

NRR-PMDAPEm Resource

From: McCoppin, Michael
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To: Shams, Mohamed; Wyman, Stephen
Cc: DiFrancesco, Nicholas; Spence, Jane; Devlin-Gill, Stephanie; Le, Tuan; Heeszal, David; Yee, On; Rivera-Lugo, Richard; Tseng, Ian; 50.54f_Seismic Resource; RidsNrodsea Resource; Andrukat, Dennis; Schleicher, Lisa; Wang, George
Subject: McGuire ESEP Checklist
Attachments: McGuire R2 1 ESEP Review Final IHT 022416.docx

March 4, 2016

MEMORANDUM TO: Mohamed K. Shams, Chief
Hazards Management Branch (JHMB)
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

FROM: Michel McCoppin, Chief
Geosciences and Geotechnical Engineering Branch 2 (RGS2)
Division of Site Safety and Environmental Analysis
Office of New Reactors

SUBJECT: MCGUIRE NUCLEAR STATION, UNITS 1 AND 2 - TECHNICAL REVIEW CHECKLIST RELATED TO INTERIM EXPEDITED SEISMIC EVALUATION PROCESS SUPPORTING IMPLEMENTATION OF NTTF RECOMMENDATION 2.1, SEISMIC, RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NO. MF5249 and MF5250)

The NRC technical staff working through the Geosciences and Geotechnical Engineering Branches 1 and 2 (RGS1 and RGS2) completed the Technical Review Checklist of the MCGUIRE NUCLEAR STATION, UNITS 1 AND 2 response to Enclosure 1, Item (6) of the March 12, 2012, request for information letter issued per Title 10 of the Code of Federal Regulations, Subpart 50.54(f), to power reactor licensees and holders of construction permits requesting addressees to provide further information to support the NRC staff's evaluation of regulatory actions to be taken in response to Fukushima Near-Term Task Force (NTTF) Recommendation 2.1: Seismic which implements lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake and subsequent tsunami. The addresses the staff review of the interim Expedited Seismic Evaluation Process (ESEP) report in response to Requested Item (6) of Enclosure 1, "Recommendation 2.1: Seismic," of the 50.54(f) letter. Attached is a file containing the technical review checklist to prepare a response letter to the licensee.

The NRC staff reviewed the information provided and, as documented in the enclosed staff checklist, determined that sufficient information was provided to be responsive to this portion of the Enclosure 1 of the 50.54(f) letter. The application of this staff review is limited to the interim ESEP as part of NTTF R2.1: Seismic activities.

This electronic memo constitutes the DSEA concurrence provided that only editorial changes are made to the staff assessment that would not affect the technical conclusions or technical context of the assessment.

This concludes the NRC's efforts associated with TAC NO. MF5249 and MF5250 for the review of the interim ESEP report for the MCGUIRE NUCLEAR STATION, UNITS 1 AND 2.

Docket No: 50-369 and 50-370

CONTACT: Stephanie Devlin-Gill
Office of New Reactors
301-415-5301

Copy: Nicholas DiFrancesco, Steve Wyman, Jane Spence, Stephanie Devlin-Gill, Dennis Andrukat, On Yee, George Wang, Ian Tseng, Lisa Schleicher, Richard, Rivera-Lugo, Nikolaos Simos, (NRC Consultant) , 50.54f Seismic Resource, RidsNroDsea Resource

Mike McCoppin, MBA, PMP

Branch Chief, Radiation Protection &
Accident Consequences (RPAC)
Office of New Reactors
United States Nuclear Regulatory Commission

 Mail Stop: T7-F03

Office: T7-F18

 Ph: 301.415.6533

Cell: 202.731.1423

 FAX: 301.415.5399

 Email: michael.mccoppin@nrc.gov

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From: McCoppin, Michael

Created By: Michael.McCoppin@nrc.gov

Recipients:

