



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

February 20, 2018

Mr. Robert T. Simril  
Site Vice President  
Duke Energy Carolinas, LLC  
Catawba Nuclear Station  
4800 Concord Road  
York, SC 29745

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2 – STAFF REVIEW OF MITIGATING STRATEGIES ASSESSMENT REPORT OF THE IMPACT OF THE REEVALUATED SEISMIC HAZARD DEVELOPED IN RESPONSE TO THE MARCH 12, 2012, 50.54(f) LETTER (CAC NOS. MF7814 AND MF7815; EPID L-2016-JLD-0006)

Dear Mr. Simril:

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 29, 2017, letter (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17244A264), submitted by Duke Energy Carolinas, LLC (Duke, the licensee) for Catawba Nuclear Station, Units 1 and 2 (CNS). The NRC staff evaluated the CNS strategies developed under Order EA-12-049 and described in Duke's Final Integrated Plan (FIP) for CNS in Attachment 6 of letter dated February 15, 2016 (ADAMS Accession No. ML16049A041). The staff's review of CNS's mitigating strategies was documented in a safety evaluation dated October 20, 2016 (ADAMS Accession No. ML16277A404). 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 November 16, 2017 (ADAMS Accession No. ML17320A365). The following NRC staff review confirms that the licensee has adequately addressed the reevaluated seismic hazard within CNS'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 April 27, 2015 (ADAMS Accession No. ML15096A513), 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 CNS Ground Motion Response Spectrum (GMRS) exceeds the safe shutdown earthquake (SSE) in the 6 to 100 Hertz (Hz) range, meriting a seismic risk evaluation, spent fuel pool evaluation and a high frequency (HF) confirmation. In addition, the staff concluded that the GMRS determined by the licensee adequately characterizes the reevaluated seismic hazard for the Catawba 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 CNS screening determination for seismic risk evaluation based on supplemental information provided by the licensee. The need for CNS to perform a stand-alone HF confirmation was established in the NRC letter dated December 22, 2016.

By letters dated August 29, 2017 and December 28, 2017 (ADAMS Accession Nos. ML17244A269 and ML18002A364, respectively), Duke submitted a HF confirmation report for CNS. By letter dated January 23, 2018 (ADAMS Accession No. ML18003B420), the NRC staff concluded, based on its review, that the licensee correctly implemented the guidance in conducting the HF confirmation for CNS. Three hundred and two of 374 evaluated components demonstrated adequate seismic capacity. Six components were removed from evaluation based on more detailed screening. Sixty-six components were resolved through operator action. No component modifications were required.

By letter dated August 29, 2017 (ADAMS Accession No. ML17244A264), Duke submitted its seismic MSA report for CNS. The licensee stated that the CNS 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 CNS 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.

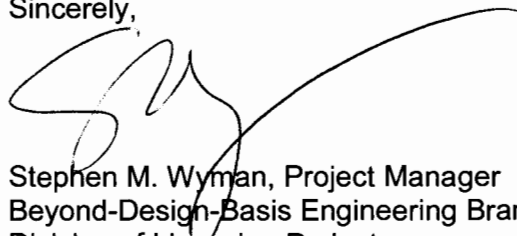
The NRC staff performed a checklist review of the seismic hazard MSA for CNS. The checklist is provided as an enclosure to this letter.

The NRC staff found that CNS 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 CNS 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 electronic mail at Stephen.Wyman@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to be 'S. Wyman', written over a horizontal line.

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

Docket Nos. 50-413 and 50-414

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  
CATAWBA NUCLEAR STATION, UNITS 1 AND 2  
DOCKET NOS. 50-413 AND 50-414

The NRC staff performed the following checklist review based on the Enclosure of the August 29, 2017, letter (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17244A264) for Catawba Nuclear Station, Units 1 and 2 (CNS). 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 1.91. 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 SSCs excluded from consideration in the ESEP were added to the MSA equipment scope. In addition, SSC failure modes not addressed in the ESEP that could potentially affect the FLEX strategies were added and evaluated.</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 CNS MSA report dated August 29, 2017.</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 used a FIRs in its evaluation of the FLEX building. C<sub>10%</sub> capacity of turbine building exceeded GMRS for Non-seismic CAT I structure. The licensee stated no piping attached to buried tanks exist within the FLEX strategy.

Deviation(s) or deficiency(ies) and Resolution: None	
Consequence(s): None	
The NRC staff concludes: <ul style="list-style-type: none"> <li>The licensee followed the NEI 12-06, Appendix H guidance in evaluating SSCs not deemed inherently rugged.</li> </ul>	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:	
<ul style="list-style-type: none"> <li>Clearly identified the SSCs and locations of the equipment that is part of the final FLEX SFP cooling strategy.</li> </ul>	Yes / No
<ul style="list-style-type: none"> <li>Clearly stated the seismic design-basis (e.g. SSE) of the equipment used in the strategy.</li> </ul>	Yes / No
<ul style="list-style-type: none"> <li>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.</li> </ul>	Yes / No
Notes from staff reviewer: The licensee stated equipment relied on for the implementation of the SFP Cooling FLEX strategy has adequate capacity to withstand the GMRS.	
Deviation(s) or deficiency(ies) and Resolution: None	
Consequence(s): None	
The NRC staff concludes: <ul style="list-style-type: none"> <li>The licensee followed the NEI 12-06, Appendix H guidance in evaluating SFP cooling.</li> </ul>	Yes / No

VI. High Frequency (HF)

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	
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<p>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><del>Yes</del> / <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 16C4437-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 CNS. 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 CNS. 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.

**SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2 – STAFF REVIEW OF MITIGATING STRATEGIES ASSESSMENT REPORT OF THE IMPACT OF THE REEVALUATED SEISMIC HAZARD DEVELOPED IN RESPONSE TO THE MARCH 12, 2012, 50.54(f) LETTER DATED February 20, 2018**

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