[7590-01-P]

NUCLEAR REGULATORY COMMISSION

10 CFR Part 50

[NRC-2011-0069]

Long-Term Cooling and Unattended Water Makeup of Spent Fuel Pools

AGENCY: Nuclear Regulatory Commission.

ACTION: Discontinuation of rulemaking activity; denial of petition for rulemaking.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is discontinuing a rulemaking activity, "Long-Term and Unattended Water Makeup of Spent Fuel Pools," and denying a petition for rulemaking. The petitioner requested that the NRC amend its regulations to require that nuclear power plant licensees ensure long-term cooling and unattended water makeup of spent fuel pools (SFPs). The purpose of this action is to inform members of the public that this rulemaking activity is being discontinued and to provide a brief discussion of the NRC's decision to discontinue the rulemaking and deny the aspects of the petition not previously addressed by the NRC.

DATES: Effective **[INSERT DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

ADDRESSES: Please refer to Docket ID **NRC-2011-0069** when contacting the NRC about the availability of information for this action. You may obtain publicly available information related to this action by any of the following methods:

- **Federal Rulemaking Website:** Go to https://www.regulations.gov and search for Docket ID **NRC-2011-0069**. Address questions about NRC dockets to Helen Chang; telephone: 301-415-3228; email: Helen.Chang@nrc.gov. For technical questions, contact the individuals listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **NRC's Agencywide Documents Access and Management System (ADAMS):** You may obtain publicly available documents online in the ADAMS Public Documents collection at https://www.nrc.gov/reading-rm/adams.html. To begin the search, select "Begin Web-based ADAMS Search." For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, at 301-415-4737, or by email to PDR.Resource@nrc.gov. For the convenience of the reader, instructions about obtaining materials referenced in this document are provided in the "Availability of Documents" section.
- **NRC's PDR:** The PDR, where you may examine and order copies of publicly available documents, is open by appointment. To make an appointment to visit the PDR, please send an email to PDR.Resource@nrc.gov or call 1-800-397-4209 or 301-415-4737, between 8 a.m. and 4 p.m. eastern time, Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Christopher Prescott, Office of Nuclear Material Safety and Safeguards, telephone: 301-287-9452; email: Christopher.Prescott@nrc.gov; or Jason Paige, Office of Nuclear Reactor Regulation, telephone: 301-415-1474; email: Jason.Paige@nrc.gov. Both are staff of the U.S. NRC, Washington, DC 20555-0001.

SUPPLEMENTARY INFORMATION:

I. Background

The NRC received a petition for rulemaking (PRM), dated March 14, 2011, submitted by Thomas Popik on behalf of the Foundation for Resilient Societies. On March 15, 2011, the petition was docketed by the NRC as PRM-50-96. The petitioner requested that the NRC amend its regulations to require facilities licensed by the NRC under Part 50, "Domestic Licensing of Production and Utilization Facilities," of Title 10 of the *Code of Federal Regulations* (10 CFR) to address concerns about the effects of a

long-term commercial grid outage on the long-term cooling and unattended water makeup of SFPs. The petitioner asserted that the North American commercial electric power grids are vulnerable to a prolonged outage caused by extreme space weather, such as coronal mass ejections and associated geomagnetic disturbances and therefore cannot be relied on to provide continual power for active cooling and/or water makeup of SFPs. Moreover, the petitioner stated that existing means of onsite backup power are designed to operate for only a few days, while spent fuel requires active cooling for several years after removal of the fuel rods from the reactor core. The petitioner suggested the following rule language for 10 CFR Part 50:

> Licensees shall provide reliable emergency systems to provide long-term cooling and water makeup for spent fuel pools using only on-site power sources. These emergency systems shall be able to operate for a period of two years without human operator intervention and without offsite fuel resupply. Backup power systems for spent fuel pools shall be electrically isolated from other plant electrical systems during normal and emergency operation. If weather-dependent power sources are to be used, sufficient water or power storage must be provided to maintain continual cooling during weather conditions which may temporarily constrict power generation.

On May 6, 2011, the NRC published a notice of receipt and request for public comment for this petition in the *Federal Register* ~~(FR)~~ (76 FR 26223). The public comment period closed on July 20, 2011, and the NRC received 97 public comments. After reviewing public comments and evaluating other ongoing activities, the NRC performed a preliminary review and analysis to ascertain the validity, accuracy, and efficacy of the petitioner's technical assertions and proposed amendment of 10 CFR Part 50.

On December 18, 2012, the NRC closed the docket for PRM-50-96 by publishing a ~~notice~~ document in the *Federal Register* (77 FR 74788) stating that the NRC would, in a phased approach, consider the PRM issues in the NRC rulemaking process. This ~~notice~~ document also stated that the NRC would monitor the progress of the rulemaking

efforts that would eventually become the “Mitigation of Beyond-Design-Basis Events” (MBDBE) final rule to determine whether the requirements established therein would address the issues raised in PRM-50-96.

