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

April 18, 2017

Mr. Peter A. Gardner
Site Vice President
Northern States Power Company - Minnesota
Monticello Nuclear Generating Plant
2807 West County Road 75
Monticello, MN 55362-9637

SUBJECT: NUCLEAR REGULATORY COMMISSION REPORT FOR THE AUDIT OF NORTHERN STATES POWER COMPANY'S FLOOD HAZARD REEVALUATION REPORT SUBMITTAL RELATING TO THE NEAR-TERM TASK FORCE RECOMMENDATION 2.1-FLOODING FOR MONTICELLO NUCLEAR GENERATING PLANT (CAC NO. MF7712)

Dear Mr. Gardner:

The purpose of this letter is to provide you with the final audit report which summarizes and documents the U.S. Nuclear Regulatory Commission's (NRC's) regulatory audit of the Flood Hazard Reevaluation Report (FHRR) submitted by Northern States Power Company, a Minnesota corporation (NSPM, the licensee), doing business as Xcel Energy, related to Monticello Nuclear Generating Plant (Monticello). The FHRR was submitted as part of implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear plant. Specifically, the FHRR documents the results of the flood hazard reevaluation being completed as part of NRC Near-Term Task Force Recommendation 2.1.

By letter dated June 7, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16152A125), the NRC informed you of the staff's plan to conduct a regulatory audit of NSPM's FHRR submittal for Monticello. The audit was intended to support the NRC staff's review of the licensee's FHRR and the subsequent issuance of a staff assessment documenting the staff's review. The audit was conducted remotely during the months of June 2016 – March 2017, with a teleconference on August 18, 2016. The audit was performed consistent with NRC Office of Nuclear Reactor Regulation Office Instruction LIC-111, "Regulatory Audits," dated December 29, 2008 (ADAMS Accession No. ML082900195). The details of the audit were discussed with Ms. Lynne Gunderson of your staff.

If you have any questions, please contact me at (301) 415-1056 or by e-mail at Lauren.Gibson@nrc.gov.

Sincerely,

Lauren K. Gibson, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket No. 50-263

Enclosure:
Audit Report

cc w/encl: Distribution via Listserv

UNITED STATES
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AUDIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR THE AUDIT OF NORTHERN STATES POWER COMPANY'S FLOOD HAZARD REEVALUATION REPORT SUBMITTAL RELATING TO THE NEAR-TERM TASK FORCE RECOMMENDATION 2.1-FLOODING FOR MONTICELLO NUCLEAR GENERATING PLANT DOCKET NO. 50-263

BACKGROUND AND AUDIT BASIS

By letter dated March 12, 2012, 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 Licenses" (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force report. Recommendation 2.1 in that document recommended that the NRC staff issue orders to all licensees to reevaluate seismic and flooding hazards for their sites using current NRC requirements and guidance. Subsequent staff requirements memoranda associated with SECY-11-0124 and SECY-11-0137 instructed the NRC staff address this recommendation through the issuance of requests for information to licensees pursuant to 10 CFR 50.54(f).

By letter dated May 12, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML16145A233), Northern States Power Company, a Minnesota corporation (NSPM, the licensee), doing business as Xcel Energy, submitted its Flood Hazard Reevaluation Report (FHRR) for Monticello Nuclear Generating Plant (Monticello). The NRC is in the process of reviewing the aforementioned submittals and has completed a regulatory audit of NSPM to inform the licensee of its review of the submittals, identify any similarities/differences with past work completed, and ultimately aid in its review of licensees' FHRR. This audit summary is being completed in accordance with the guidance set forth in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-111, "Regulatory Audits," dated December 29, 2008 (ADAMS Accession No. ML082900195).

AUDIT LOCATION AND DATES

The audit was completed by document review via the electronic reading room (ERR) and a teleconference held on August 18, 2016. A closeout phone call was held on April 5, 2017.

