



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

December 21, 2017

Mr. Steven D. Capps  
Duke Energy Carolinas, LLC  
McGuire Nuclear Station  
12700 Hagers Ferry Road  
Huntersville, NC 28078-8985

SUBJECT: MCGUIRE NUCLEAR STATION, UNITS 1 AND 2 – STAFF REVIEW OF MITIGATING STRATEGIES ASSESSMENT REPORT OF THE IMPACT OF THE RE-EVALUATED SEISMIC HAZARD DEVELOPED IN RESPONSE TO THE MARCH 12, 2012, 50.54(f) LETTER (CAC NOS. MF7843 AND MF7844; EPID L-2016-JLD-0006)

Dear Mr. Capps:

The purpose of this letter is to provide the U.S. Nuclear Regulatory Commission's (NRC) assessment of the seismic hazard mitigating strategies assessment (MSA), as described in the August 10, 2017, letter (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17233A167), submitted by Duke Energy Carolinas, LLC (Duke, the licensee) for McGuire Nuclear Station, Units 1 and 2 (MNS). The NRC staff evaluated the MNS strategies developed under Order EA-12-049 and described in Duke's Final Integrated Plans (FIPs) for MNS (ADAMS Accession No. ML15343A010). The staff's review of MNS's mitigating strategies was documented in a safety evaluation dated June 20, 2016 (ADAMS Accession No. ML16104A078). The purpose of the safety evaluation is to ensure that the licensee has developed guidance and proposed designs which, if implemented appropriately, should adequately address the requirements of Order EA-12-049. An inspection confirmed compliance with the order and is documented in a report dated August 30, 2016 (ADAMS Accession No. ML16243A298). The following NRC staff review confirms that the licensee has adequately addressed the reevaluated seismic hazard within MNS's mitigation strategies for beyond-design-basis external events.

#### BACKGROUND

By letter dated March 12, 2012 (ADAMS Accession No. ML12053A340), the NRC issued a request for information pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) (hereafter referred to as the 50.54(f) letter). The 50.54(f) letter was issued as part of implementing lessons-learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 1 to the 50.54(f) letter requested that licensees reevaluate the seismic hazard using present-day methodologies and guidance.

Concurrent with the reevaluation of seismic hazards, the NRC issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A736). The order requires holders of operating power reactor licenses and construction permits issued under 10 CFR Part 50 to develop, implement, and maintain guidance and strategies to maintain or restore

core cooling, containment, and spent fuel pool cooling following a beyond-design-basis external event. In order to proceed with the implementation of Order EA-12-049, licensees used the current design basis flood and seismic hazard or the most recent flood and seismic hazard information, which may not be based on present-day methodologies and guidance, in developing their mitigation strategies.

On December 10, 2015 (ADAMS Accession No. ML16005A621), the Nuclear Energy Institute (NEI) submitted Revision 2 to NEI 12-06, including guidance for conducting MSAs using the reevaluated hazard information. The NRC subsequently endorsed NEI 12-06, Revision 2, with exceptions, clarifications, and additions, in Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2012-01, Revision 1, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML15357A163).

### MITIGATION STRATEGIES ASSESSMENT

By letter dated July 20, 2015 (ADAMS Accession No. ML15182A067), the NRC staff documented its review of the licensee's reevaluated seismic hazard, also referred to as the mitigation strategies seismic hazard information. The staff found that the MNS Ground Motion Response Spectrum (GMRS) exceeds the safe shutdown earthquake (SSE) in the 7 to 100 Hertz (Hz) range. Because the GMRS exceeds the SSE above 10 Hz, a high frequency (HF) confirmation is merited. In addition, the staff concluded that the GMRS determined by the licensee adequately characterizes the reevaluated seismic hazard for the MNS site.

As described in NRC letters dated October 27, 2015 (ADAMS Accession No. ML15194A015), and December 22, 2016 (ADAMS Accession No. ML16344A313), the NRC changed the MNS screening determination for seismic risk evaluation based on supplemental information provided by the licensee. The need for MNS to perform a stand-alone HF confirmation was established in the NRC letter dated December 22, 2016.