On August 9, 2019, the NRC published the MBDBE final rule (84 FR 39684), which partially resolved this PRM because it requires, in part, that licensees have plans to acquire and use offsite assistance and resources to support the functions of maintaining or restoring core cooling, containment, and SFP cooling capabilities during an extended loss of alternating current power. Furthermore, in the preamble for the MBDBE final rule, the Commission stated that the NRC would address the remaining issues in PRM-50-96 following the completion of the MBDBE rulemaking. A discussion of the NRC’s decision to discontinue this rulemaking activity and deny PRM-50-96 is provided in section II of this document.

II. Discussion

A. Basis for Denying the Petition and Discontinuing Rulemaking Activity

The NRC will discontinue rulemaking activities associated with PRM-50-96 and deny aspects of the petition related to the two issues that were not fully addressed by the MBDBE final rule. The first such issue was that current NRC regulations do not require power reactor licensees to undertake mitigating efforts for prolonged grid failure scenarios that could be caused by geomagnetically induced currents resulting from an extreme solar storm. The second issue was the petitioner’s request that licensees be required to have emergency systems to assure long-term cooling and water makeup of SFPs capable of operating for a period of 2 years without human intervention and without offsite fuel resupply. These concerns not resolved by the MBDBE final rule have been addressed by other industry and government action, as described below.

Since 2012, there have been improvements in electrical grid resilience to geomagnetic disturbances and overall knowledge regarding the potential impacts of

geomagnetic disturbances that address, in large part, the unresolved aspects of the PRM. The current understanding is that geomagnetic disturbances may cause localized grid failures but are unlikely to cause a widespread, long-term grid failure. This is demonstrated by improvements in space weather induced geoelectric field modeling through research sponsored by the United States Geological Survey, National Oceanic and Atmospheric Administration (NOAA), and the National Aeronautics and Space Administration (see examples listed in section III of this document), in conjunction with industry efforts to quantify the associated risk to the power grid such as the 2017 Electric Power Research Institute (EPRI) report, “Magnetohydrodynamic Electromagnetic Pulse Assessment of the Continental U.S. Electric Grid: Voltage Stability Analysis.” Additionally, the Federal Energy Regulatory Commission has worked to improve the resiliency of the grid to geomagnetic disturbances by implementing improved standards such as the North American Electric Reliability Corporation (NERC) TPL-007-4, “Transmission System Planned Performance for Geomagnetic Disturbance Events.” Currently, more than 80 percent of extra high voltage transformers are resistant against the effects of geomagnetically induced currents. With TPL-007-4 in effect, a widespread, long-term grid failure is unlikely because such grid failure is largely driven by failure of extra high voltage transformers that are now subject to standards for vulnerability assessments and associated corrective action plans.

Moreover, improvements in space weather monitoring allow grid operators to take actions that can protect grid equipment. Grid operators are directly engaged with NOAA - Space Weather Prediction Center (SWPC). For example, the SWPC provides grid operators with timely notification of impending geomagnetic storms, forecasts, and real-time onset, strength, and duration information. This information allows active mitigation of potential space weather impacts. As such, damage to transformers and other vital equipment is less likely to occur. In 2014, the White House Office of Science

and Technology Policy established the Space Weather Operations, Research, and Mitigation (SWORM) Subcommittee to address operations, research, and mitigation of space weather issues. The first National Space Weather Strategy and Action Plan (NSW-SAP) in 2015 established the framework for a government-wide approach to space weather. In 2019, building on this coordinated effort and supported by Executive Order 13744, "Coordinating Efforts to Prepare the Nation for Space Weather Events," the SWORM developed a revised NSW-SAP that improved and clarified ongoing and future space weather activities. The 2023 Implementation Plan of the National Space Weather Strategy serves as a roadmap for implementing the 2019 NSW-SAP over the following 5 years and supports continued grid management activities. Therefore, the petitioner's concerns of a potential geomagnetic disturbance resulting in 2-year grid failure have been addressed.

