NUCLEAR REGULATORY COMMISSION

Docket No. 50-263;

Norther States Power Company

Monticello Nuclear Generating Plant

Exemption

I. Background.

Northern States Power Company, doing business as Xcel Energy (the licensee), is the holder of Renewed Facility Operating License Number 50-263 which authorizes operation of Monticello Nuclear Generating Plant (Monticello). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

The facility consists of a boiling water reactor located in Wright County, Minnesota.

II. Request/Action.

In its letter dated April 6, 2017 (Agencywide Document Access and Management System (ADAMS) Accession No. ML17096A599), as supplemented by its letter dated November 20, 2017 (ADAMS Accession No. ML17324B361), the licensee requested an exemption from Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix R, Section III.G.2, which requires that where redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside of primary containment, that one of the redundant trains remains free of fire damage by either a 3-hour rated barrier; or 20 feet horizontal separation, no intervening combustibles, and detection and suppression system; or a 1-hour barrier, and detection and suppression systems. The licensee

requested NRC approval for Monticello to use a method to maintain a hot shutdown train free of fire damage that is not one of the acceptable methods listed in 10 CFR Part 50, Appendix R, Section III.G.2. The licensee's exemption request is intended to justify why the proposed alternative, the use of a shorting switch, is acceptable in accordance with the requirements of 10 CFR 50.12, Specific Exemptions.

The regulatory framework that applies to Monticello is contained in 10 CFR 50.48(b)(1) which requires that plants licensed before January 1, 1979, to meet Sections III.G, J, and O, of Appendix R to 10 CFR Part 50. Monticello began commercial operations in 1971. Section III.G.2 of 10 CFR Part 50, Appendix R, requires, that, "where cables or equipment, including associated non-safety circuits that could prevent operation or cause maloperation due to hot shorts, open circuits, or shorts to ground, of redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside of primary containment, one of the following means of ensuring that one of the redundant trains is free of fire damage shall be provided: a. Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that of the barrier; b. Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area; or c. Enclosure of cable and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour fire rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area."

In its April 29, 2014, triennial fire protection inspection report 05000263/2014008, (ADAMS Accession No. ML14119A216), the NRC staff identified two pairs of Drywell Spray (DWS) motor-operated valve (MOV) control cables that are not protected in accordance with an

acceptable option provided in 10 CFR Part 50, Appendix R, Section III.G.2. In 2012, the licensee installed a modification, called a shorting switch, to mitigate the lack of protection. The shorting switch modification had been approved for use at some plants that had adopted a risk-informed (RI), performance-based (PB) fire protection program (FPP) under 10 CFR 50.48(c)(4). Although Monticello had at one time expressed intent to adopt a 10 CFR 50.48(c)(4) FPP (ADAMS Accession No. ML053460342), Monticello later withdrew its letter of intent (ADAMS Accession No. ML102000433).

The requirements at 10 CFR Part 50, Appendix R, Section III.G.2, require that hot shorts and open circuits be considered, and the licensee's analysis showed that the shorting switch modification could fail to meet its design purpose if certain hot shorts and open circuits were to occur due to fire damage. Therefore, on April 6, 2017, the licensee submitted an RI request for an exemption from the requirements of 10 CFR Part 50, Appendix R, Section III.G.2, to address postulated spurious actuations of the DWS MOVs that could occur in the event that an open circuit caused the shorting switch to fail to perform its function.

III. Discussion.

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the regulations when: (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. The licensee requested an exemption from 10 CFR Part 50, Appendix R, Section III.G.2, claiming that the special circumstances of 10 CFR 50.12(a)(2)(ii), which states that, "Application of the regulation in the particular circumstances would not serve the underlying purposed of the rule or is not necessary to achieve the underlying purpose of the rule," apply.

The underlying purpose of 10 CFR Part 50, Appendix R, Section III.G.2, is to provide reasonable assurance of fire protection of safe shutdown capability by providing a means to ensure that one of the redundant trains of systems necessary to achieve and maintain hot shutdown conditions is free of fire damage. The licensee's position is that the safety benefit, when measured using accepted probabilistic risk assessment (PRA) techniques, is "virtually" the same as if the plant had used one of the three separation options described in 10 CFR Part 50, Appendix R, Section III.G.2.a, b, or c.

The NRC staff's evaluation of the licensee's exemption request is provided below.

3.1 Deterministic Technical Evaluation

The fire scenario, as described in the licensee's exemption request, is that there will be spurious operation of two normally closed DWS MOVs due to a fire. The cables are routed from the control room and may be subject to a fire in three other rooms. Two of the rooms are in Fire Area IX, the rooms (called fire zones) are Fire Zone 13C – Turbine Building East – Engineered Safeguards Feature Motor Control Center Area, and Fire Zone 19C – Turbine Building East – Pipe and Cable Tray Penetration Area. The third room is in Fire Area XII, Fire Zone 19B, Turbine Building East and Engineered Safeguards Features Motor Control Center Cable Tunnel. It is within these three rooms that the separation required by 10 CFR Part 50, Appendix R, Section III.G.2, is not provided.

