

**NUCLEAR REGULATORY COMMISSION**

**10 CFR Part 50**

**[Docket No. PRM-50-111; NRC-2015-0124]**

**Power Reactor In-Core Monitoring**

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Petition for rulemaking; denial.

**SUMMARY:** The U.S. Nuclear Regulatory Commission (NRC) is denying a petition for rulemaking (PRM), dated March 13, 2015, submitted by Mark Edward Leye (petitioner). The petition was docketed by the NRC on April 24, 2015, and assigned Docket No. PRM-50-111. The petitioner requested that the NRC require all holders of operating licenses for nuclear power plants to operate them with in-core temperature-monitoring devices (e.g., thermoacoustic sensors or thermocouples) located at different elevations and radial positions throughout the reactor core. The NRC is denying the petition because current regulations provide a sufficient level of safety, such that additional requirements for in-core temperature-monitoring devices as specified in the petition are not needed.

**DATES:** The docket for the petition for rulemaking, PRM-50-111, is closed on **[INSERT DATE OF PUBLICATION OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

**ADDRESSES:** Please refer to Docket ID NRC-2015-0124 when contacting the NRC

about this petition. You may obtain publicly-available information related to this action by any of the following methods:

- **Federal Rulemaking Web Site:** Go to <http://www.regulations.gov> and search for Docket ID NRC-2015-0124. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: [Carol.Gallagher@nrc.gov](mailto:Carol.Gallagher@nrc.gov). For technical questions, contact the individual 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 <http://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, 301-415-4737, or by e-mail to [pdr.resource@nrc.gov](mailto:pdr.resource@nrc.gov). For the convenience of the reader, instructions about obtaining materials referenced in this document are provided in Section III, "Availability of Documents," of this document.

- **NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

**FOR FURTHER INFORMATION CONTACT:** James O'Driscoll, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington DC 20555-0001; telephone: 301-415-1325; e-mail: [James.O'Driscoll@nrc.gov](mailto:James.O'Driscoll@nrc.gov).

## SUPPLEMENTARY INFORMATION:

### III.I. The Petition

Section 2.802 of title 10 of the *Code of Federal Regulations* (10 CFR), “Petition for rulemaking—requirements for filing,” provides an opportunity for any interested person to petition the Commission to issue, amend, or rescind any regulation. The NRC received a petition dated March 13, 2015, from Mark Edward Leyse and assigned it Docket No. PRM-50-111. The NRC published a notice of docketing in the *Federal Register* on July 16, 2015 (80 FR 42067). The NRC did not request public comment on PRM-50-111 because the staff had sufficient information to review the issues raised in the petition.

The NRC identified three issues that provide the bases for the request in PRM-50-111:

1. Measurement of the temperatures at various locations within the reactor core would enable nuclear power plant operators to better understand the condition of the core under normal and transient conditions, and to more clearly foresee incipient or impending damage to the reactor core.
2. The use of in-core temperature-monitoring devices is needed in boiling-water reactors.
3. The use of in-core temperature-monitoring devices would satisfy recommendations regarding enhanced reactor instrumentation made in the near-term task force report, “Recommendations for Enhancing Reactor Safety in the 21st Century:

The Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident,” dated July 12, 2011 (ADAMS Accession No. ML111861807).

The petitioner requested that the NRC amend its regulations at 10 CFR part 50, “Domestic Licensing of Production and Utilization Facilities,” to require all holders of operating licenses for nuclear power plants to operate them with in-core temperature-monitoring devices (e.g., thermoacoustic sensors or thermocouples) located at different elevations and radial positions throughout the reactor core. The petitioner stated that the use of the devices would enable nuclear power plant operators to accurately measure in-core temperatures, thereby providing crucial information to help them track the progression of core damage and manage the accident (for example, by indicating the correct time to transition from emergency operating procedures to implementing severe accident management guidelines).

The petitioner stated that installing in-core temperature-monitoring devices would satisfy the recommendations in the near-term task force report, “Recommendations for Enhancing Reactor Safety in the 21st Century,” dated July 12, 2011, regarding enhanced reactor instrumentation. Specifically, the petitioner referenced the following from the report:

[A] new and dedicated portion of the regulations would allow the Commission to recharacterize its expectations for safety features beyond design basis more clearly and more positively as ‘extended design-basis’ requirements.

