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

August 1, 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: MONTICELLO NUCLEAR GENERATING PLANT – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT (CAC NO. MF7945)

Dear Mr. Gardner:

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), 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 (NTTF) report (ADAMS Accession No. ML111861807).

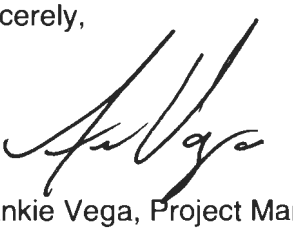
Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses. Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," (ADAMS Accession No. ML12054A735). In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not be based on present-day methodologies and guidance, in the development of their mitigating strategies.

By letter dated January 25, 2017 (ADAMS Accession No. ML17026A415), Northern States Power Company, a Minnesota corporation (the licensee), doing business as Xcel Energy, submitted the mitigation strategies assessment (MSA) for Monticello Nuclear Generating Plant (Monticello). The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events. The purpose of this letter is to provide the NRC's assessment of the Monticello MSA.

The NRC staff has concluded that the Monticello MSA was performed consistent with the guidance described in Appendix G of Nuclear Energy Institute 12-06, Revision 2, as endorsed by Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2012-01, Revision 1, and that the licensee has demonstrated that the mitigation strategies appear reasonably protected from conditions associated with beyond-design-basis reevaluated flood hazards. This closes out the NRC's efforts associated with CAC No. MF7945.

If you have any questions, please contact me at 301-415-1617 or at Frankie.Vega@nrc.gov.

Sincerely,



Frankie Vega, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Enclosure:
Staff Assessment Related to the
Mitigating Strategies for Monticello

Docket No. 50-263

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO MITIGATION STRATEGIES FOR MONTICELLO NUCLEAR GENERATING

PLANT, AS A RESULT OF THE REEVALUATED FLOODING HAZARD

NEAR-TERM TASK FORCE RECOMMENDATION 2.1

DOCKET NO. 50-263

1.0 INTRODUCTION

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML 12053A340), 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 (NTTF) report (ADAMS Accession No. ML111861807).

Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A046). Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). That order requires holders of operating reactor licenses and construction permits issued under 10 CFR Part 50 to modify the plants to provide additional capabilities and defense-in-depth for responding to beyond-design-basis external events, and to submit to the NRC for review a final integrated plan that describes how compliance with the requirements of Attachment 2 of the order was achieved. In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not be based on present-day methodologies and guidance, in the development of their mitigating strategies.

The NRC staff and industry recognized the difficulty in developing and implementing mitigating strategies before completing the reevaluation of flood hazards. The NRC staff described this issue and provided recommendations to the Commission on integrating these related activities in COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flood Hazards," dated November 21, 2014 (ADAMS Accession No. ML14309A256). The Commission issued a staff requirements memorandum on March 30, 2015 (ADAMS Accession No. ML15089A236), affirming that the Commission expects licensees for operating nuclear power plants to address the reevaluated flood hazards, which are considered beyond-design-basis external events, within their mitigating strategies.

Nuclear Energy Institute (NEI) 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625), has been endorsed by the NRC as an appropriate methodology for licensees to perform assessments of the mitigating strategies against the reevaluated flood hazards developed in response to the March 12, 2012,

50.54(f) letter. The guidance in NEI 12-06, Revision 2, and Appendix G in particular, supports the proposed Mitigation of Beyond-Design-Basis Events rulemaking. The NRC's endorsement of NEI 12-06, including exceptions, clarifications, and additions, is described in NRC 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). Therefore, Appendix G of NEI 12-06, Revision 2, describes acceptable methods for demonstrating that the reevaluated flooding hazard is addressed within the Monticello Nuclear Generating Plant (Monticello) mitigating strategies for beyond-design-basis external events.