The second issue raised in the PRM regarding licensees' capability to have adequate fuel supply to provide continual power for active cooling and/or water makeup of SFPs during a grid failure resulting from a geomagnetic disturbance has also been addressed. The NRC has reasonable assurance of an onsite 7-day fuel supply to maintain safe shutdown; that offsite diesel fuel can be obtained in the event of such a grid failure through existing industry contracts; and that Federal, State, and local organizations have the capability to provide fuel supplies, if needed. The NRC's regulations in 10 CFR Part 50, appendix A, establish the minimum requirements for the principal design criteria for water-cooled nuclear power plants. Criterion 17, "Electric Power Systems," requires that onsite electric power supplies, and the onsite electric distribution system, to have sufficient independence, redundancy, and testability to perform their safety functions, eliminating any single points of failure. The general design criteria in 10 CFR Part 50, appendix A, are considered to be generally applicable to other types of nuclear power units and are intended to provide guidance for the

development of principal design criteria for such other units. The NRC guidance in Regulatory Guide 1.137, Revision 2, “Fuel Oil Systems for Emergency Power Supplies,” and industry standards such as American National Standards Institute/American Nuclear Society 59.51, “Fuel Oil Systems for Safety-Related Emergency Diesel Generators,’’ recommend that sites should maintain onsite a minimum of a 7-day fuel supply. Most sites include additional fuel storage capacity. The Federal Emergency Management Agency’s National Response Framework identifies roles and responsibilities in the Emergency Support Function #12 – Energy, and the Emergency Support Function #7 – Logistics, to ensure adequate planning and subsequent support to jurisdictions, citizens, nongovernmental organizations, and businesses in the case of energy emergencies and disruptions. Both Federal and State emergency response organizations use the National Response Framework and have the organizational structure and authority to ensure that nuclear power plants receive fuel resupplies. Furthermore, onsite equipment to provide makeup water to the SFP would not be affected by a grid failure resulting from a geomagnetic disturbance because emergency equipment like stand-alone diesel pumps do not run on electricity.

The NRC concludes that there is no safety concern necessitating the changes requested by the petitioner.

B. Discussion of Public Comments Received

The NRC received 97 comment submissions on PRM-50-96. The NRC considered all the comments on the PRM and the comments from the MBDBE rulemaking that were not addressed by the final rule. Of the 97 comment submissions, 58 were form letter submissions. One comment came from an industry group, and the remainder were either anonymous submissions or from individuals.

For PRM-50-96, the only comment submission recommending the denial of the petition came from the Nuclear Energy Institute. The majority of comments supporting

the petition were in a form letter format and did not provide additional technical information. The common concerns raised included long-term grid failure, loss of operators, inadequate or unreliable emergency generator fuel supply, SFP fires, solar flares, electromagnetic pulse (EMP) attack, and cyberattack.

Since the events of September 11, 2001, the NRC has actively addressed cybersecurity threats by establishing requirements in 2009 to protect safety, security, and emergency preparedness (SSEP) functions at commercial nuclear power plants. Specifically, 10 CFR 73.54, “Protection of digital computer and communication systems and networks,” requires commercial nuclear power plant licensees to protect digital computer and communication systems and networks associated with SSEP functions against cyberattacks. Commercial nuclear power plant licensees submitted cybersecurity plans and an implementation schedule that were reviewed and approved by the NRC in 2010. Since then, licensees completed full implementation of their cybersecurity programs from 2017 to 2020. During this period, the NRC conducted inspections verifying compliance with the requirements and the implementation schedule. Cybersecurity inspections are still ongoing to make sure those systems required for SSEP are protected, protections are maintained, and that upgrades are analyzed to ensure th~~e~~ate adequate protections are in place prior to installation. Licensee cybersecurity programs are required to provide defense-in-depth protective strategies to ensure the capability to detect, respond to, and recover from cyberattacks, and these aspects are verified every 2 years via inspections.

Multiple comments raised the issue of the impacts of geomagnetic disturbances from solar flare activity or an EMP attack on transmission system protections. As described in section II.A of this document, this issue has been addressed through the implementation of the National Space Weather Action Plan, improved grid reliability standards, and other activities required by the 2019 Executive Order 13865,

"Coordinating National Resilience to Electromagnetic Pulses," as well as close coordination between the utilities, grid operators, and the SWPC.

Additionally, several commenters were concerned with the safety of SFPs and potential risks from fires, malicious attacks, and the compromise of structural integrity. These comments did not introduce any new information that has not been previously considered and addressed by the NRC. The NRC has a long history of evaluating SFP safety and security and has taken action to enhance safety and security, when necessary. The NRC's responses to public comments on the MBDBE proposed rule, dated July 31, 2019, include a description of some of the more important NRC actions involving SFPs.

Public comment submissions also echoed the concern of the petitioner that emergency systems need to be able to run without human intervention for up to 2 years and suggested that operators may be unavailable to reach the site to perform their duties. As discussed in Part A of this section, the aspect of the PRM regarding licensees' capability to provide continual power for active cooling and/or water makeup of SFPs has been addressed. In addition, experience with past natural disasters and emergency events has shown that the NRC and licensees can respond to emergency situations affecting the ability of operators to perform their duties. For example, during the COVID-19 public health emergency, licensees were restricted in their ability to maintain an appropriate workforce to meet the NRC's minimum reactor operator staffing requirements. Despite these personnel challenges, public health and safety were maintained during continuous nuclear power plant operations. Therefore, the NRC has reasonable assurance that long-term disruptions to emergency systems will not occur and that operators will be able to perform their duties.

