



POLICY ISSUE **(Notation Vote)**

October 30, 2023

SECY-23-0091

FOR: The Commissioners

FROM: Daniel H. Dorman
Executive Director for Operations

SUBJECT: PETITION FOR RULEMAKING ON LICENSING SAFETY ANALYSIS
FOR LOSS-OF-COOLANT ACCIDENTS (PRM-50-124; NRC-2022-0178)

PURPOSE:

The purpose of this paper is to request Commission approval to consider the petition for rulemaking (PRM) docketed as PRM-50-124, "Licensing Safety Analysis for Loss-of-Coolant Accidents," in the ongoing rulemaking for "Increased Enrichment of Conventional and Accident Tolerant Fuel Designs for Light-Water Reactors" (increased enrichment rulemaking). This paper does not address any new resource implications.

BACKGROUND:

The staff provided a rulemaking plan to the Commission in SECY-21-0109, "Rulemaking Plan on Use of Increased Enrichment of Conventional and Accident Tolerant Fuel Designs for Light-Water Reactors," dated December 20, 2021 (Agencywide Documents Access and Management System Accession No. ML21232A237). In a staff requirements memorandum dated March 16, 2022 (ML22075A103), the Commission approved the rulemaking plan and further directed the staff to consider fuel fragmentation, relocation, and dispersal (FFRD) issues relevant to higher fuel enrichment and burnup levels as part of this rulemaking.

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In a letter dated August 1, 2022 (ML22284A087), Ralph O. Meyer (the petitioner) submitted a PRM requesting that the U.S. Nuclear Regulatory Commission (NRC) amend Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors." The regulations in 10 CFR 50.46 require the calculation of emergency core cooling system performance following postulated loss-of-coolant accidents (LOCAs) to demonstrate that the acceptance criteria in 10 CFR 50.46(b) are met. The petition raises concerns regarding the current acceptance criteria for the calculated peak cladding temperature (PCT) and maximum cladding oxidation (commonly referred to as maximum local oxidation, or MLO). The petitioner's underlying safety concern is that these acceptance criteria would not ensure adequate core cooling during a LOCA because these criteria do not prevent significant fuel dispersal at currently authorized fuel burnup levels and higher. The petition also raises concerns regarding the bases for these acceptance criteria and the ability to perform meaningful calculations to demonstrate that these criteria would be met. To resolve these concerns, the petitioner requests that the NRC replace the acceptance criteria for the calculated PCT and MLO with limits on the calculated percentage of fuel rod ruptures during LOCAs.

The NRC published a notice of docketing and request for comment on the PRM in the *Federal Register* on November 23, 2022 (87 FR 71531). In response to a request by the Nuclear Energy Institute, the comment period was extended to March 8, 2023 (88 FR 7012; February 2, 2023). The NRC considered the seven comment submissions provided prior to March 31, 2023, in making its determination on the petition. The petitioner submitted three sets of comments prior to March 31, 2023, that provided additional support for the petition and two sets of comments several months later. During the comment period, Westinghouse Electric Company LLC, Framatome Inc., the Pressurized Water Reactors Owners Group, and the Nuclear Energy Institute each provided a comment submission opposing the petition.

DISCUSSION:

The staff evaluated the petition, considering public comments and previous Commission direction on the issues raised in the petition. The staff considers the PCT and MLO acceptance criteria to be important for preventing gross fuel rod failure through a brittle failure mechanism. This ensures that fuel assemblies will remain in a rod-like array within the reactor core that is easier to cool than a rubble pile of fuel and cladding. However, research shows that these criteria do not prevent ductile failure of the cladding (ballooning and rupture), which could lead to fuel dispersal in the reactor core through a rupture in the fuel cladding at currently authorized fuel burnup levels and higher. Therefore, the staff agrees with the petitioner's assertion that the acceptance criteria for the calculated PCT and MLO in 10 CFR 50.46(b) do not prevent fuel dispersal at higher fuel burnup levels.

For currently authorized fuel burnup levels, the staff has reasonable assurance, based on research and analyses, that the extent and consequences of fuel dispersal during a LOCA would be limited such that reactor core coolability would not be challenged on a large scale. Thus, the staff is not recommending more immediate action to address the petition. However, for higher fuel burnup levels, the NRC recognizes that fuel dispersal could challenge reactor core coolability on a larger scale, and the Commission has directed the staff to consider FFRD issues relevant to higher fuel enrichment and burnup levels as part of the increased enrichment rulemaking. Therefore, the staff agrees with the petitioner that rulemaking may be needed to address FFRD issues at higher fuel burnup levels.