2.0 BACKGROUND

By letter dated May 12, 2016 (ADAMS Accession No. 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. By letter dated September 16, 2016 (ADAMS Accession No. ML16248A004), the NRC issued an interim staff response (ISR) letter for Monticello. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for Monticello, which were to be used as suitable input for the mitigating strategies assessment (MSA). For Monticello, the only mechanism listed as not bounded by the CDB in the ISR letter is local intense precipitation (LIP). The NRC staff subsequently issued the staff assessment of the FHRR by letter dated April 24, 2017 (ADAMS Accession No. ML17104A310), containing additional details supporting the NRC staff's conclusions summarized in the ISR letter. The NRC staff review of the flood event duration (FED) and associated effects (AE) parameters associated with the LIP mechanisms is provided below. By letter dated March 28, 2017 (ADAMS Accession No. ML17087A343), NSPM submitted the Monticello MSA for review by the NRC staff.

3.0 TECHNICAL EVALUATION

3.1 Mitigating Strategies under Order EA-12-049

Monticello's FLEX strategy is described in the document, "Notification of Full Compliance of Required Action for NRC Order EA-12-049 Mitigation Strategies for Beyond-Design-Basis External Events", which was submitted by letter dated July 6, 2017 (ADAMS Accession No. ML17187A153). The NRC staff is evaluating the strategies in the plan and will document the review in a safety evaluation. The purpose of the safety evaluation is to ensure the licensee has developed guidance and proposed designs that, if implemented appropriately, will adequately address the requirements of Order EA-12-049. An inspection will confirm compliance with the order.

A brief summary of Monticello's FLEX strategies is listed below:

- The site has redundant FLEX diesel generators that can provide the power required for vital instrumentation and the applicable FLEX equipment. The FLEX diesel fuel supply is provided by on-site fuel oil storage tanks, which will not be adversely affected by a flooding event.

- The control room indications of vital instruments are initially powered by the station batteries and eventually by the FLEX diesel generators.

- Core cooling is maintained by ensuring adequate reactor pressure vessel inventory for decay heat removal. Initially, the reactor core isolation cooling (RCIC) system will be used to provide reactor pressure vessel (RPV) makeup. Subsequently, a portable FLEX pump taking suction from the ultimate heat sink will makeup to the RPV.

- The primary strategy for maintaining containment integrity will be through venting the containment using the hardened containment vent system.

3.2 Evaluation of Current FLEX Strategies Against Reevaluated Hazard(s)

While the ISR flood levels for the reevaluated LIP hazard are not addressed in the site's design basis flood evaluation, the licensee concluded that the increased flood water elevations do not result in impacts to the FLEX strategy. In assessing the impact of the ISR flood levels for the LIP event, NSPM assumed that the extended loss of alternating current power occurred at time zero ("t = 0"), coincident with the highest precipitation rate. The licensee notes that the assumption that the ELAP occurs at time zero places the maximum FLEX strategy implementation time concurrent with the LIP event, which is assumed to have a 6 hour duration. Although the LIP flood levels are not bounded by the current design basis (LIP is not included in the Monticello CDB), the levels are below the FLEX equipment storage level so the equipment would remain functional.

Only one operator action outside of plant structures is required to be performed as part of the licensee's FLEX strategy (hydrogen purge of the main generator); this action can be performed after the precipitation rate has partially abated and water has receded from the affected area, at about one hour after the start of the event. Therefore, according to the licensee, the LIP event will not prevent any necessary operator actions outside of the plant structures. Additionally, FLEX equipment does not need to be externally deployed until well after the duration of the LIP event, thus the LIP flood waters should recede and not impede deployment of the FLEX equipment or use of offsite resources. Additionally, no external connections need to be made until LIP flood waters have receded. Lastly, because NSPM's FLEX strategy does not involve the installation of temporary flood protection measures during a LIP event, they did not need to make any procedural changes. Based on the above assessment, the licensees stated that the ISR flood levels for LIP do not adversely impact the FLEX strategies.