The petitioner asserted that a new regulation is needed, requiring that a wide range of in-core temperatures be accurately measured in the event of a severe accident.

#### **IV-II. Reasons for Denial**

The NRC addressed a substantial portion of the request in this petition in its response to a previous petition. PRM-50-105 was submitted on February 28, 2012, and the NRC published a notice of receipt and request for comment in the *Federal Register* on May 23, 2012 (77 FR 30435). In PRM-50-105, the petitioner requested that the NRC require all holders of operating licenses for nuclear power plants to operate them with in-core thermocouples at different elevations and radial positions throughout the reactor core to enable the operators to accurately measure a large range of in-core temperatures in nuclear power plant steady-state and transient conditions. The NRC limited the scope of the review of PRM-50-105 to only the use of in-core thermocouples in pressurized-water reactors because that was the primary focus of the requests in PRM-50-105, although boiling-water reactors were mentioned. The petition was denied on September 12, 2013 (78 FR 56174).

As discussed below, the NRC is denying PRM-50-111 because the petitioner does not justify the need for a regulation that requires the use of in-core temperature-monitoring devices in nuclear power plants.

#### **NRC's Response to Issue 1:**

In its denial of PRM-50-105, the NRC evaluated whether, in the event of a severe accident, in-core thermocouples would enable nuclear power plant operators to accurately measure in-core temperatures better than core exit thermocouples, and would provide crucial information to help operators manage the accident. In PRM-50-111, the petitioner reiterated this assertion and expanded on the previous request by including other instrument types that might be used in the measurement of in-core temperatures (e.g., thermoacoustic sensors).

The NRC denied PRM-50-105 because the NRC concluded that knowledge of

core temperatures at various elevations and radial positions would not enhance safety or change operator action. Furthermore, core-exit thermocouples, despite known limitations, are sufficient to allow nuclear power plant operators to take timely and effective action in the event of an accident. Core-exit thermocouples in pressurized-water reactors provide an indication of initial core damage during accident conditions and provide the necessary indication to make operational decisions with respect to the approach to imminent core damage.

The current suite of instrumentation used in pressurized-water reactors, which includes core-exit thermocouples, provides sufficient information to determine the need for operator action well before the onset of significant core damage. Other indications include reactor coolant system level and containment pressure. A more comprehensive description of the applications of core-exit thermocouples is provided in NRC's denial of PRM-50-105, Issue 1. In its denial of PRM-50-105, the NRC concluded that there is no need for more accurate measurement of temperatures throughout the core in pressurized-water reactors. The NRC concludes that the reasons for that decision remain valid and are applicable to PRM-50-111.

In PRM-50-111, the petitioner discusses core temperature measurement devices other than thermocouples. The NRC evaluated this information and concludes that the nature of the device is not relevant to the decision of whether or not to require the use of in-core temperature instrumentation.

As in the denial of PRM-50-105, the NRC has determined that precise in-core temperatures would not provide information that would enable nuclear power plant operators to better respond to and manage a reactor accident.

The NRC therefore concludes that more accurate and precise temperature distribution information within the reactor core that would be provided by such

instrumentation is not necessary for adequate protection of the public or nuclear power plant staff, nor would it provide a substantial safety enhancement at nuclear power plants. Therefore, installation of such instrumentation need not be required by regulation.

### **NRC's Response to Issue 2:**

The petitioner asserted that in the event of a severe accident at a boiling-water reactor, in-core temperature-monitoring devices would be more accurate and immediate for detecting inadequate core cooling and core uncover than readings of the reactor water level, reactor pressure, containment pressure, or wetwell water temperature. The petitioner also asserted that, after the onset of core damage, water level indicators in boiling-water reactors are unreliable.

The NRC determined that the current means to detect and respond to inadequate core cooling is already anticipatory in nature, and emergency operator actions would be no different if in-core temperature-monitoring devices were present. Therefore, no safety benefit would result from the availability of such devices.