The scenario postulates that a fire in one of these areas could damage the control cables to the two DWS MOVs and cause the normally closed valves to spuriously open. If these valves were to open while the same division's residual heat removal (RHR) pump were operating, the scenario postulates that the RHR pumps would be damaged and safe shutdown capability would be impaired.

3.1.1 Explanation of Postulated Scenario and Shorting Switch Modification

The NRC staff evaluated the licensee's analysis of how the protection provided by the shorting switch compares to the 10 CFR Part 50, Appendix R, Section III.G.2 requirement that

one train be free of fire damage by comparing the installed shorting switch configuration to the configuration required by the regulation. This section includes a discussion of how the installed shorting switch works to prevent a spurious opening of the DWS MOVs.

To reduce the likelihood of a spurious actuation, the licensee installed a shorting switch on one of the valves in series. There are two trains of DWS. A shorting switch is installed on MOV MO-2020 (Division I), and installed on MOV MO-2021 (Division II). The other valves in series, MOVs MO-2022 (Division I) and MO-2023 (Division II), are not equipped with a shorting switch, and therefore may be subject to an energized cable fault that could cause a spurious opening of those valves. Figure 1 of the licensee's exemption request includes a one-line diagram of the system.

When the control room switch is in the closed position, the shorting switch creates an electrical circuit that provides a low impedance path bypassing the valve's "open" coil. If an energized cable fault or hot short were to occur that would energize the "open" coil, this low impedance path would divert enough current away from the "open" coil through the shorting switch electrical circuit to prevent the "open" coil from actuating. When the control room switch is set to the open position, this low impedance path is removed from the circuit and the valve can be opened normally. The shorting switch only functions to prevent spurious actuation of the valve in the event of an energized cable fault. A simplified shorting switch circuit is shown in Figure 2 of the licensee's exemption request.

The fire scenario of concern would involve three fire-induced failures. First, an energized cable fault or hot short would need to occur on control circuitry for the DWS MOV that does not have a shorting switch installed, for example MO-2022. Second, the fire would need to cause a cable to become severed, also called an open circuit, on one of the conductors for the shorting switch protected valves, such as MO-2020. Third, the fire would have to cause that same severed cable to MO-2020 to be exposed to an energized cable fault or hot short. Essentially the severed cable would remove the shorting switch from the circuit, thereby,

defeating the design capability of the shorting switch. Similarly, the pair of valves MO-2021 and MO-2023 would be vulnerable to the same potential failure mode. Note that both valves in a pair, MO-2020 and MO-2022 or MO-2021 and MO-2023, would need to be impacted to remove the shorting switch from the circuit. A hot short from one cable in the first pair and one cable in the second pair would not create a condition where the RHR pumps could be damaged.

3.2 Risk-Informed Technical Evaluation

The licensee's exemption request includes a risk assessment of the proposed plant change. The use of risk information in a 10 CFR Part 50, Appendix R, exemption request is in accordance with Regulatory Position 1.8 of Regulatory Guide (RG) 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, dated October 2009 (ADAMS Accession No. ML092580550), which says that RI/PB methodologies may be used to evaluate the acceptability of FPP changes; however, for this approach, the licensee should use methodologies and acceptance criteria that the NRC has reviewed and approved. RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, (ADAMS Accession No. ML100910006), includes guidance for RI changes to a plant's current licensing bases.

Accordingly, the NRC staff reviewed the licensee's exemption request using the review methodology and criteria contained in RG 1.174, Revision 2, which includes the following elements:

- Defining the proposed change,
- Performing an engineering analysis, including an evaluation that the proposed change is consistent with the defense-in-depth (DID) philosophy and the principle that sufficient safety margins are maintained,
- Assessing the technical adequacy of the PRA analysis, the methods used to determine the risk impact of the proposed change, and the results of the risk impact assessment,

- Defining the implementation and monitoring program to ensure that no unexpected adverse safety degradation occurs due to the proposed change, and
- Confirming that an integrated approach was used to evaluate the proposed change.

3.2.1 Proposed Change to the Appendix R Program

Pursuant to 10 CFR 50.12, the licensee requested an exemption from 10 CFR Part 50, Appendix R, Section III.G.2 requirements with respect to the protection of the control circuitry for the DWS MOVs. In lieu of meeting the protection requirements of Section III.G.2, the licensee has installed a shorting switch modification on the control circuitry for one MOV in each division of the DWS system to reduce the risk impact of a fire-induced multiple spurious operation (MSO) that fails both MOVs. A detailed description of the modification is provided in Enclosure 1, Section 3.1, of the licensee's exemption request.

3.2.2 Engineering Analysis

Regulatory Position 2.1 of RG 1.174, Revision 2, indicates that, for RI changes to the plant licensing basis, the licensee should evaluate the proposed change to determine whether it is consistent with the DID philosophy and the principle that sufficient safety margins are maintained.

Fire Protection DID

Regulatory Position 2.1.1 of RG 1.174, Revision 2, provides guidance on maintaining the philosophy of nuclear safety DID and identifies several elements to consider in this evaluation. DID involves prevention, protection, and mitigation. With respect to nuclear power plant FPPs, the regulations in 10 CFR Part 50, Appendix R, Section II.A state that the FPP shall extend the concept of DID to fire protection in fire areas important to safety with the following objectives:

- to prevent fires from starting;
- to detect rapidly, control, and extinguish promptly those fires that do occur; and

- to provide protection for structures, systems and components important to safety so that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant.