Enclosure

AUDIT TEAM

Title	Team Member	Organization
Team Leader, NRR/JLD	Anthony Minarik	NRC
Project Manager, NRR/JLD	Lauren Gibson	NRC
Branch Chief, NRO/DSEA	Aida Rivera	NRC
Branch Chief, NRO/DSEA	Christopher Cook	NRC
Technical Manager	Richard Rivera-Lugo	NRC
Lead Hydrologist	Mike Lee	NRC
Contractor	Vinod Mahat	ANL
Contractor	Nicholoas Haas	ANL
Contractor	John Quinn	ANL
Contractor	Eugene Yan	ANL

DOCUMENTS AUDITED

Attachment 1 of this report contains a list that details all the documents reviewed by the NRC staff, in part or in whole, as part of this audit. The documents were located in an ERR during the NRC staff review.

AUDIT ACTIVITIES

In general, the audit activities consisted of the following actions:

- Review background information on site topography and geographical characteristics of the watershed.
- Review site physical features and plant layout.
- Understand the selection of important assumptions and parameters that would be the basis for evaluating the individual flood-causing mechanisms described in the 50.54(f) letter.
- Review model input/output computer files, such as Hydrologic Engineering Center (HEC)-River Analysis System (RAS), FLO-2D, and HEC- Hydrologic Modeling System (HMS), to gain an understanding of how modeling assumptions were programmed and executed.

Attachment 2 of this report provides more detail and summarizes specific technical topics (and resolution) of important items that were discussed and clarified during the audit. The items discussed in Attachment 2 may be referenced/mentioned in the staff assessment in more detail.

CLOSEOUT TELECONFERENCE MEETING

Following the August 18, 2016, teleconference, the NRC staff identified certain information that needed to be provided on the docket in order to resolve some of the items discussed during the audit. The information updated or supplemented the FHRR based on the audit discussions. This information included the following:

1) Certain plant diagrams showing the locations of key doors

The requested information was received by e-mail dated September 23, 2016 (ADAMS Accession No. ML16323A329).

On April 5, 2017, the NRC informed the licensee that no further information was needed for the audit and that the virtual audit was henceforth considered closed.

Attachments:
1. Audit Documents
2. Monticello Information Needs – Audit/Post-Audit Summary

ATTACHMENT 1

Monticello Nuclear Generating Plant, Unit 1 Audit Document List

1. Black & Veatch, 2015, "Local Intense PMP Hydrology and Hydraulics," Calculation No. 180999.51.1005, Revision 2. April 2016.

2. NRC (U.S. Nuclear Regulatory Commission), 2011d, "Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United State of America," NUREG/CR-7046, November 2011, ADAMS Accession No. ML11321A195.

3. NSPM (Northern States Power – Minnesota), 2016a, "FHRR (Flood Hazard Reevaluation Report) Audit Presentation 8-18-16 – Webinar Slides", in response to Monticello Nuclear Generating Plant (MNGP) Unit 1 Information Needs – Local Intense Precipitation, August 18, 2016.

4. NSPM, 2016b, "Subject: Monticello Nuclear Generating Plant Flood Hazard Reevaluation Report – Responses to Requested Information (COC no. MF7712)," email from John S. Fields, Monticello Projects Licensing to Lauren Gibson, Project Manager, U.S. Nuclear Regulatory Commission, September 23, 2016, 11:03:54 AM, ADAMS Accession No. ML16323A329.

5. NSPM, 2016c, "Excel Spreadsheet HEC-RAS Inflows -- MNGP Spreadsheet Discussed in Q3 & Q4", in response to Monticello Nuclear Generating Plant (MNGP) Unit 1 Information Needs – Local Intense Precipitation, August, 2016.

6. NSPM, 2016d, "Hydraulic Models Tables – Tables 1-3 Discussed in Webinar for MNGP Q3", in response to Monticello Nuclear Generating Plant (MNGP) Unit 1 Information Needs – Local Intense Precipitation, August 18, 2016.

7. Xcel Energy, 2016a, "Calculation 180999.51.1005 – Local Intense Precipitation, HEC-HMS Input & Output files", in a CD of "Monticello Nuclear Generating Plant" prepared on June 15, 2016 and sent to Victor Hall, Project Manager, U.S. Nuclear Regulatory Commission, June 2016.