Over two-thirds of the public comment submissions for PRM-50-96 were partially addressed by the MBDBE final rule as they included concerns about the sufficiency of

long-term cooling and offsite power availability. The requirements in § ~~10 CFR~~ 50.155(b)(1) and (c) address, in part, the issues raised by the comments because these regulations require licensees to establish offsite assistance to support maintenance of the key functions, including both reactor and SFP cooling, following an extended loss of alternating current power.

Additionally, the NRC received multiple public comment submissions on the MBDBE proposed rule that concerned the effects of geomagnetic disturbances, and the Commission deferred these comments to the resolution of the outstanding issues in PRM-50-96. Although the MBDBE rule requires mitigation strategies that could be initially deployed and used to address the effects of geomagnetic disturbances if such disturbances lead to adverse impacts on the transmission system and an associated loss of offsite power, the MBDBE rule's regulatory scope does not address the issue of geomagnetic disturbances in its entirety. The deferred comments were concerned about the long-term failure of critical grid infrastructure and SFP cooling equipment and adequate resupply of licensees by outside resources. Section II.A of this document explains how these concerns have been addressed.

III. Availability of Documents

The documents identified in the following table are available to interested persons through one or more of the following methods, as indicated.

Document	ADAMS Accession No. / Web link / *Federal Register* Citation
PRM-50-96 – Foundation for Resilient Societies Petition to Amend 10 CFR 50 "To Assure Long-Term Cooling and Unattended Water Makeup of Spent Fuel Pools," March 14, 2011	ML110750145
Federal Register Notice: Petition for rulemaking; receipt and request for comment; PRM-50-96: "Petition for	76 FR 26223

Rulemaking Submitted by Thomas Popik," May 6, 2011	
Federal Register Notice: Petition for rulemaking; consideration in the rulemaking process; PRM-50-96: "Long-Term Cooling and Unattended Water Makeup of Spent Fuel Pools," December 18, 2012	77 FR 74788
Federal Register Notice: Final Rule, "Mitigation of Beyond-Design-Basis Events," August 9, 2019	84 FR 39684
NOAA SWPC Models	https://www.swpc.noaa.gov/models
NOAA SWPC Press Release, "New Space Weather Model, the Geoelectric Field Model, Announced Today," June 27, 2017	https://www.swpc.noaa.gov/news/new-space-weather-model-geoelectric-field-model-announced-today
Cooperative Institute for Research in Environmental Sciences (CIRES) Press Release, "A NOAA and CIRES team, Breakthrough Space Weather Model," 2022	https://cires.colorado.edu/recognition/noaa-and-cires-team-breakthrough-space-weather-model
EPRI Report "Magnetohydrodynamic Electromagnetic Pulse Assessment of the Continental U.S. Electric Grid: Voltage Stability Analysis," December 20, 2017	https://www.epri.com/research/products/3002011969
NERC TPL-007-4, "Transmission System Planned Performance for Geomagnetic Disturbance Events"	https://www.nerc.com/pa/Stand/Reliability%20Standards/tpl-007-4.PDF
Presidential Document: Executive Order 13744, "Coordinating Efforts to Prepare the Nation for Space Weather Events," October 18, 2016	81 FR 71573
National Science and Technology Council Report, "Implementation Plan of the National Space Weather Strategy and Action Plan," December 2023	https://bidenwhitehouse.archives.gov/ostp/news-updates/2023/12/20/implementation-plan-of-the-national-space-weather-strategy-and-action-plan/
Regulatory Guide 1.137, Revision 2, "Fuel Oil Systems for Emergency Power Supplies," June 2013	ML12300A122
Presidential Document: Executive Order 13865, "Coordinating National Resilience to Electromagnetic Pulses," March 29, 2019	84 FR 12041
Federal Emergency Management Agency, "National Response Framework," October 28, 2019	https://www.fema.gov/sites/default/files/2020-04/NRF_FINALApproved_2011028.pdf

IV. Conclusion

The NRC is denying the aspects of PRM-50-96 that were not fully addressed by the MBDBE final rule and is discontinuing the "L~~l~~ong-~~t~~Term ~~c~~Cooling and ~~u~~Unattended ~~w~~Water ~~m~~Makeup of Spent Fuel Pool~~F~~s" rulemaking for the reasons discussed in this document. If the NRC decides to pursue similar or related rulemaking activities in the future, it will inform the public through new rulemaking entries in the Unified Agenda.

Dated: <Month XX, 2025.

For the Nuclear Regulatory Commission.

Carrie Safford,
Secretary of the Commission.