By letters dated August 10, 2017, and September 27, 2017 (ADAMS Accession Nos. ML17230A085 and ML17279A112, respectively), Duke submitted a HF confirmation report for MNS. By letter dated November 20, 2017 (ADAMS Accession No. ML17320A770), the NRC staff concluded, based on its review, that the licensee correctly implemented the guidance in conducting the HF confirmation for MNS. Two hundred and eighty nine of 317 evaluated components demonstrated adequate seismic capacity and 28 components were resolved through operator action. No component modifications were required.

By letter dated August 10, 2017 (ADAMS Accession No. ML17233A167), Duke submitted its seismic MSA report for MNS. The licensee stated that the MNS MSA was performed consistent with Appendix H of NEI 12-06, Revision 2, which describes acceptable methods for demonstrating that the reevaluated seismic hazard is addressed within the MNS mitigation strategies for beyond-design-basis external events. Guidance document NEI 12-06, Revision 2 was endorsed by NRC staff document JLD-ISG-2012-01, Revision 1. Therefore, the methodology used by the licensee is acceptable to perform an assessment of the mitigation strategies that addresses the reevaluated seismic hazard.

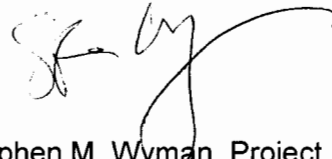
The NRC staff performed checklist reviews of the seismic hazard MSA for MNS. The checklists are provided as an enclosure to this letter.

The NRC staff found that MNS met the intent of the guidance. The staff did not identify any deficiencies. All evaluated components demonstrated adequate seismic capacity and no component modifications were required.

The NRC staff completed its review of the seismic hazard MSA for MNS and concluded that sufficient information has been provided to demonstrate that the licensee's plans for the development and implementation of guidance and strategies under Order EA-12-049 appropriately address the reevaluated seismic hazard information stemming from the 50.54(f) letter.

If you have any questions, please contact me at (301) 415-3041 or via e-mail at Stephen.Wyman@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read 'S. Wyman', with a long, sweeping horizontal stroke extending to the right.

Stephen M. Wyman, Project Manager  
Beyond-Design-Basis Engineering Branch  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

Docket No. 50-369 and 50-370

Enclosure:  
Technical Review Checklist

cc w/encl: Distribution via Listserv

TECHNICAL REVIEW CHECKLIST  
BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO PATH FOUR MITIGATING STRATEGY ASSESSMENT  
MCGUIRE NUCLEAR STATION, UNITS 1 AND 2  
DOCKET NOS. 50-369 AND 50-370

The NRC staff performed the following checklist review based on the Enclosure of the August 10, 2017, letter (Agency Documents Access and Management System (ADAMS) Accession No. ML17233A167) for McGuire Nuclear Station, Units 1 and 2 (MNS). Deviations, deficiencies, and conclusions are noted at the end of each section and an overall conclusion is provided at the end of the checklist.

I. Background and Assessment to Mitigation Strategies Seismic Hazard Assessment (MSSHI)

<p>This section establishes basic background and assessment to MSSHI criteria in Nuclear Energy Institute (NEI) 12-06, Appendix H.</p>	
<p>Licensee approach to mitigating strategies assessment (MSA):</p>	
<p>Was the MSA conducted in accordance with NEI 12-06, Revision 2 as endorsed by the staff?</p>	<p>Yes / No</p>
<p>Was the MSA conducted using an alternate method?</p>	<p>Yes / No</p>
<p>Status of Order EA-12-049 Flexible Mitigation Strategy at the time of this review:</p>	
<p>Has the licensee submitted a Final Integrated Plan?</p>	<p>Yes / No</p>
<p>Has the NRC staff completed a safety evaluation for the mitigation strategy?</p>	<p>Yes / No</p>
<p>Has the NRC staff confirmed compliance with Order EA-12-049 by successfully completing the temporary instruction (TI)-191 inspection?</p>	<p>Yes / No</p>
<p>Status of MSSHI</p>	
<p>Did the licensee use the Ground Motion Response Spectra (GMRS) and Uniform Hazard Response Spectra as submitted in response to the 50.54(f) request for information and reviewed by the NRC staff?</p>	<p>Yes / No</p>