8. Xcel Energy, 2016b, "Calculation 180999.51.1005 – Local Intense Precipitation, HEC-RAS Input & Output files", in a CD of "Monticello Nuclear Generating Plant" prepared on June 15, 2016 and sent to Victor Hall, Project Manager, U.S. Nuclear Regulatory Commission, June 2016.

ATTACHMENT 2

Monticello Nuclear Generating Plant Information Needs – Audit/Post-Audit Summary

Information Need No.	Information Need Description	Response
1	**Local Intense Precipitation – Critical opening locations** Background: In the Flood Hazard Reevaluation Report (FHRR) Table 2 and Tables 3.0-1 and 5.4-5 of the local intense precipitation (LIP) calculation package (Black & Veatch, 2015), the calculated maximum water surface elevations (WSEs) exceeded the as-built door sill elevations at 11 critical door opening locations. The locations for 7 of the 11 critical doors are shown in Figures 5.3.5-1 and 5.3.6-1 of the LIP calculation package. However, the locations of the remaining 4 critical openings are not presented or discussed in any of the FHRR-related documents. In a related matter, Table 5.4-5 presents hydraulic model – "MNGP [Monticello Nuclear Generating Plant] Site West Sub21" – and the maximum WSEs simulated by this model for one critical door location; however, the model is not cited (referenced) in any of the documents just described. Request: It is requested that the licensee describe the locations and modeling results for all critical door openings that are assumed for safety-related structures, systems and components at the reactor site. It is also requested that the licensee provide the hydraulic model files and related documents for computer model designated "MNGP Site West Sub21".	The licensee provided additional annotated figures (NSPM 2016a) showing locations of the four missing critical door openings, and indicated that those door locations are designated Doors 1, 193, 341, and 483 in both Table 2 of the FHRR and the supporting LIP calculation package (Tables 3.0-1 and 5.4-5). One of the figures provided also illustrates the location of Door 30 that was mentioned in FHRR Section 2.10.1. In its response, the licensee also addressed a related door opening location question related to the Fuel Oil Transfer Pumping House. The licensee noted that the maximum WSE simulated for a critical door opening there was based on the hydraulic model described as "MNGP Site West Sub2a Plan.P01." The licensee acknowledged that the hydraulic model mentioned in the Table 5.4-5 calculation package as "MNGP Site West Sub21 Plan.P01" was in fact a typographical error (NSPM 2016a). In order to complete the review of all critical door opening locations at the Monticello site, the staff requested that the licensee provide revised figures to include all critical door opening locations in question, their river reaches, and associated cross sections using appropriate annotations and legends. On September 23, 2016, the figures were submitted to the NRC (NSPM, 2016b). The NRC staff reviewed information provided during the audit and the figures subsequently provided by the licensee after the audit, and concluded that the information provided by the licensee was sufficient to address this information need request.

Information Need No.	Information Need Description	Response
2	**Local Intense Precipitation – Unit hydrograph** Background: The licensee used the Soil Conservation Service (SCS) Unit Hydrograph method to transform precipitation into surface runoff. The derived unit hydrograph (including the SCS unit hydrograph) may not always represent the actual hydrometeorological conditions that might prevail during the probable maximum flood (PMF) event. Consequently, NUREG/CR-7046 (NRC, 2011) recommends that nonlinearity adjustments to the unit hydrograph should be made by increasing the peak of the unit hydrograph by 20% and reducing the time of peak by 33%. As part of its review, the staff found that the licensee reduced the time of the peak by 33% but didn't increase the peak of the unit hydrograph by 20%. Request: It is requested that the licensee explain its reasoning for why unit hydrograph was not adjusted to account for the nonlinear effects of the basin response to the peak flow.	In response to the information need request, the licensee explained that the reduction in the lag time by 33% in the SCS of the unit hydrograph method will result in an increase in the unit hydrograph peak discharge. For a lag time range of 3.6 to 88.7 minutes, the estimated discharge increase ranges from 41% to 49% after lag time adjustment, and further adjustment of the peak discharge was not warranted (NSPM, 2016a). The NRC staff concluded that the information provided by the licensee was sufficient to address the staff's information need request.
3	**Local Intense Precipitation – Model input/output files and the model runs** Background: The licensee provided several input/output (I/O) model files for both the U.S. Army Corps of Engineer's Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) and Hydrologic Engineering Center River Analysis System (HEC-RAS) software packages. Both the HEC-HMS and HEC-RAS computer models and their attendant I/O files were placed in the licensee's electronic	In response to the information need request, the licensee prepared: (a) an Excel spreadsheet (NSPM, 2016c); and (b) summary tables (NSPM, 2016d) containing the names of the final versions of the I/O files that were associated with the simulated model results for the critical door openings presented in the FHRR. That spreadsheet was placed in the licensee's ERR. Upon review, the staff found that the spreadsheet included a cross-walk between the HEC-HMS sub-basins and the corresponding HEC-RAS models. The staff also confirmed