Existing boiling-water reactor emergency operating procedures (EOPs) do not require operator assessment of core cooling. Instead, operators use specific parametric data such as the water level, containment pressure, containment radiation, and reactor pressure) in conjunction with the EOP actions to respond to the event. Under accident conditions, reactor vessel water level is an acceptable indication of conditions relating to imminent core damage, and drywell radiation monitors are typically the primary method for determining the presence of core damage and severe accident management guideline entry conditions. For boiling-water reactors, severe accident management guideline entry conditions are also tied to parameters such as water level, containment

hydrogen concentration, and component failures. If reactor water level is unknown or conditions render water level instrumentation unreliable, then the EOPs require the operators to proactively flood the reactor vessel. In addition, the EOPs for boiling-water reactors describe steam cooling as a method of cooling the core when there is insufficient water to cover the core, typically available when water level is at or above two-thirds of core height. This method allows additional time to restore reactor coolant injection and reduce the likelihood of emergency reactor depressurization, which would be necessary for the injection of low pressure sources.

The intent of NRC's regulations is to prevent or minimize significant core damage. The detection of inadequate core cooling and actual core uncover is not necessary for managing emergency and accident scenarios. Nuclear power plant operators are directed by EOPs to take proactive emergency operating actions based on the indication of parameters that are anticipatory to actual inadequate core cooling conditions, while the instruments reading those parameters are still functioning within their acceptably-accurate performance ranges. If significant core damage were to occur, water level instrumentation and in-core temperature instrumentation (if installed) would no longer be relied upon for operator action.

The NRC has determined that boiling-water reactor operators do not need in-core temperature-monitoring devices to safely navigate emergency and accident scenarios. Because the use of water level instrumentation is sufficient to inform operator actions prior to significant core damage, the NRC finds that the information representing the temperature within specific core locations does not provide an improvement in the prevention or mitigation of the consequences of an accident. The NRC has further determined that having the core temperature data would not provide any additional safety margins in managing post accident or severe accident conditions. Therefore, the



NRC concludes that more accurate and precise temperature distribution within the reactor core that would be provided by such instrumentation is not necessary for adequate protection of the public or nuclear power plant staff, nor would it provide a substantial safety enhancement at nuclear power plants. Installation of such instrumentation need not be required by regulation.

### **NRC's Response to Issue 3:**

The petitioner stated that in-core temperature-monitoring devices would satisfy the July 12, 2011, near-term task force report recommendations for enhanced reactor instrumentation. As justification for this claim, the petitioner cited Recommendation 8, in Section 4.2.5 of the report, which recommends strengthening and integrating onsite emergency response capabilities such as emergency operating procedures, severe accident management guidelines and extensive damage mitigation guidelines. The petitioner also cited Volume 10 of NUREG-1635, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program: A Report to the U.S. Nuclear Regulatory Commission," dated October 31, 2012. The petitioner quoted sections from pages 11 and 12 of this report, in which the NRC stated that the agency recognized the need for enhanced reactor instrumentation, that such instrumentation would help clarify the transition points of various onsite emergency response capabilities, and that the NRC was in the process of adding this to the implementation of the near-term task force report recommendations. The petitioner gave, as an example of a transition point, the point at which nuclear power plant operators should transition from EOPs to implementing severe accident management guidelines.

The staff proposed plans to the Commission for resolving open near-term task force recommendations in SECY-15-0137, "Proposed Plans for Resolving Open

Fukushima Tier 2 and 3 Recommendations,” dated October 29, 2015. In SECY-15-0137, the staff described how remaining open recommendations from the near-term task force report should be resolved. The staff specifically assessed the need for enhanced reactor instrumentation for beyond-design-basis conditions in Enclosure 5 of SECY-15-0137. The staff recommended that the Commission not pursue additional regulatory action beyond the current requirements, including those imposed by orders EA-12-049, “Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” and EA-12-051, “Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation.” In SRM-SECY-15-0137, dated February 8, 2016, the Commission approved the staff’s closure plan for these items. On January 24, 2019, in SRM-M190124A, the Commission directed agency staff to publish a final rule based on lessons learned from the March 2011 accident at Japan’s Fukushima Daiichi plant. The final rule will make generically applicable the requirements from the above orders, taking into account lessons learned in the implementation of the orders and feedback received from stakeholders.