<p>Has the plant equipment relied on for FLEX strategies previously been evaluated as seismically robust to the plant safe shutdown earthquake (SSE) levels?</p> <p>Is the maximum ratio of GMRS/SSE in the range of 1-10 Hertz (Hz) less than 2?</p> <p>Did the licensee meet the seismic evaluation criteria described in NEI 12-06, Section H.5?</p>	<p>Yes / No / NA</p> <p>Yes / No</p> <p>Yes / No</p>
<p>Notes from staff reviewer: The GMRS/SSE ratio is approximately 1.74. This meets the criteria of NEI 12-06, Appendix H.5.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None</p> <p>Consequence(s): None</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>The licensee meets the background and assessment to MSSHI criteria in NEI 12-06, Appendix H.</li> </ul>	<p>Yes / No</p>

II. Expedited Seismic Evaluation Process (ESEP) Equipment

<p>Equipment used in support of the FLEX strategies has been evaluated to demonstrate seismic adequacy following the guidance in Section 5 of NEI 12-06. As stated in Appendix H of NEI 12-06, previous seismic evaluations should be credited to the extent that they apply for the assessment of the MSSHI, including the ESEP evaluations performed in accordance with Electric Power Research Institute 3002000704.</p> <p>Licensees may reference a previous ESEP submittal, submit a new or updated ESEP report, or provide other adequate justification or evaluation.</p>	
<p>Did the licensee previously perform an ESEP?</p>	<p>Yes / No</p>
<p>Did the licensee provide a new or updated ESEP report with the MSA?</p>	<p>Yes / No</p>
<p>If the licensee did not perform ESEP, did they provide adequate justification that the expedited seismic equipment list structures, systems, and components (SSCs) are acceptable</p>	<p>Yes / No / NA</p>

<p>in accordance with the original guidance and in accordance with NEI 12-06 Section H.5 C<sub>10%</sub> capacity criteria?</p> <p>If the licensee did not perform the ESEP, did they perform an evaluation consistent with the guidance in NEI 12-06, Section H.4.4, Steps 2 and 3, including the evaluation of FLEX components that were not previously evaluated to GMRS or 2 times the SSE?</p>	<p>Yes / No / NA</p>
<p>Notes from staff reviewer: The licensee stated that FLEX items not included in the ESEP were evaluated and qualified for the MNS MSSHI. The licensee performed an analysis in accordance with NEI 12-06 Section H.5 and concluded that these items have adequate capacity.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None</p> <p>Consequence(s): None</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>The licensee has evaluated seismic adequacy of equipment used in support of FLEX strategy consistent with the NEI 12-06, Appendix H guidance.</li> </ul>	<p>Yes / No</p>

III. Inherently / Sufficiently Rugged Equipment

<p>Appendix H, Section 4.4 of NEI 12-06, Revision 2 documents the process and justification for inherently and sufficiently rugged SSCs.</p> <p>The licensee:</p> <p>Documented the inherently and sufficiently rugged SSCs consistent with the NEI 12-06 Appendix H guidance.</p>	<p>Yes / No</p>
<p>Notes from staff reviewer: The process to identify inherently rugged items is documented in Section 2.3 of the MNS MSA report dated August 10, 2017. The licensee stated that a qualitative assessment was presented in Stevenson &amp; Associates Report 16C4418-RPT-002.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None</p> <p>Consequence(s): None</p>	

<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>The licensee's assessment of inherently and sufficiently rugged SSCs met the intent of the NEI 12-06, Appendix H guidance.</li> </ul>	<p>Yes / No</p>
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IV. Evaluation of Components Not Covered by ESEP

<p>The ESEP specifically excluded the evaluation of certain components of the FLEX strategy in an effort to provide stakeholders with near-term confidence in a plant's seismic capacity. However, licensees will be required to complete those evaluations as part of the Path 4 MSA to demonstrate compliance with the impending rule. Were the following components, not evaluated in the ESEP, evaluated as part of the MSA? :</p> <ul style="list-style-type: none"> <li>FLEX Storage Building</li> <li>Non-seismic CAT I structures</li> <li>Operator Pathways credited in FLEX strategy</li> <li>Tie down of FLEX portable equipment</li> <li>Seismic interactions             <ul style="list-style-type: none"> <li>Masonry block wall</li> <li>Piping attached to tanks</li> <li>Flooding from non-seismically robust tanks</li> <li>Distributed systems (Piping/conduit/raceways/cable trays)</li> <li>Other potential areas of interaction</li> </ul> </li> <li>FLEX equipment haul paths</li> <li>Other equipment (list in Staff Reviewer Notes)</li> </ul> <p>Did the licensee provide adequate description/documentation of the evaluation?</p>	<p>Yes / No</p> <p>Yes / No / NA</p> <p>Yes / No</p> <p>Yes / No</p> <p>Yes / No</p> <p>Yes / No</p> <p>Yes / No</p> <p>Yes / No</p> <p>Yes / No / NA</p> <p>Yes / No</p>
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Notes from staff reviewer: The licensee stated no piping attached to buried tanks exist within the FLEX strategy. The staff also reviewed referenced documents 16C4418-RPT-002 and 16C4418-CAL-001 from Stevenson & Associates to confirm the MSA submittal

statements regarding FLEX buildings and block wall seismic capacity in Sections 2.4.1 and 2.4.4.