Several comments recommended rejection of the PRM but supported rulemaking to address FFRD in a holistic manner that takes into account industry initiatives, including accident tolerant fuel, increased fuel enrichment, and higher fuel burnups. In addition, several comments suggested that the NRC revise the pending draft final rule commonly referred to as 10 CFR 50.46c to address FFRD issues and industry fuel design initiatives. The staff provided the draft final rule for 10 CFR 50.46c to the Commission in SECY-16-0033, "Draft Final Rule – Performance-Based Emergency Core Cooling System Requirements and Related Fuel Cladding Acceptance Criteria (RIN 3150-AH42)," dated March 16, 2016 (package ML15238A947). As discussed in SECY-15-0148, "Evaluation of Fuel Fragmentation, Relocation and Dispersal Under Loss-of-Coolant Accident (LOCA) Conditions Relative to the Draft Final Rule on Emergency Core Cooling System Performance During a LOCA (50.46c)," dated November 30, 2015 (ML15230A200), the staff previously considered addressing FFRD issues in the draft final 10 CFR 50.46c rule. The draft final 10 CFR 50.46c rule addresses several issues, including a concern regarding the brittle fracture of the cladding due to hydrogen absorption, but none of the issues addressed are related to the FFRD issue. The FFRD issue is associated with the ductile failure of the cladding at higher burnups, which is a different phenomenon than brittle fracture, and FFRD can be a concern for design-basis events besides LOCAs. Therefore, the staff continues to support the conclusion in SECY-15-0148 that including new requirements to address FFRD issues in the draft final 10 CFR 50.46c rule would not be practical or appropriate. The Commission has directed that the increased enrichment rulemaking address FFRD issues, and it would not be practical to address FFRD issues in two separate rulemakings. Therefore, the staff is recommending consideration of the PRM in the increased enrichment rulemaking and is not proposing to revise the draft final rule for 10 CFR 50.46c.

The petition asserts that calculations of temperature and oxidation within the burst region of a fuel rod are prone to large uncertainties. Several commenters stated that current methods for calculating MLO and PCT are sufficiently conservative to demonstrate compliance with 10 CFR 50.46 with a high probability. The staff has found that these calculations can be performed in an appropriately conservative manner. The petition, however, asserts that the technical bases for the PCT and MLO acceptance criteria are complex and misunderstood. Several commenters disagreed with this assertion. The staff also disagrees with this assertion because the NRC staff and experts that perform such calculations understand that the PCT and MLO are relatively simple surrogate metrics for cladding embrittlement. As such, while the staff has proposed revisions to the emergency core cooling system acceptance criteria in the draft final 10 CFR 50.46c rule that is currently with the Commission, the staff continues to consider the PCT and MLO to be appropriate surrogate metrics for cladding embrittlement. Although the staff disagrees with some of the petition's assertions, the staff recognizes that rulemaking to address FFRD issues could affect the existing methods for performing emergency core cooling system analyses and could revise the basis for the acceptance criteria in 10 CFR 50.46 in a manner that resolves the petitioner's concerns.

If the Commission approves the staff's recommendation, the issues raised in the PRM would be considered in the rulemaking process. However, the issues may not be addressed exactly as requested in the PRM. For example, the staff found that the petition did not provide evidence to support replacing the current PCT and MLO limits with the proposed limits on the percentage of fuel rod ruptures. The petition indicated that the proposed fuel rod rupture limits are included in Germany's nuclear power reactor regulations, but the staff confirmed with the German regulators that these limits are related to the confinement of radioactive materials, not to core coolability. In fact, the German regulations include PCT and MLO limits to ensure core coolability during a LOCA that are similar to the acceptance criteria in the NRC regulations.

Therefore, the staff concludes that additional research and analysis would be needed to support changing the regulations as requested in the PRM.

COMMITMENT:

The staff commits to inform the appropriate congressional committees of the Commission's decision on the PRM.

RECOMMENDATION:

The staff recommends that the Commission approve the following:

1. Consideration of PRM-50-124 in the ongoing increased enrichment rulemaking
2. Closure of the docket for PRM-50-124
3. Publication of the enclosed draft notice in the *Federal Register*
4. Issuance of the enclosed letter, for the Secretary's signature, informing the petitioner of the Commission's decision regarding the PRM

RESOURCES:

Approval of the staff's recommendation would not affect the schedule or resource estimates for the increased enrichment rulemaking, provided that Commission approval is received within 6 months of the date of this paper.

COORDINATION:

The Office of the General Counsel reviewed this package and has no legal objection.

Daniel H. Dorman
Executive Director
for Operations

Enclosures:

1. FRN - Petition for Rulemaking,
Consideration in the Rulemaking
Process Licensing Safety Analysis
for LOC Accidents (PRM-50-124)
2. LTR to Ralph O. Meyer Regarding Licensing
Safety Analysis for LOC Accidents
(PRM-50-124) Letter to the Petitioner

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DATED: October 30, 2023

ADAMS Accession No.: ML23180A062 (Package)**SECY-012**

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NAME	IBerrios	CBladey	SKrepel
DATE	7/11/2023	7/12/2023	7/6/2023
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NAME	DSilberfeld (CRegan for)	MRoss-Lee (JDonoghue for)	BHarris
DATE	7/17/2023	7/20/2023	8/8/2023
OFFICE	NRR/DD	EDO	
NAME	AKock (AVeil for)	DDorman	
DATE	9/15/2023	10/ 30/2023	

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