An engineering analysis that evaluates the impact of a proposed change to an Appendix R FPP on the balance among these FPP DID elements is deemed by the NRC staff to satisfy the RG 1.174 guidance. Enclosure 1, Section 3.2, of the exemption request provides the licensee's evaluation of the FPP DID elements. Fire protection DID elements consist of administrative controls such as plant procedures to limit combustible materials or control hot work activities, plant design features, fire protection inspections, installed fire detection and suppression systems, and passive fire protection features such as fire barriers.

The licensee's position is that the use of a shorting switch meets the underlying purpose of the rule by providing equivalent protection to one of the separation methods of 10 CFR Part 50, Appendix R, Section III.G.2. The licensee chose to install the shorting switch in lieu of possibly separating the cables for the valves in series (MO-2021 from MO-2023, and MO-2020 from MO-2022) into separate areas. The following sections discuss the fire protection DID elements of preventing fires, suppressing fires that do occur, and protecting safe shutdown.

Fire Protection DID Element 1 – Preventing Fires

The licensee indicated that each of the three rooms has administratively controlled restrictions on combustibles. The licensee described that of the three zones, only Fire Area IX, Fire Zone 13C, has significant fixed ignition sources, which are motor control centers. The NRC staff finds that this exemption does not degrade the preventing fires DID element, because the proposed change does not introduce additional combustibles or ignition sources at such a level that necessitates additional controls be put in place to prevent fires from starting.

Fire Protection DID Element 2 – Detecting and Extinguishing Fires

The licensee indicated that all three of the rooms addressed in this exemption are equipped with full area ionization smoke detection systems. Only Fire Area IX, Fire Zone 13C,

has significant fixed ignition sources and it is equipped with an automatic water based suppression system which the licensee indicates is based on the significance of the fire hazards contained within that room. The smoke detection system annunciates to the control room which results in response of the fire brigade.

Each of the three rooms included in this exemption has fire hose stations and fire extinguishers in the rooms or in adjacent rooms. Fire Area IX, Fire Zone 13C, and Fire Area XII, Fire Zone 19B, are 900 square feet, are considered large rooms, and have extinguishers and hose stations within the rooms. Fire Area IX, Fire Zone 19C, does not have a fire hose station or extinguisher in the room. Because Fire Area IX, Fire Zone 19C, has a small floor area of 204 square feet, the NRC staff concludes that it is reasonable that extinguishers and fire hoses could be brought from adjoining areas. The NRC staff also concludes that this exemption does not degrade the detecting and extinguishing fires DID element, because the installation of the switches (1) does not impact the ability of the installed detection and suppression systems to detect and extinguish a fire, and (2) does not impact the fire brigades ability to manually extinguish a fire using the installed extinguishers and fire hose stations.

Fire Protection DID Element 3 – Safe Shutdown

The NRC staff determined that the safe shutdown element of fire protection DID is impacted by this exemption request. The licensee proposes to install an engineered feature called a shorting switch, in lieu of the protection required by 10 CFR Part 50, Appendix R, Section III.G.2. Compliance with the regulation by use of a barrier, or separation with fire detection and suppression, protects against possible failure modes, but the shorting switch modification results in a possible failure mode involving hot shorts and open circuits. 10 CFR Part 50, Appendix R, Section III.G.2, specifically states that a plant licensed before January 1, 1979, must address these failure modes (i.e., “maloperation due to hot shorts [and] open circuits”).

Although the licensee has chosen to use a RI analysis to compare compliance with the regulation and the proposed alternative using a shorting switch, the following deterministic features are in place, in addition to the fire prevention, fire detection, and fire suppression that are discussed above.

A fire would have to occur in one of the three subject areas and damage the cables to two of the MOVs. One MOV cable would have to be subjected to an energized fault or hot short, and the second MOV cable would have to be subjected to both a hot short and a severed cable also called an open circuit. For the combination of cable faults to damage the RHR pumps, the pumps would have to be running at the time of the cable faults. Although possible in an actual plant event, the licensee did not assume in its evaluation that plant operators would turn off the pumps before they became damaged. The NRC staff considers this assumption to be conservative because the licensee indicated that operators would initiate a controlled shutdown to preclude equipment failures.

Additionally, the NRC staff determined that hot shorts would have to be of sufficient duration to open the MOVs enough to result in a flow that would cause RHR pump failure due to runout and that typically, hot shorts are of a very short duration.

These aspects of the scenario, the likelihood of cable faults, the assumption that the RHR pumps are operating, and the possible operator actions and timing related to mitigating the potentially damaging configuration were not explicitly credited in the analysis. The NRC staff has determined that the DID discussion regarding prevention, protection, and mitigation satisfies the RG 1.174 guidance for a DID analysis because it discussed multiple means to accomplish safety functions in accordance with the guidance provided in Regulatory Position 2.1.1 of RG 1.174.