As discussed under Issues 1 and 2, the NRC evaluated the potential contribution that more accurate and precise temperature information would have on improving nuclear power plant safety for both boiling-water reactor and pressurized-water reactor plants. The NRC has determined that the availability of such information would not improve operator actions to prevent or mitigate a reactor accident. The NRC finds that the Commission’s conclusions in SRM-SECY-15-0137 apply for the instrumentation proposed by the petitioner. The NRC concludes that more accurate and precise temperature distribution information that would be provided by such instrumentation is not necessary for adequate protection of the public or nuclear power plant staff, nor

would it provide a substantial safety enhancement at nuclear power plants. Therefore, installation of such instrumentation need not be required by regulation.

### **V.III. Availability of Documents**

The documents identified in the following table are available to interested persons as indicated. For more information on accessing ADAMS, see the ADDRESSES section of this document.

Date	Document	ADAMS Accession Number/Web site / <i>Federal Register</i> Citation
Petition Documents		
March 13, 2015	PRM-50-111 - Petition for Rulemaking from Mark E. Leyse Regarding In-Core Temperature Monitoring at Nuclear Power Plants	<a href="#">ML15113B143</a>
July 16, 2015	Federal Register notice: Petition for Rulemaking, Notice of Docketing, Power Reactor In-Core Monitoring	<a href="#">80 FR 42067</a>
February 28, 2012	Petition for Rulemaking submitted Mark Edward Leyse, on PRM-50-105, Request NRC Require all Holders of Operating Licenses for Nuclear Power Plants to Operate with In-Core Thermocouples at Different Elevations and Radial Positions	<a href="#">ML12065A215</a>
May 23, 2012	Federal Register notice: Petition for Rulemaking; Receipt and Request for Comment, In-core Thermocouples at Different Elevations and Radial Positions in Reactor Core	<a href="#">77 FR 30435</a>

September 12, 2013	Federal Register notice: Petition for rulemaking; Denial, In-core Thermocouples at Different Elevations and Radial Positions in Reactor Core	<a href="#">78 FR 56174</a>
Other Documents		
October 30, 1979	The Need for Change, the Legacy of TMI: Report of the President's Commission on the Accident at Three Mile Island	<a href="https://tmi2kml.inl.gov/Documents/Common/Presidents%20Commission,%20(Main%20Report)%20The%20Need%20For%20Change,%20The%20Legacy%20of%20TMI-2%20(1979-10-30).pdf">https://tmi2kml.inl.gov/Documents/Common/Presidents%20Commission,%20(Main%20Report)%20The%20Need%20For%20Change,%20The%20Legacy%20of%20TMI-2%20(1979-10-30).pdf</a>
July 12, 2011	SECY-11-0093 - Enclosure: The Near Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident	<a href="#">ML111861807</a>
October 31, 2012	NUREG-1635, Volume 10, "Review and Evaluation of the Nuclear Regulatory Commission Safety Research Program: A Report to the U.S. Nuclear Regulatory Commission"	<a href="#">ML12311A417</a>
October 29, 2015	SECY-15-0137, "Proposed Plan for Resolving Open Fukushima Tier 2 and 3 Recommendations"	<a href="#">ML15254A006</a>
March 12, 2012	EA-12-049 "Issuance of Order to Modify Licenses with regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events"	<a href="#">ML12054A735</a>
March 12, 2012	EA-12-051, "Order Modifying Licenses with regard to Reliable Spent Fuel Pool Instrumentation"	<a href="#">ML12056A044</a>
February 8, 2016	SRM-SECY-15-0137 – Proposed Plans for Resolving Open Fukushima Tier 2 and 3 Recommendations	<a href="#">ML16039A175</a>
January 24, 2019	SRM-M190124A: Affirmation Session-SECY-16-0142: Final Rule: Mitigation of	<a href="#">ML19024A073</a>

	Beyond-Design-Basis Events (RIN 3150-AJ49)	
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#### IV. Conclusion

For the reasons cited in Section II of this document, the NRC is denying PRM-50-111. The NRC finds that no improvement in safety would result from amending its regulations to require the installation of in-core temperature-monitoring devices. Therefore, installation of such instrumentation need not be required by regulation.

Dated at Rockville, Maryland, this xxth day of Xxxxx, 2019.

For the Nuclear Regulatory Commission.

Annette L. Vietti-Cook,  
Secretary of the Commission.