X308	Overvoltage Relay	AC/DC Power Support Systems	BATTERY CHARGER 171B OVERVOLTAGE RELAY	Relay is part of a Solidstate No. 85-CC5000-03 battery charger.		SBC171B	Switchgear	Turbine	261	Qualification Test	Cap > Dem
87	1	RLY-(102)50G	Overcurrent Relay	AC/DC Power Support Systems	R1021 GROUND OVERCURRENT RELAY	General Electric	12PJC11AV1A	PB-102	Switchgear	Turbine	261	GERS	Cap > Dem
88	1	RLY-(103)50G	Overcurrent Relay	AC/DC Power Support Systems	R1031 GROUND OVERCURRENT RELAY	General Electric	12PJC11AV1A	PB-103	Switchgear	Turbine	261	GERS	Cap > Dem

Table B-2: Reactor Coolant Leak Path Valve Identified for High Frequency Confirmation

Valve	P&ID	Sh.	P&ID (FCMS Format)	Note	Evaluated for Electrical Impact in 15C4344-RPT-001
PSV-01-102A	C18002C	1	C18002C-001	SRV	Yes*
PSV-01-102B	C18002C	1	C18002C-001	SRV	Yes*
PSV-01-102C	C18002C	1	C18002C-001	SRV	Yes*
PSV-01-102D	C18002C	1	C18002C-001	SRV	Yes*
PSV-01-102E	C18002C	1	C18002C-001	SRV	Yes*
PSV-01-102F	C18002C	1	C18002C-001	SRV	Yes*
PSV-01-119A	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*
Type Safety Valve					Yes*
PSV-01-119B	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*
Type Safety Valve					Yes*
PSV-01-119C	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*
Type Safety Valve					Yes*
PSV-01-119D	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*
Type Safety Valve					Yes*
PSV-01-119F	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*
Type Safety Valve					Yes*
PSV-01-119G	C18002C	1	C18002C-001	Spring-loaded Pop-open	Potentially -- Would only be a Leak Path if 37-01 fails to be closed
Type Safety Valve					Potentially -- Would only be a Leak Path if 37-01 fails to be closed
PSV-01-119H	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*
Type Safety Valve					Yes*
PSV-01-119J	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*
Type Safety Valve					Yes*
PSV-01-119M	C18002C	1	C18002C-001	Spring-loaded Pop-open	Yes*

Valve	P&ID	Sh.	P&ID (FCMS Format)	Note	Evaluated for Electrical Impact in 15C4344-RPT-001
Type Safety Valve					Yes*
BV-37-01	C18002C	1	C18002C-001		Yes*
BV-37-02	C18002C	1	C18002C-001	This is the second in series both 37-01 and this would have to fail open	Yes*
BV-37-06	C18002C	1	C18002C-001	This is the second in series both 37-01 and this would have to fail open	Yes*
IV-38-01	C18006C	1	C18006C-001		No
IV-38-13	C18006C	1	C18006C-001		No
IV-01-01	C18006C	1	C18006C-001		No
IV-01-02	C18006C	1	C18006C-001		Yes*
IV-01-03	C18006C	1	C18006C-001		Yes*
IV-01-04	C18006C	1	C18006C-001		Yes*
IV-110-127	C18006C	1	C18006C-001		Yes*
IV-31-07	C18006C	1	C18006C-001		Yes*
IV-31-08	C18006C	1	C18006C-001		No
31-01R	C18006C	1	C18006C-001	Simple Check Valve (No need to be included)	No
31-02R	C18006C	1	C18006C-001	Simple Check Valve (No need to be included)	No
42.1-02	C18006C	1	C18006C-001	Simple Check Valve (No need to be included)	No
IV-33-01R	C18006C	1	C18006C-001		No
IV-33-02R	C18006C	1	C18006C-001		No
IV-33-04	C18006C	1	C18006C-001		No
BV-37-08R	C18009C	1	C18009C-001		No
BV-37-09R	C18009C	1	C18009C-001		No
IV-40-01	C18007C	1	C18007C-001	Downstream of Simple Check Valve IV-40-03; therefore, no Leakage	No
IV-40-03	C18007C	1	C18007C-001	Simple Check Valve (No need to be included)	Yes*
IV-40-05	C18007C	1	C18007C-001	Per the Plant on 22 Feb 2016 this Valve is normally closed and deenergized with breakers locked open except during testing or fill and vent operations	No

Valve	P&ID	Sh.	P&ID (FCMS Format)	Note	Evaluated for Electrical Impact in 15C4344-RPT-001
IV-40-06	C18007C	1	C18007C-001	Per the Plant on 22 Feb 2016 this Valve is normally closed and deenergized with breakers locked open except during testing or fill and vent operations	No
IV-40-09	C18007C	1	C18007C-001	Downstream of Simple Check Valve IV-40-03; therefore, no Leakage	No
IV-40-10	C18007C	1	C18007C-001	Downstream of Simple Check Valve IV-40-13; therefore, no Leakage	No
IV-40-11	C18007C	1	C18007C-001	Downstream of Simple Check Valve IV-40-13; therefore, no Leakage	No

* Note: the evaluation of this valve is discussed in Section 2.2 of this report as well as in report 15C4344-RPT-001 (Ref. 81).