Safety Margins

In Enclosure 1, Section 3.4.3, of the exemption request, the licensee provided its assessment of how sufficient safety margins are maintained. The licensee explained that the design and installation of the shorting switches was completed using applicable codes and standards and that the Monticello safety analyses were not impacted by the installation of the switches or the exemption request. In its letter dated November 20, 2017, in response to the NRC's October 18, 2017, request for additional information (RAI) (ADAMS Accession No. ML17293A091), the licensee indicated that sufficient safety margins are demonstrated by the design, operation, and performance monitoring of the shorting switches. The licensee indicated that the RHR system currently meets all applicable codes and standards (with the exception of the stated 10 CFR Part 50, Appendix R, Section III.G.2 noncompliance), and also stated that granting the exemption will not affect Monticello's ability to demonstrate consistency with all applicable codes and standards.

In its November 20, 2017, letter, the licensee also summarized some of the PRA bases for ensuring sufficient safety margins. The summarized bases included maintaining a FPP that meets regulatory requirements, using a fire PRA (FPRA) that was developed in accordance with NUREG/CR-6850, "Fire PRA Methodology for Nuclear Power Facilities," having had formal industry peer reviews of internal events PRAs (IEPRAs) and FPRAs, and using verified and validated fire models.

The NRC staff concludes that the licensee's safety margins assessment is acceptable because it demonstrated that codes and standards or their alternatives approved by the NRC are met, and that the safety analysis acceptance criteria described in the licensing basis are met.

3.2.3 PRA

The licensee performed a risk impact assessment for installation of the shorting switches rather than physically separating the control circuitry for the DWS MOVs in accordance with the

10 CFR Part 50, Appendix R, separation requirements. For the assessment, the risk was evaluated by estimating the change in risk between an Appendix R-compliant configuration and the as-installed and as-operated configuration of the shorting switches. The risk assessment was provided in Enclosure 1, Section 3.3, of the licensee's exemption request.

Technical Adequacy of the PRA

The licensee used Revision 4.0 of the Monticello FPRA model to perform the risk impact assessment. For the development of the FPRA, the licensee modified its IEPRA model to capture the effects of fire. Therefore, the NRC staff evaluated both the IEPRA and FPRA quality information provided by the licensee in the exemption request to determine whether the plant-specific PRA used in the risk impact assessment includes sufficient scope, level of detail, and technical adequacy for this assessment.

Consistent with the information provided in NRC Regulatory Issue Summary 2007-06, "Regulatory Guide 1.200 Implementation," March 22, 2007 (ADAMS Accession No. ML070650428), the NRC staff uses RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2 (ADAMS Accession No. ML090410014).

The licensee stated that a full-scope peer review was performed in April 2013, for the IEPRA model (Revision 3.2). The peer review was performed using Nuclear Energy Institute (NEI) 05-04, Revision 2, "Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS [American Society of Mechanical Engineers/American Nuclear Society] PRA Standard" (ADAMS Accession No. ML083430462), as clarified by RG 1.200, Revision 2. The PRA standard provides supporting requirements for the PRA against capability categories (CC) CC-I, CC-II, or CC-III. The peer review resulted in identification of PRA standard supporting requirements that did not meet CC-II, or that were met and had related findings (Reference: Evaluation of Risk Significance of Permanent Integrated Leak Rate Testing Extension – ML16047A273). In Enclosure 2 of the exemption request, the licensee provided the peer review

finding-level facts and observations (F&Os) against the PRA standard supporting requirements and the licensee's resolution to each of the F&Os. The licensee stated that all of the finding-level F&Os have been resolved and that none were determined to affect the exemption request.

The licensee stated that a full-scope peer review of the FPRA model (Revision 1a) was performed in March 2015, using NEI 07-12, Revision 1, "Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines," June 2010 (ADAMS Accession No. ML102230070), and RG 1.200, Revision 2. The peer review resulted in identification of PRA standard supporting requirements that did not meet CC-II, or CC-III for one supporting requirement (Reference: Monticello ILRT license amendment – ML16047A273). In Enclosure 3 of the exemption request, the licensee provided the peer review finding-level F&Os against the PRA standard supporting requirements and its resolution to each of the F&Os. The licensee stated that all of the finding-level F&Os have been resolved and that none were determined to affect the exemption request.

The licensee stated that a focused-scope peer review of Revision 4.0 of the FPRA model was performed in December 2016, of a subset of high-level requirements impacted by the use of enhanced fire modeling methods that were implemented subsequent to the March 2015, peer review. The licensee provided the two peer review finding-level F&Os from this focused-scope peer review in Enclosure 4 of the exemption request. The licensee stated that the two finding-level F&Os have been resolved and that neither was determined to affect the exemption request. The licensee also stated that the PRA used in the risk impact assessment represents the current as-installed and as-operated configuration of Monticello.

The NRC staff reviewed the exemption request to determine the technical adequacy of the Monticello IEPRA and FPRA models used for this exemption request. The licensee stated that it evaluated its PRA against Revision 2 of RG 1.200 and the ASME/ANS PRA standard. The licensee stated that it had resolved all peer review and focused-scope peer review finding-level F&Os and concluded that they had no impact on the exemption request. Based on the

information provided by the licensee, the NRC staff found that the licensee's PRA represents the current as-installed and as-operated plant, and the margin between the reported risk values and the guidance recommended values is acceptable.