"DiFrancesco, Nicholas" <Nicholas.DiFrancesco@nrc.gov>
Tracking Status: None
"Spence, Jane" <Jane.Spence@nrc.gov>
Tracking Status: None
"Devlin-Gill, Stephanie" <Stephanie.Devlin-Gill@nrc.gov>
Tracking Status: None
"Le, Tuan" <Tuan.Le@nrc.gov>
Tracking Status: None
"Heeszal, David" <David.Heeszal@nrc.gov>
Tracking Status: None
"Yee, On" <On.Yee@nrc.gov>
Tracking Status: None
"Rivera-Lugo, Richard" <Richard.Rivera-Lugo@nrc.gov>
Tracking Status: None
"Tseng, Ian" <Ian.Tseng@nrc.gov>
Tracking Status: None
"50.54f_Seismic Resource" <50.54f_Seismic.Resource@nrc.gov>
Tracking Status: None
"RidsNroDsea Resource" <RidsNroDsea.Resource@nrc.gov>
Tracking Status: None
"Andrukat, Dennis" <Dennis.Andrukat@nrc.gov>
Tracking Status: None
"Schleicher, Lisa" <Lisa.Schleicher@nrc.gov>
Tracking Status: None
"Wang, George" <George.Wang@nrc.gov>
Tracking Status: None
"Shams, Mohamed" <Mohamed.Shams@nrc.gov>
Tracking Status: None
"Wyman, Stephen" <Stephen.Wyman@nrc.gov>
Tracking Status: None

Post Office: HQPWMSMRS07.nrc.gov

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TECHNICAL REVIEW CHECKLIST
BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO EXPEDITED SEISMIC EVALUATION PROCESS INTERIM EVALUATION
IMPLEMENTING NTTF RECOMMENDATION 2.1 SEISMIC
MCGUIRE NUCLEAR STATION, UNITS 1 AND 2
DOCKET NOS. 50-369 AND 50-370

By letter dated March 12, 2012 (USNRC, 2012a), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) "Conditions of License" (hereafter referred to as the "50.54(f) letter"). Enclosure 1 of the 50.54(f) letter requests addressees to reevaluate the seismic hazard at their site using present-day methods and guidance for licensing new nuclear power plants, and identify actions to address or modify, as necessary, plant components affected with the reevaluated seismic hazards. Requested Information Item (6) in Enclosure 1 to the 50.54(f) letter requests addressees to provide an interim evaluation and actions taken or planned to address a higher seismic hazard relative to the design basis, as appropriate, prior to completion and submission of the seismic risk evaluation.

Additionally, by letter dated April 12, 2013¹, the Electric Power Research Institute (EPRI) staff submitted EPRI TR 3002000704 "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force (NTTF) Recommendation 2.1: Seismic" (hereafter referred to as the guidance). The Augmented Approach proposed that licensees would use an Expedited Seismic Evaluation Process (ESEP) to address the interim actions as requested by Information Item (6) in the 50.54(f) letter. The ESEP is a simplified seismic capacity evaluation with a focused scope of certain key installed Mitigating Strategies equipment that is used for core cooling and containment functions to cope with scenarios that involve a loss of all AC power and loss of access to the ultimate heat sink to withstand the Review Level Ground Motion, which is up to two times the safe shutdown earthquake (SSE). Due to the expedited and interim nature of the ESEP, the assessment does not include many considerations that are part of a normal risk evaluation. These deferred items, include but are not limited to, structures, piping, non-seismic failures, and operator actions, as well scenarios such as addressing loss of coolant accidents. By letter dated May 7, 2013², the NRC staff endorsed the guidance. Central and eastern United States licensees with a reevaluated seismic hazard exceeding the SSE submitted an ESEP interim evaluation in December 2014.