The NRC staff reviewed the licensee's assessment of the reevaluated LIP flood level in the MSA. The NRC staff confirmed that the water surface elevation (WSE) reported in the MSA matches the value in the ISR letter of 935.8 feet (ft.) National Geodetic Vertical Datum of 1929 (NGVD29). Since LIP flood levels exceed the elevation of several door sills/inverts, the NRC staff reviewed the impacts of the LIP water intrusion at doors that would not be protected and agrees that structures, systems, and components important to safety in the plant structures where water could accumulate would not be adversely affected by the LIP. The NRC staff also evaluated if the reevaluated LIP hazard impacted any of the storage location(s) of FLEX equipment, any staging areas, haul paths, connection points, activities, etc. The staff agrees that, based on the duration of the LIP event and eventual recession, there appears to be sufficient time for flood waters to recede prior to the FLEX response activity taking place and therefore, no impact is expected to occur as a result of the reevaluated LIP hazard. The NRC staff concludes that the licensee has adequately assessed the ISR flood levels for the LIP event and that the applicable FLEX strategy can be implemented.

3.3 Confirmation of the Flood Hazard Elevations in the MSA

The NRC staff reviewed the flood hazard elevations in the MSA and confirmed that the elevations for the LIP flood mechanism match the values in the site's ISR, even though the licensee's flood analysis in the MSA letter is based on a site-specific Probable Maximum Precipitation (ssPMP) scenario and two-dimensional (2D) numerical model.

In performing the review, the licensee decided to rely on an ssPMP value of 20.6 inches (in.) for the purposes of the MSA. In its FHRR, the licensee previously relied on an value of 23.6 in. derived from the National Weather Service's Hydrometeorological Reports (or HMRs) applicable to the site. Using HMR-51 (National Oceanic and Atmospheric Association (NOAA), 1982) and HMR-52 (NOAA, 1982) methodology, the precipitation intensity for the 6-hour, 10-mi^2 PMP event was estimated as 23.60 in., which is 13 percent more than the ssPMP-derived estimate now being reported. In determining the significance of the change, the WSE due to LIP was estimated as 935.8 ft. NGVD29 whereas the revised WSE based on an ssPMP scenario was 935.72 ft. NGVD29. In its FHRR, the licensee reevaluated the flood hazard due to a LIP event using the one-dimensional U.S. Army Corps of Engineers Hydrologic Engineering Center (HEC) Hydrologic Modeling System (HEC-HMS) and River Analysis System (HEC-RAS) software packages. In its MSA, the licensee did not discuss the computer software applied to compute the water elevation. Because the change in the maximum-computed WSE is nearly identical between the FHRR and MSA, the staff determined that it is not necessary to review the manner in which the ssPMP value was derived in the MSA, as well as the licensee's MSA (i.e., revised) LIP model.

3.4 Evaluation of Flood Event Duration

The staff reviewed information provided by the licensee in its FHRR and MSA submittals regarding the FED parameters needed to perform the MSA for flood hazards not bounded by the CDB at the Monticello site. The FED parameters for the flood-causing mechanisms not bounded by the CDB are summarized in Table 1 of this assessment.

The licensee did not report a warning time for LIP-related flooding in its MSA as the warning time is not credited in the flood protection strategy since only permanent/passive measures are used for the LIP flood-causing mechanism. The staff notes that the licensee also has the option to use NEI 15-05, "Warning Time for Local Intense Precipitation Events" (ADAMS Accession No. ML15104A158), to estimate warning time for LIP.

The licensee provided the maximum WSEs generated during the LIP flood-causing mechanism at multiple locations within the Monticello powerblock. Those locations and their corresponding elevations are described by the staff in Table 2 of the ISR letter. In its MSA letter, the licensee amended the list of flood monitoring locations and in doing so, described the duration of inundation. In its FHRR, the licensee previously relied on a 6-hr precipitation event for the purposes of LIP flood analysis. In light of the grading of the site and existing surface water drainage system within the powerblock previously described in the FHRR, the staff found that a 1.7-hr estimate for duration of inundation is reasonable to use for the purposes of the MSA. In its MSA letter, the licensee reported that the time necessary for the LIP flood waters to recede completely from critical site locations within the powerblock is no more than 4 hrs.

Based on this review, the staff determined that the licensee's FED parameters for the LIP flood-causing mechanism are reasonable and acceptable for use in the MSA.