The NRC staff concludes that the IEPRA is adequate and can be used to support the FPRA because the licensee demonstrated that the resolution of the F&Os did not affect the technical adequacy of the licensee's PRA analysis submitted to support the licensee's risk evaluation of the proposed exemption request.

The NRC staff concludes that the IEPRA is adequate and can be used to support the FPRA because the licensee demonstrated that the resolution of the F&Os support the technical adequacy of the licensee's PRA analysis submitted for the licensee's risk evaluation of the proposed exemption request.

The NRC staff also concludes that the FPRA is of sufficient technical adequacy and that its quantitative results can be used to demonstrate that the change in risk due to the lack of physical separation between the DWS division meets the acceptance guidelines in RG 1.174 because the licensee demonstrated that the resolution of the relevant F&Os supports the determination that the quantitative results are adequate and have no significant impact on the FPRA. For several F&Os, the NRC staff determined that the resolutions could impact the delta risk results reported in the exemption request, but that their resolution is unlikely to change the delta risk results reported by the licensee in the exemption request enough to increase the delta core damage frequency (CDF) and the delta large early release frequency (LERF) by an amount necessary to exceed the RG 1.174 risk guidelines for very small changes.

Based on the above, NRC staff concludes that the FPRA model is of sufficient technical adequacy to support the risk impact assessment of the proposed change.

Risk Impact Assessment

The licensee stated that the evaluation of the risk for the proposed change was done using Revision 4.0 of the Monticello FPRA model to estimate the change in risk between an

Appendix R-compliant configuration and the as-installed and as-operated configuration of the shorting switches.

In Enclosure 1, Section 3.3.3, of the exemption request, the licensee described how it developed the risk of the as-installed and as-operated configuration of the plant with shorting switches installed. For this plant configuration, the licensee modified the FPRA model to include new basic events to fail the DWS MOVs due to fire-induced MSOs (referred to as the "variant model"). The model modification included identifying the cables that could cause a DWS MOV MSO, identifying the plant locations (fire zones) where these cables are located in the plant, and linking these cables to specific fire scenarios modeled in the FPRA. The exemption request also described the revised fault tree logic that incorporated the new basic events.

Each of the two DWS trains includes two-normally-closed in-series MOVs that could fail open due to a fire-induced MSO and result in core damage. Each in-series pair of DWS MOVs were added together in the fault tree and assigned a hot short probability. The MOVs without a shorting switch have a hot short probability of 0.39, which is taken from Volume 2 of NUREG/CR-7150, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE)" (ADAMS Accession No. ML14141A129). The MOVs with a shorting switch are assumed to have a failure probability of 1.0E-03, which is the assumed failure probability of the shorting switch. In enclosure 1, section 3.3.5 of the exemption request, the licensee justified its use of the 1.0E-03 failure probability by explaining that it was found acceptable by the NRC staff in the safety evaluations related to National Fire Protection Association 805 license amendment requests by other licensees (see ADAMS Accession Nos. ML15212A796 and ML16223A481). The licensee stated that the control circuitry configuration for the shorting switch application at these plants is substantially similar to that for the Monticello DWS MOVs.

The NRC staff finds that the use of a hot short probability of 0.39 is acceptable because it is the most bounding of the MOV hot short probabilities for grounded and ungrounded alternate current control circuits as described in Table 8-1 of NUREG/CR-7150, Volume 2. The

NRC staff also finds that the licensee's use of the 1.0E-3 failure probability for the shorting switches is acceptable because the conditions that would have to occur to fail a shorting switch are considered extremely unlikely.

The exemption request further explained that the flow diversion created by the failure of just one train of DWS MOVs (i.e., spurious opening of both in-series MOVs) was assumed to result in damage of the RHR pumps because activation of the Drywell Sprays would result in lowering the drywell pressure. This in turn could result in the potential loss of containment accident pressure, which leads to a loss of net positive suction head and which, in turn, would fail the RHR pumps. All RHR pumps are potentially damaged because the RHR removal cross-tie valves are normally kept open. The failure of the RHR pumps and loss of net positive suction head result in failure of all associated functions modeled in the PRA (except DWS), specifically:

- Shutdown cooling,
- Low pressure coolant injection (LPCI),
- Torus cooling (which fails high pressure coolant injection and reactor coolant isolation cooling when suction is from the torus),
- Core spray,
- Alternate injection with condensate service water, the fire protection system, or RHR service water, and
- Primary containment.

Because of the failure of RHR pumps, the torus sprays would also fail, which is not modeled in the PRA.

In Enclosure 1, Section 3.3.2, of the exemption request, the licensee described how it developed the risk of the Appendix R-compliant configuration. For this plant configuration, the licensee revised the FPRA model to assume the DWS MOVs do not fail due to a fire-induced

MSO (referred to as the “compliant model”). The licensee explained that its assumption is conservative because it assumes a failure probability of zero for the DWS MOVs due to a fire-induced MSO. The NRC staff concludes that this assumption is conservative because, although unlikely, there is a greater-than-zero probability of a large enough fire that could defeat the Appendix R protection requirements and produce a MSO that would fail the MOVs.