Consistent with the interim nature of this activity, the staff performed the review of the licensee's submittal to assess whether the intent of the guidance was implemented. A multi-disciplined team checked whether the identified methods were consistent with the guidance. A senior expert panel reviewed the team's questions, if any, and checklist for consistency and scope. New or updated parameters (e.g., In-Structure Response Spectra, High Confidence of Low Probability of Failure calculations) presented by the licensees were assessed only based on licensee statements for acceptability for the Item (6) response. The application of this staff review is limited to the ESEP interim evaluation as part of NTTF R2.1: Seismic activities.

¹ ADAMS Accession No. ML13102A142

² ADAMS Accession No. ML13106A331

NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

Technical Review Checklist for McGuire Nuclear Station, Units 1 and 2

By letter dated December 17, 2014³, Duke Energy Carolinas LLC (the licensee) provided an Expedited Seismic Evaluation Process (ESEP) report in a response to Enclosure 1, Requested Information Item (6) of the 50.54(f) letter, for the McGuire Nuclear Station, Units 1 and 2 (McGuire).

I. Review Level Ground Motion

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| The licensee: <ul style="list-style-type: none"> • described the determination of the review level ground motion (RLGM) using one of the means acceptable by the guidance • identified location of the control point and is consistent with March 2014 seismic hazard and screening report submittal⁴ • compared the site ground motion response spectra used to select the ESEP RLGM to the SSE. | Yes Yes Yes |
| McGuire used a scaled SSE at a ratio of 1.74 at 10 Hz | |
| Notes from the Reviewer: None | |
| Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified. | |
| The NRC staff concludes: <ul style="list-style-type: none"> • the licensee's RLGM meets the intent of the guidance • the RLGM is reasonable for use in the interim evaluation | Yes Yes |

II. Selection of the Success Path

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| The licensee: <ul style="list-style-type: none"> • described the success path • described normal and desired state of the equipment for the success path • ensured that the success path is consistent with the plant's overall mitigating strategies approach or provided a justification for an alternate path • stated that the selection process was in accordance with the guidance or meets the intent of the guidance • used installed FLEX Phase 1 equipment as part of the success path • included FLEX Phase 2 and/or 3 connections • considered installed FLEX Phase 2 and/or 3 equipment | Yes Yes Yes Yes Yes Yes Yes |
| Notes from the Reviewer: None | |
| Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified. | |
| The NRC staff concludes that: <ul style="list-style-type: none"> • the selected success path is reasonable for use in the interim evaluation | Yes |

³ ADAMS Accession No. ML15005A085

⁴ ADAMS Accession No. ML14098A421

NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

Technical Review Checklist for McGuire Nuclear Station, Units 1 and 2

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| <ul style="list-style-type: none"> the licensee considered installed Phase 2 and 3 connections or equipment in the interim evaluation. | Yes |
| <p>III. Selection of the Equipment List</p> | |
| <p>The licensee:</p> <ul style="list-style-type: none"> developed and provided the ESEL by applying the ESEP identified equipment considering the following functions: <ul style="list-style-type: none"> Core cooling (with focus on Mode 1) function Available, sustainable water source Containment function and integrity | <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> |
| <p>Notes from the Reviewer: None</p> | |
| <p>Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified.</p> | |
| For PWR Plants ONLY | |
| <p>The licensee included indicators / instrumentation for the following functions: level, pressure, temperature, that would be indicative of (but not explicitly identified to specific instruments): water level of the steam generator (SG), pressure of SG, containment, and reactor coolant system (RCS); and temperature of the RCS.</p> | Yes |
| For BWR Plants ONLY | |
| <p>The licensee considered indicators for the following functions: level, pressure, temperature that would be indicative of (but not explicitly identified to specific instruments): Temperature of suppression pool, RCS, containment); Pressure of suppression pool, RCS, and drywell; water level of the suppression pool.</p> | N/A |
| <p>Notes from the Reviewer: None</p> | |
| <p>Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified.</p> | |
| <p>Through a sampling of the ESEP key components, the NRC staff concludes that:</p> <ul style="list-style-type: none"> the licensee's process to develop the ESEL meets the intent of the guidance for the interim evaluation the desired equipment state for the success path were identified the licensee considered the support equipment for the ESEL both front-line and support systems appeared to be included in the ESEL as evidenced by inclusion of SSCs on the success path and of support systems (e.g., batteries, motor control centers, inverters). | <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> |

NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

Technical Review Checklist for McGuire Nuclear Station, Units 1 and 2

IV. Walkdown Approach

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| <p>The licensee:</p> <ul style="list-style-type: none"> • described the walkdown screening approach, including walkbys and walkdowns performed exclusively for the ESEP, in accordance with the guidance • credited previous walkdown results, including a description of current action(s) to verify the present equipment condition and/or configuration (e.g., walk-bys), in accordance with the guidance • stated that the walkdown was performed by seismically trained personnel | <p>Yes</p> <p>Yes</p> <p>Yes</p> |
| <p>Notes from the Reviewer: None</p> <p>Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified.</p> | |
| <p>The licensee:</p> <ul style="list-style-type: none"> • described, if needed, adverse material condition of the equipment (e.g., material degradation) • credited previous walkdown results, included a description of current action(s) to verify the present equipment condition (e.g., walk-bys), meeting the intent of the guidance | <p>Yes (see note 1)</p> <p>Yes</p> |
| <p>The licensee:</p> <ul style="list-style-type: none"> • described, if needed, the conditions of structural items considered for the interim evaluation, including: <ul style="list-style-type: none"> ○ spatial interactions (i.e. interaction between block walls and other items/components) ○ anchorage ○ piping connected to tanks (i.e., differential movement between pipes and tanks at connections) | <p>Yes</p> <p>Yes</p> <p>Yes</p> |
| <p>Notes from the Reviewer:</p> <p>1. The ESEP report did not describe any adverse material condition of the equipment in the results of the walk-by, but did not explicitly state that no adverse material condition was found. Given the format of the report, this omission implies that no adverse material conditions were found during the walk-by. Furthermore, the licensee stated that care was taken to inspect items from IPEEE included in the ESEP and determine that they did not degrade since. The staff finds this acceptable for the purposes of this interim evaluation.</p> <p>Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified.</p> | |
| <p>The licensee reported deviations for McGuire.</p> | <p>No</p> |
| <p>If deviations were identified, there is a discussion of how the deficiencies were or will be addressed in the ESEP submittal report.</p> | <p>N/A</p> |

NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

Technical Review Checklist for McGuire Nuclear Station, Units 1 and 2

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| The NRC staff concludes that: <ul style="list-style-type: none"> • the licensee described the performed walkdown approach, including any credited previous efforts (e.g., Individual Plant Examination of External Events (IPEEE) consistent with the guidance • the licensee addressed identified deviations consistent with the guidance, if any | Yes N/A |
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V. Capacity Screening Approach and HCLPF Calculation Results

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| The licensee: <ul style="list-style-type: none"> • described the capacity screening process for the ESEL items, consistent with the guidance (e.g., use of EPRI NP-6041 screening table). • presented the results of the screened-out ESEL items in the ESEP report • described the development of in-structure response spectrum (ISRS) based on scaling • described the development of ISRS based on new analysis consistent with the guidance • described the method for estimating HCLPF capacity of screened-in ESEL items, including both structural and functional failure modes consistent with the guidance: <ul style="list-style-type: none"> ○ use of Conservative Deterministic Failure Margin (CDFM) ○ use of fragility analysis (FA) ○ use of experience data or generic information • credited IPEEE spectral shape for HCLPF capacity estimates is similar to or envelopes the RLGGM, and anchored at the same control point • presented the results of HCLPF capacities including associated failure modes for screened-in ESEL items • reviewed the ESEL items with the lowest HCLPF values to ensure that their capacities are equal or greater than the RLGGM | Yes (see notes 1 and 2) Yes Yes N/A Yes Yes Yes Yes Yes |
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Notes from the Reviewer:

1. The ESEP report does not specifically address screening criteria for ESEL items mounted more than 40 ft above grade, nor did the report explicitly establish the elevation of the effective grade, or its relation to the components. The licensee was requested to provide clarification regarding how these items were screened, and a clarification of the defined grade level. In a presentation from the licensee on June 9, 2015, which was attached to the report for the subsequent audit on September 15, 2015 (ML15344A183), the licensee provided clarification that effective grade was defined at the base of the building. All components above the foundation level, whether above or below 40 ft above grade, were screened using guidance typically used only for components mounted above 40 feet above grade. This screening criteria uses 1.5 times the EPRI 6041 basic screening levels (0.8g/1.2g) for comparison to ISRS. This alternate approach for elevations below 40 ft above grade is described in EPRI 6041, and is acceptable to the staff for the purposes of this interim evaluation on the basis that the licensee's screening results for elevations below 40 ft above grade are consistent with screening results that would be obtained following the EPRI ESEP guidance for screening below 40 ft above grade.

NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

Technical Review Checklist for McGuire Nuclear Station, Units 1 and 2

2. Through a series of clarifying questions and responses, the staff also identified that raw narrow-banded ISRS were used in lieu of the design-basis broadened ISRS, that the peaks were clipped, and that the North-South and East-West clipped peaks were averaged. The reduction effect of peak clipping on narrow-banded ISRS is significantly greater than the effect on broadened ISRS; and averaging the ISRS peak accelerations further reduces the numerical value that is used for screening. In a presentation by the licensee on June 9, 2015, which was attached to the report for the subsequent audit on September 15, 2015 (ML15344A183), the licensee presented examples that demonstrated to the staff that the conclusions reached by using the licensee's methodology are equivalent to the conclusions that would be reached using the EPRI evaluation guidance. The staff finds that the licensee has sufficiently demonstrated the acceptability of their screening results for the purposes of this interim evaluation.

3. MNS relied on a seismic probabilistic risk assessment (SPRA) performed in 1983 for their IPEEE evaluation performed in the 1990s. The only exception to this was the capacity calculations related to anchorages in the updated IPEEE, which were based on CDFM. The ESEP is also based on CDFM. The demand was determined following NUREG/CR-0098, anchored at 0.3g as RLE > RLGM (ESEP). This is acceptable for the purposes of this interim evaluation.

Deviation(s) or Deficiency(ies), and Resolution:

No deviations or deficiencies were identified.

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| The NRC staff concludes that: | |
| <ul style="list-style-type: none"> • the licensee described the implementation of the capacity screening process consistent with the intent of the guidance | Yes |
| <ul style="list-style-type: none"> • the licensee presented capacity screening and calculation results, as appropriate, in the ESEP report | Yes |
| <ul style="list-style-type: none"> • the method used to develop the ISRS is consistent with guidance for use in the ESEP | Yes |
| <ul style="list-style-type: none"> • for HCLPF calculations, the licensee used HCLPF calculation methods as endorsed in the guidance | Yes |
| <ul style="list-style-type: none"> • no anomalies were noted in the reported HCLPF | Yes |

VI. Inaccessible Items

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| The licensee: | |
| <ul style="list-style-type: none"> • provided a list of inaccessible items | Yes |
| <ul style="list-style-type: none"> • provided a schedule of the planned walkdown and evaluation for all inaccessible items | Yes |
| <ul style="list-style-type: none"> • provided Regulatory Commitment to complete walkdowns. | Yes |
| McGuire will provide results or complete walkdown by: December 31, 2016 for actions that do not require a refueling outage, and by the second planned refueling outage (after December 31, 2014) for actions that require a planned refueling outage. | |

Notes from the Reviewer:

NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

Technical Review Checklist for McGuire Nuclear Station, Units 1 and 2

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| <p>1. As stated in Section 7.1, "All ESEL items were accessible for walkdowns except the Unit 1 and 2 diesel generator fuel oil storage tanks. These tanks are not accessible for visual inspection since they are buried below grade. Walk-bys of the yard areas above the tanks were performed to check for visible outliers or potential seismic interaction hazards." The staff finds this acceptable for the purposes of this interim evaluation.</p> <p>Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified.</p> | |
| <p>The NRC staff concludes that the licensee:</p> <ul style="list-style-type: none"> • listed inaccessible items • committed to provide the results (e.g. walkdowns, walkbys, etc) of the remaining inaccessible items consistent with the guidance • substitutions, if needed, were appropriately justified | <p>Yes</p> <p>Yes</p> <p>N/A</p> |

VII. Modifications to Plant Equipment

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| <p>The licensee:</p> <ul style="list-style-type: none"> • identified modifications for ESEL items necessary to achieve HCLPF values that bound the RLGM (excluding mitigative strategies equipment (FLEX)), as specified in the guidance • provided a schedule to implement such modifications (if any), consistent with the intent of the guidance • provided Regulatory Commitment to complete modifications • provided Regulatory Commitment to report completion of modifications. | <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> |
| <p>McGuire will:</p> <ul style="list-style-type: none"> • <u>complete modifications by December 31, 2016 for actions that do not require a refueling outage, and by the second planned refueling outage (after December 31, 2014) for actions that require a planned refueling outage.</u> • <u>report completion of modifications within 60 days following completion of ESEP activities.</u> | |
| <p>Notes from the Reviewer:</p> <p>1. McGuire identified 6 items that require modifications in Unit 1, and 3 items in Unit 2.</p> | |
| <p>Deviation(s) or Deficiency(ies), and Resolution: No deviations or deficiencies were identified</p> | |
| <p>The NRC staff concludes that the licensee:</p> <ul style="list-style-type: none"> • identified plant modifications necessary to achieve the target seismic capacity • provided a schedule to implement the modifications (if any) consistent with the guidance | <p>Yes</p> <p>Yes</p> |

VIII. Conclusions:

The NRC staff assessed the licensee's implementation of the ESEP guidance. Due to the interim applicability of the ESEP evaluations, use of the information for another application would require a separate NRC review and approval. Based on its review, the NRC staff concludes that the licensee's implementation of the interim evaluation meets the intent of the guidance. The staff concludes that, through the implementation of the ESEP guidance, the

NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

Technical Review Checklist for McGuire Nuclear Station, Units 1 and 2

licensee identified and evaluated the seismic capacity of certain key installed Mitigating Strategies equipment that is used for core cooling and containment functions to cope with scenarios that involve a loss of all AC power and loss of access to the ultimate heat sink to withstand a seismic event up to the Review Level Ground Motion (RLGM) and thus, provides additional assurance while the plant seismic risk evaluation is being conducted. In the case of McGuire, in accordance with the guidance, the RLGM used a scaled SSE at the ratio of 1.74. The application of this staff review is limited to the ESEP interim evaluation as part of NTTF R2.1: Seismic activities. As noted in the review checklist, the staff did not identify deviations or exceptions were taken from the guidance. The licensee identified safety enhancing modifications based on the evaluation and committed to complete modifications by December 31, 2016 for actions that do not require a refueling outage, and by the second planned refueling outage (after December 31, 2014) for actions that require a planned refueling outage. The licensee committed to report completion of modifications within 60 days following completion of ESEP activities.

In summary, the licensee, by implementing the ESEP interim evaluation, has demonstrated additional assurance which supports continued plant safety while the longer-term seismic evaluation is completed to support regulatory decision making. The NRC staff concludes that the licensee responded appropriately to Enclosure 1, Item (6) of the 50.54(f) letter, dated March 12, 2012, for McGuire Nuclear Station, Units 1 and 2.

Principal Contributors: Dennis Andrukat, On Yee, George Wang, Ian Tseng, Lisa Schleicher, Richard, Rivera-Lugo, Nikolaos Simos, (NRC Consultant)