Deviation(s) or deficiency(ies) and Resolution: None

Consequence(s): None

The NRC staff concludes:

- The licensee followed the NEI 12-06, Appendix H guidance in evaluating SSCs not deemed inherently rugged.

Yes / No

#### V. Spent Fuel Pool (SFP) Cooling

Per NEI 12-06, Appendix H, Section 4.4, licensees need to evaluate the adequacy of SFP cooling equipment to the GMRS. Most plants include the Order EA-12-051 SFP level instrument as part of the strategy.

The licensee:

- Clearly identified the SSCs and locations of the equipment that is part of the final FLEX SFP cooling strategy.
- Clearly stated the seismic design-basis (e.g. SSE) of the equipment used in the strategy.
- Provided adequate description or documentation of the SFP cooling equipment's evaluation to the GMRS. Portable equipment and flexible hoses do not need to be evaluated.

Yes / No

Yes / No

Yes / No

Notes from staff reviewer: The NRC staff confirmed that the SFP cooling equipment described in the licensee's FIP was reevaluated to the GMRS as documented in Stevenson & Associates Report 16C4418-RPT-002. The NRC staff reviewed the calculation and confirmed that it meets the guidance in NEI 12-06, Appendix H, Section 4.4.

Deviation(s) or deficiency(ies) and Resolution: None

Consequence(s): None



<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>The licensee followed the NEI 12-06, Appendix H guidance in evaluating SFP cooling.</li> </ul>	<p>Yes / <del>No</del></p>
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VI. High Frequency (HF)

<p>Per NEI 12-06, Appendix H, Section 4.4, licensees with GMRS exceedance of the SSE above 10 Hz need to evaluate bi-stable components such as relays using the methodology described in NEI 12-06, Section H.4.2. The HF evaluation may have been submitted under separate letter or may be sent as an attachment to the MSA Report. The staff review checklist is included as an attachment to this report.</p> <p>The licensee:</p> <ul style="list-style-type: none"> <li>GMRS exceeds the SSE above 10 Hz.</li> <li>Provided a HF evaluation as described in NEI 12-06, Section H.4.2.</li> <li>Appeared to follow the guidance for the HF evaluation.</li> <li>Provided results of demand vs. capacity with identification of resolutions as needed.</li> </ul>	<p>Yes / <del>No</del></p> <p>Yes / <del>No</del> / NA</p> <p>Yes / <del>No</del> / NA</p> <p>Yes / <del>No</del> / NA</p>
<p>Notes from staff reviewer: The selection process for high frequency evaluation is described in detail in Stevenson &amp; Associates Report 16C4435-RPT-001. The NRC staff confirmed that no FLEX related components were identified for HF evaluation. No modifications were required.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None</p> <p>Consequence(s): None</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>The licensee's component capacity evaluation met the intent of the HF guidance.</li> </ul>	<p>Yes / <del>No</del></p>

VII. Conclusions:

The NRC staff assessed the licensee's implementation of the MSA guidance for MNS. Based on its review, the NRC staff concludes that the licensee's implementation of the MSA meets the intent of the guidance. The staff concludes that through the implementation of the MSA guidance, the licensee identified and evaluated the seismic capacity of the mitigating strategies equipment to ensure functionality will be maintained following a seismic event up to the GMRS. As noted in the review checklist, the staff identified no deviations and no exceptions taken from the guidance and the licensee did not identify any necessary equipment modifications or changes to the strategy.

In summary, the NRC staff has reviewed the seismic hazard MSA for MNS. The NRC staff concludes that sufficient information has been provided to demonstrate that the licensee's plans for the development and implementation of guidance and strategies under Order EA-12-049 appropriately address the reevaluated seismic hazard information stemming from the 50.54(f) letter.

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