In Enclosure 1, Section 3.3.4, of the exemption request, the license explained that it calculated the change in risk for the proposed change by subtracting the calculated risk (CDF) and LERF) for the compliant model from the calculated risk for the variant model.

Furthermore, in Enclosure 1, Section 3.3.5, of the exemption request, the licensee identified several conservatisms in the PRA model that would overestimate the calculated change in risk. These conservatisms include: the assumption that all postulated control room fires fail the shorting switches, assumption that the RHR pumps are running at the time of the MSO event, and the assumption that the loss of containment accident pressure and net positive suction head is instantaneous with the MSO event. The NRC staff finds that these conservatisms make the model overestimate the calculated change in risk because not all control room fires fail the shorting switches, because the RHR pumps may not be running at the time of the MSO event, and because loss of containment accident pressure and net positive suction head may not be instantaneous with the MSO event.

Based on the licensee’s description of the fault tree modeling of the MSO event in the compliant and variant models, the NRC staff concludes that the hot short probability and shorting switch failure probability are acceptable, and that the calculated change in risk is likely conservative. The NRC staff further concludes that the licensee’s method for calculating the change in risk is acceptable.

PRA Results and Comparison with Risk Guidelines

In Enclosure 1, Section 3.3.4, of the exemption request, the licensee reported the results of its risk impact assessment. The licensee reported the calculated change in risk (variant

model risk minus compliant model risk) for the proposed plant change to be 1.8E-08 per year for CDF and 1.4E-08 per year for LERF, which are below the RG 1.174, Revision 2, risk guidelines for a “very small” change.

Based on its review of the risk impact assessment results, and the margin between the reported risk values and the risk guidelines, the NRC staff concludes that the increase in CDF and LERF from the proposed change is very small per the definition in RG 1.174, Revision 2. Also, while the licensee did not provide the total plant risk from all hazards, the NRC staff finds this acceptable and consistent with RG 1.174, Revision 2, because there is no indication that the total CDF and LERF is considerably higher than 1.0E-04 and 1.0E-05 per reactor year, respectively.

3.2.4 Implementation and Monitoring

In Enclosure 1, Section 3.4.5, of the exemption request, the licensee described the implementation and the monitoring program for the shorting switches and the DWS MOVs. The licensee explained that the shorting switches were installed in 2012 and that post-maintenance testing was conducted to ensure that the switches were installed in accordance with the approved design and that the MOVs continued to operate as expected. The DWS MOVs will continue to be regularly exercised in accordance with the Monticello MOV program, which has been accepted by the NRC staff, as providing an acceptable level of quality and safety, and are monitored under the Monticello Maintenance Rule Program.

In its November 20, 2017, letter, the licensee indicated that Monticello will generate a preventive maintenance task for the shorting switches to ensure acceptable resistance, and that this task will be completed within 180 days of the date of the exemption is issued. The licensee will introduce performance monitoring of the shorting switches into the Monticello, Appendix R, program, with the objective to ensure the shorting switches provide a low impedance path to ground in the event of a fire-induced hot short. The program will include acceptance criteria, which if exceeded, will cause the licensee to enter the issue into its corrective action program.

The NRC staff concludes that the proposed monitoring program for the shorting switches meets the guidelines of RG 1.174, Revision 2, and that RI applications include performance monitoring and feedback provisions.

3.2.5 Integrated Decision-making

As described in the previous sections, the licensee's exemption request and responses to NRC staff RAIs provided an integrated approach to evaluating the proposed change. Specifically, the licensee's assessment of the proposed change included:

- Performing a traditional engineering analysis, including an evaluation that the proposed change is consistent with the DID philosophy and the principle that sufficient safety margins are maintained,
- Assessing the technical adequacy of the PRA analysis, evaluating the risk impact of the proposed change, and comparing the results of the risk impact assessment to the
- RG 1.174, Revision 2, risk guidelines, and
- Defining the implementation of the proposed change and of a monitoring program to ensure that no unexpected adverse safety degradation occurs due to the proposed change.

Based on the NRC staff's review of each of these elements of the licensee's exemption request, the NRC staff concludes that the licensee's evaluations are acceptable and in accordance with RG 1.174, Revision 2, and that the risk increase of the proposed change meets the RG 1.174, Revision 2, risk guidelines for a "very small" change. Based on this, the NRC staff concludes that the licensee's integrated evaluation of the proposed change is acceptable.

3.3 Technical Evaluation Conclusion

Based on its review of the information provided by the licensee, the NRC staff concludes that the licensee's request to credit a shorting switch does not create any new accident precursors because the plant's operation remains the same in that fire protection for structures,

systems, and components important to safe shutdown continues to be provided, and fire damage continues to be limited so that one of the redundant trains is free of fire.

The NRC staff also concludes that the licensee's evaluations are acceptable and in accordance with RG 1.174, Revision 2, and that the risk increase of the proposed change meets the RG 1.174, Revision 2, risk guidelines for a "very small" change. Based on this, the NRC staff concludes that the licensee's integrated evaluation of the proposed change is acceptable.