Information Need No.	Information Need Description	Response
	reading room (ERR). However, upon review, it is not clear which version of those I/O files was the principal file associated with the results presented in the licensee's FHRR. Request: It is requested that the licensee identify the final version(s) of the I/O files used, and their corresponding results presented in the FHRR for the respective HEC-HMS and HEC-RAS computer models.	that the Excel spreadsheet identified the flow distribution calculations in relation to the 11 critical door opening locations. The NRC staff reviewed the information provided by the licensee and the I/O files for HEC-HMS and HEC-RAS models (Xcel Energy, 2016a and 2016b) and concluded that the information provided was sufficient to address the staff's information need request.
4	**Local Intense Precipitation – Flow distribution to reaches/cross sections** Background: The HEC-HMS model was used to transform the precipitation into runoff (flow). For each sub-basin or reach, the flow simulated by the HEC-HMS model serves as an input to the HEC-RAS model. However, in the HEC-RAS models, many of the model sub-basins have more than one reach (drainage path), and sub-basin flow can be distributed among multiple reaches. Upon review, the staff found that surface flow was also distributed to many cross sections within a sub-basin. In its FHRR, the licensee stated that the flow was distributed to different reaches or cross sections via a spatial weighting scheme, but it is not clear from the FHRR text how that spatial weighting scheme was determined and how the results were subsequently implemented in the HEC-RAS model. For example, HEC-HMS model (MNGP Site East: Sub-Basin-3) simulated peak flow for sub-basin 3 is 448.8 cubic feet per second (ft^3/s, cfs) (Figure 1), and this flow value was distributed to three reaches within the same sub-basin in the HEC-RAS model as 168.1 ft^3/s (37%), 92.7 ft^3/s (21%) and 188 ft^3/s (42%) (See page 51 of the calculation package [Black & Veatch, 2015]). It is not clear how these distributed	In response to the information need request, the licensee explained that the distribution of the flow to reaches and cross-sections within a sub-basin was calculated using a spatial weighting scheme based on: (a) the percentage of drainage area corresponding to each reach within the basin; and (b) a flow accumulation estimate that itself was based on an estimate of accumulated GIS pixels corresponding to a specific location of interest. In response to this information need request, a spreadsheet was placed in the ERR documenting the spatial weighting schemes and flow distributions to reaches and cross sections in each sub-basin used by the licensee (NSPM, 2016c). The NRC staff reviewed the spreadsheet and concluded that the information provided by the licensee was sufficient to address the information need request.

Information Need No.	Information Need Description	Response
	values were derived. Similarly, in the HEC-HMS model MNGP Site South: Sub-Basin 9, simulated peak flow for sub-basin 9 is 242.7 cfs (Figure 2), and the flow was distributed to four cross sections within the same sub-basin. Again, it is not clear how the flow distribution was achieved within the model. Request: It is requested that the licensee identify which FHRR supporting documents contain the calculation results showing the flow distributions among the respective reaches and cross sections for the various sub-basins. In connection with the identification, it is also requested that the licensee place these documents in the ERR.	

Sources:

Black & Veatch, 2015, "Local Intense PMP Hydrology and Hydraulics," Calculation No. 180999.51.1005, Revision 2. April 2016.

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