3.5 Evaluation of Flood Associated Effects

The staff reviewed the information provided by Monticello in the FHRR and MSA submittals regarding AE parameters for flood hazards not bounded by the CDB. The AE parameters related to WSE (i.e., stillwater elevation with wind waves and run-up effects) were previously reviewed by staff, and were transmitted to the licensee via the ISR letter. The AE parameters not directly associated with WSE are discussed below and are summarized in Table 2 of this assessment.

For the LIP flood-causing mechanism, the licensee stated in its FHRR and MSA that the associated effects of LIP flooding are not considered credible (minimal) due to the relative low flow velocities for a LIP event and limited debris effects within the protected area. The NRC staff confirmed this statement by reviewing the licensee-provided LIP model input and output files. The NRC staff found that the licensee-provided inundation depths and water velocities in the MSA letter are acceptable and that the modeling is reasonable for use in the MSA. The NRC staff agrees with the licensee's conclusion that the AE parameters for LIP are either minimal or will have no impact on FLEX strategies. In light of the small inundation depths and low water velocities anticipated, the NRC staff found that the debris, sediment deposition and erosion, and hydrostatic and hydrodynamic loads associated with the LIP flood-causing mechanism would be minimal. Consequently, the licensee's assumptions and AE parameters are reasonable for use as part of the MSA review.

In summary, the staff determined the licensee's methods were appropriate and the provided AE parameters are reasonable for use in the MSA.

3.6 Conclusion

The NRC staff has reviewed the information provided in the Monticello MSA related to the original FLEX strategies, as evaluated against the reevaluated hazard described in Section 2 of this staff assessment, and found that:

- The FLEX strategies are not affected by the impacts of the ISR flood levels (including impacts due to the environmental conditions created by the ISR flood levels);
- The deployment of the FLEX strategies is not affected by the impacts of the ISR flood levels; and
- AEs and FED are reasonable and acceptable for use in the MSA, and have been appropriately considered in the MSA.

Therefore, the NRC staff concludes that the licensee has followed the guidance in NEI 12-06, Revision 2, and demonstrated the capability to deploy the original FLEX strategies, as designed, against a postulated beyond-design-basis event for the LIP flood-causing mechanism, including associated effects and flood event duration.

4.0 CONCLUSION

The NRC staff has reviewed the information presented by the licensee in its MSA for Monticello. The NRC staff confirmed that the licensee's flood hazard MSA for Monticello was performed consistent with the guidance in Appendix G of NEI 12-06, Revision 2, as endorsed by JLD-ISG-2012-01, Revision 1. Based on the licensee's use of the hazards characterized in the NRC staff's ISR letter, the methodology used in the Monticello MSA evaluation, and the description of its current FLEX strategy in the Monticello MSA and supporting documentation, the NRC staff concludes that the licensee has demonstrated that the mitigation strategies appear to be reasonably protected from reevaluated flood hazards conditions.

Table 1. Flood Event Durations for Flood-Causing Mechanisms Not Bounded by the CDB

FLOOD-CAUSING MECHANISM	TIME AVAILABLE FOR PREPARATION FOR FLOOD EVENT	DURATION OF INUNDATION OF SITE	TIME FOR WATER TO RECEDE FROM SITE
Local Intense Precipitation and Associated Drainage	Use NEI 15-05 (NEI, 2015)	< 1.7 h	2 – 4 h

TABLE 2. ASSOCIATED EFFECTS PARAMETERS NOT DIRECTLY ASSOCIATED WITH TOTAL WATER HEIGHT FOR FLOOD-CAUSING MECHANISMS NOT BOUNDED BY THE CDB

	FLOOD-CAUSING MECHANISM
Associated Effects Parameter	**LOCAL INTENSE PRECIPITATION**
Hydrodynamic loading at plant grade	Minimal
Debris loading at plant grade	Minimal
Sediment loading at plant grade	Minimal
Sediment deposition and erosion	Minimal
Concurrent conditions, including adverse weather	Minimal
Groundwater ingress	Minimal
Other pertinent factors (e.g., waterborne projectiles)	Minimal

Source: Xcel Energy

MONTICELLO NUCLEAR GENERATING PLANT – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT DATED AUGUST 1, 2017

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