3.4 Authorized by Law

The exemption would allow the licensee to rely on the installed shorting switch and other fire protection DID features instead of providing separation in accordance with 10 CFR Part 50, Appendix R, Section III.G.2. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR Part 50. The NRC staff has determined, as described in Section 3.7 below, that special circumstances exist to grant the proposed exemption and that granting of the licensee's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, the exemption is authorized by law.

3.5 No Undue Risk to Public Health and Safety

The underlying purposes of 10 CFR Part 50, Appendix R, is to provide reasonable assurance of fire protection safe shutdown capability. As discussed in Sections 3.1 and 3.2 above, the NRC staff found that the crediting of a shorting switch permitted by the proposed exemption does not create any new accident precursors or degrade detection systems because the plant's operation remains the same and the installed shorting switch provides an acceptable level of protection as compared to that provided by compliance with the regulation.

Because no new accident precursors are created by the proposed exemption, which would allow the licensee to use, or take credit using a risk-informed approach, for an installed shorting switch to ensure that one redundant train is free of fire damage, the probability of postulated accidents is not significantly increased, and reasonable assurance of fire protection

of safe shutdown capability is maintained. Therefore, the NRC staff concludes that the consequences of postulated accidents are not significantly increased, and there is no undue risk to public health and safety.

3.6 Consistent with Common Defense and Security

The proposed exemption would allow the licensee to rely on the installed shorting switch instead of providing separation required by 10 CFR Part 50, Appendix R, Section III.G.2. The NRC staff concludes that this change to the plant design has no relation to security issues, therefore, the common defense and security is not impacted by this exemption.

3.7 Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12, are present whenever an application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR Part 50, Appendix R, Section III.G.2, is to provide reasonable assurance of fire protection of safe shutdown capability by providing a means to ensure that one of the redundant trains of systems necessary to achieve and maintain hot shutdown conditions is free of fire damage. The technical evaluation above demonstrates that the shorting switch and DID features provide reasonable assurance that the underlying purpose of the rule is met because the licensee demonstrated that the installed shorting switch provides an acceptable level of protection that is similar to that provided by compliance with the regulation. The licensee performed a deterministic engineering analysis and demonstrated that the proposed change is consistent with the DID philosophy and maintains sufficient safety margins. The licensee also assessed the technical adequacy of the PRA analysis and evaluated the risk impact of the proposed change and compared the results to the RG 1.174, Revision 2, risk guidelines, and also defined the implementation of the proposed change and of a monitoring program to ensure that no unexpected adverse safety degradation occurs due to the proposed change. Therefore, the NRC staff concludes that since the underlying purpose of 10 CFR 50, Appendix R, Section III.G.2 (i.e., ensuring one of the

redundant trains of Drywell Spray is free of fire damage), is achieved, the special circumstances required by 10 CFR 50.12 for the granting of an exemption from 10 CFR Part 50, Appendix R, Section III.G.2, exist.

V. Environmental Considerations.

The NRC staff determined that the issuance of the requested exemption meets the provisions of categorical exclusion 10 CFR 51.22(c)(9) because the exemption is from a requirement, with respect to the installation or use of a facility component located within the restricted area, as defined in 10 CFR part 20 and the issuance of the exemption involves: (i) No significant hazards consideration; (ii) no significant change in the types or significant increase in the amounts of any effluents that may be released offsite; and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's issuance of this exemption. The basis for the NRC staff's determination is provided in the following evaluation of the requirements in 10 CFR 51.22(c)(9)(i) – (iii).

Requirements in 10 CFR 51.22(c)(9)(i)

The NRC staff evaluated whether the exemption involves no significant hazards consideration by using the standards in 10 CFR 50.92(c), as presented below:

1. Does the requested exemption involve a significant increase in the probability or consequences of an accident previously evaluated?

No. The proposed exemption would allow the licensee to rely on the installed shorting switch instead of providing physical separation in accordance with 10 CFR Part 50, Appendix R, III.G.2 to protect structures, systems or components important to safe shutdown of the plant in the event of a fire. The licensee performed a risk impact assessment for installation of the

shorting switches rather than physically separating the control circuitry in accordance with the 10 CFR Part 50, Appendix R, III.G.2 separation requirements. For the assessment, the risk was evaluated by estimating the change in fire risk between an Appendix R-compliant configuration and the as-installed and as-operated configuration of the shorting switches. Based on its review of the licensee's exemption request, the NRC staff concludes that the licensee's evaluations are acceptable and in accordance with Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2, and that the risk increase of the proposed change meets the RG 1.174, Revision 2, risk guidelines for a "very small" change.

The installation of the shorting switch does not alter plant operation or affect fire detection capability because fire protection for structures, systems, and components important to safe shutdown continues to be provided, and fire damage continues to be limited so that one of the redundant trains is free of fire damage and, therefore, would not alter the consequences of any accident previously evaluated.

Therefore, the exemption does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the requested exemption create the possibility of a new or different kind of accident from any accident previously evaluated?

No. The underlying purposes of 10 CFR Part 50, Appendix R, III.G.2 is to provide reasonable assurance of fire protection safe shutdown capability. The exemptions' crediting of a shorting switch and defense in depth measures does not create any new accident precursors because the plant's operation and fire detection capability remains the same.

Therefore, the exemption does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the requested exemption involve a significant reduction in a margin of safety?

No. The installation of the shorting switch and reliance on defense in depth measures does not alter plant operation and does not impact any safety margins because codes and standards or their alternatives approved by the NRC are met, and the safety analysis acceptance criteria described in the licensing basis are met.

Therefore, the exemption does not involve a significant reduction in a margin of safety.

Based on the evaluation above, the NRC staff has determined that the proposed exemption involves no significant hazards consideration. Therefore, the requirements of 10 CFR 51.22(c)(9)(i) are met.

Requirements in 10 CFR 51.22(c)(9)(ii) and (iii)

The proposed exemption would allow the Monticello Nuclear Generating Plant to maintain a hot shutdown train of Drywell Spray free of fire damage by using a method that is different from one of the acceptable methods listed in 10 CFR part 50, Appendix R, Section III.G.2. Specifically, In lieu of meeting these protection requirements, the licensee has installed a shorting switch modification on the control circuitry for one motor-operated valve (MOV) in each division of the Drywell Spray system to reduce the risk impact of a fire-induced multiple spurious operation that fails both MOVs. In addition, the licensee will rely on fire protection DID features such as administrative controls, plant design features, fire protection inspections, installed fire detection and suppression systems, and passive fire protection features. The exemption does not modify plant operation because fire protection for structures, systems, and components important to safe shutdown continues to be provided, and fire damage continues to be limited so that one of the redundant trains of Drywell Spray is free of fire damage. Thus the exemption does not result in a significant change in the types or amount of effluents that may be released and does not result in any additional occupational exposure. Therefore, the requirements of 10 CFR51.22(c)(9)(ii) and (iii) are met.

IV. Conclusions.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12, the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present in that application of the regulation is not necessary to achieve the underlying purpose of the rule. Therefore, the Commission hereby grants Northern States Power Company, doing business as Xcel Energy, an exemption from the requirements of 10 CFR 50, Appendix R, Section III.G.2, for Monticello Nuclear Generating Plant, to allow the use of a shorting switch to ensure that one redundant train of Drywell Spray is free of fire damage to achieve and maintain hot shutdown conditions in the event of a fire.

VI. Availability of Documents.

The documents identified in the following table are available in ADAMS.

DOCUMENT	ADAMS ACCESSION NO.
Risk-Informed Request for Exemption from 10 CFR 50, Appendix R, III.G.2 Requirements for Multiple Spurious Operations of Drywell Spray Motor-Operated Valves	ML17096A599
Request for additional information RE: Monticello Request for Exemption from Appendix R Requirements (CAC NO. MF9586; EPID L-2017-LLE-00012)	ML17293A091
Response to Request for Additional Information regarding Risk-Informed Request for Exemption from 10 CFR 50, Appendix R, III.G.2 Requirements for Multiple Spurious Operations of Drywell Spray Motor-Operated Valves (CAC No. MF9586)	ML17324B361

DOCUMENT	ADAMS ACCESSION NO.
Monticello Nuclear Generating Plant Triennial Fire Protection Inspection Report 05000263/2014008	ML14119A216
Letter of Intent to Transition to 10 CFR 50.48(c) - National Fire Protection Association Standard NFPA 805. "Performance-based Standards for Fire Protection for Light Water Reactor Electric Generating Plants." 2001 Edition	ML053460342
Notice of Withdrawal of Letter of Intent to Transition to 10 CFR 50.48(c)"	ML102000433
NRC Regulatory Issue Summary 2007-06 Regulatory Guide 1.200 Implementation	ML070650428
NEI 05-04, Rev. 2 Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS PRA Standard	ML083430462
NEI 07-12 [REV 1] Fire Probabilistic Risk Assessment (FPRA) Peer Review Process Guidelines	ML102230070
NUREG/CR-7150, Vol. 2 Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE)	ML14141A129
Browns Ferry Nuclear Plant, Units 1, 2, And 3 - Issuance of Amendments Regarding Transition to a Risk-Informed, Performance-Based Fire Protection Program in Accordance with 10 CFR 50.48(c) (CAC NOS. MF1185, MF1186, AND MF1187)	ML15212A796
Arkansas Nuclear One, Unit 1 - Issuance of Amendment Regarding Transition to a Risk-Informed, Performance-Based Fire Protection Program in Accordance with 10 CFR 50.48(c) (CAC NO. MF3419)	ML16223A481
Regulatory Guide 1.189 "Fire Protection for Nuclear Power Plants," Revision 2	ML092580550
Regulatory Guide 1.174 "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 2	ML100910006
Regulatory Guide 1.200 "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2	ML090410014

DOCUMENT	ADAMS ACCESSION NO.
Monticello Nuclear Generating Station: Evaluation of Risk Significance of Permanent Integrated Leak Rate Test Extension	ML16047A273

Dated at Rockville, Maryland, this 1st day of May 2018.

For the Nuclear Regulatory Commission.

/RA/

Gregory F. Suber, Acting Director,
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Office of Nuclear Reactor Regulation.