

## **POLICY ISSUE NOTATION VOTE**

May 23, 2003

SECY-03-0085

FOR: The Commissioners

FROM: William D. Travers  
Executive Director for Operations

SUBJECT: DENIAL OF PETITIONS FOR RULEMAKING ON REVISING 10 CFR 50.46 AND APPENDIX K TO 10 CFR PART 50 TO REQUIRE LICENSEES TO ADDRESS THE IMPACT ON COOLANT FLOW OF RELEASE AND RESUSPENSION OF CRUD BUILDUP ON FUEL CLADDING DURING LOSS-OF-COOLANT ACCIDENT SCENARIOS AND DURING NORMAL OPERATIONS (PRM 50-73 AND PRM 50-73A)

PURPOSE:

To obtain Commission approval for denial of two related petitions for rulemaking on 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and Appendix K to Part 50, "ECCS Evaluation Models."

BACKGROUND:

10 CFR 50.46 specifies the performance criteria against which the emergency core cooling system (ECCS) must be evaluated. Appendix K to Part 50 provides the required and acceptable features of ECCS evaluation models. The criteria include the peak cladding temperature that cannot be exceeded, the maximum cladding oxidation thickness, the maximum total hydrogen generation, and requirements to assure a core geometry that can be cooled and abundant long term cooling. The regulations also state that calculated cooling performance following postulated loss-of-coolant accidents (LOCAs) must be calculated in accordance with an acceptable evaluation model and that in applying the model, comparisons

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to applicable experimental data must be made. The petitioner contends that these sections of the Commission's regulations are inadequate because they do not address the effect of crud on the cooling of the reactor, both under the turbulent coolant flow conditions of a LOCA and during normal operations. Crud is a colloquial term for corrosion and wear products (rust particles, etc.) that become radioactive (i.e., activated) when exposed to neutron irradiation. The petitioner states that crud detachment and resuspension during a LOCA could lead to obstructed flow of coolant, inadequate cooling, and ultimately to meltdown. In addition, the petitioner contends that crud buildup during normal operations could result in severe fuel damage. The petitioner identified numerous elements of the specified ECCS evaluation procedures and the evaluation model that he believed need to include comparisons to applicable experimental data.

The petition for rulemaking (PRM) designated PRM-50-73 addressing potential crud interference with coolant flow during a fast-moving (large-break) LOCA was received by the NRC on September 4, 2001, and the notice of receipt of the petition and request for public comment was published in the *Federal Register* (FR) on October 12, 2001 (66 FR 52065). The public comment period ended on December 26, 2001. On November 5, 2001, the NRC received a second, supplemental petition, designated PRM-50-73A, from the same petitioner alleging crud interference with core cooling during normal operations. The staff determined that the two petitions should be addressed as one action. The notice of receipt of the second petition was published in the FR on January 29, 2002 (67 FR 4214). The public comment period ended on April 15, 2002. Five letters of public comment were received in response to PRM-50-73, and seven letters addressed PRM-50-73A.

#### DISCUSSION:

##### PRM-50-73

In PRM-50-73, the petitioner stated that §50.46 and Appendix K to Part 50 do not address the impact of crud on core cooling during a fast moving (large-break) LOCA. The petitioner noted that a licensed power reactor had operated with heavy crud deposits on many of the fuel rods. The petitioner stated that had a fast-moving (large-break) LOCA occurred before shutdown for refueling, extensive blockage of flow channels within the fuel bundles would have developed, leading to a degradation of core cooling and compromising defense in depth. The petitioner further stated that significant crud deposits could lead to extensive fuel failure during full-power operation and that the amount of failed fuel would then lead to a decision to shut down the reactor as the inventory of radioactive material in the reactor coolant reached the limits allowed by the technical specifications. However, the petitioner also stated that operating experience indicates that it is possible to continue to operate a reactor within technical specification limits with unusually heavy crud deposits present.

The petitioner requested that §50.46 and specific paragraphs in Appendix K to Part 50 be revised to include comparisons to applicable experimental data that address the impact of crud deposits on fuel rods.

Five letters of public comment were received on PRM-50-73, all opposed to the action requested in the petition. The commenters were Framatome ANP, Exelon Nuclear, Westinghouse Electric Company LLC, General Electric Nuclear Energy, and the Nuclear Energy Institute (NEI). Two commenters stated that existing regulations and guidance are already adequate to address crud buildup and its potential impact on coolant flow during a LOCA. Three of the commenters stated that the postulated release of crud would not create flow blockage because the consistency of crud was powdery. Another commenter noted that in 30 years of monitoring fuel performance in numerous plants, only one plant ever experienced severe crud buildup, and in that case the buildup was quickly noticed and remediated. Subsequently crud deposits have been effectively controlled using Electric Power Research Institute (EPRI) Chemistry Guidelines.

One commenter noted that in the worst case crud release event that has occurred, River Bend, the core remained in a configuration that could be cooled and the licensee was able to maintain a substantial margin to the 2200°F peak cladding temperature criterion specified by 10 CFR 50.46. In addition, this commenter stated that fuel performance and coolant activity levels are monitored routinely to ensure that core evaluation models accurately reflect real conditions. Another commenter noted that existing regulations are not overly prescriptive in terms of specifying phenomena to be addressed in evaluating core cooling capability, which allows for advances in the technical database and updating of the evaluation procedures without the need for rulemaking. In addition, this commenter stated that the extensive data collected on crud deposits and their impact on coolant flow do not support the petitioner's contentions.

#### PRM-50-73A

In addition to the petition regarding the effect of crud on reactor cooling during a LOCA, the petitioner submitted a supplemental petition for rulemaking, PRM-50-73A. The supplemental petition stated that §50.46 and Appendix K to Part 50 do not address the impact of severe crud deposits on fuel bundle cooling during normal operations of a light-water-cooled reactor at (full) power. The petition stated that a licensed power reactor had operated with unusually heavy crud deposits, which, had they been allowed to build up, would likely have blocked flow channels, interfered with core cooling and led to significant damage to structural components of the core. The petitioner asked that §50.46 and Appendix K be revised to consider the impact of crud deposits on fuel bundles during normal operations.

Of the seven letters of public comment, two were submitted by the petitioner to provide additional information and related technical support for the assertions in PRM-50-73 and PRM-50-73A. The other five letters opposed the request for rulemaking as discussed in PRM-50-73A, and were submitted by Strategic Teaming and Resource Sharing (STARS), General Electric Nuclear Energy, Tennessee Valley Authority, Westinghouse Electric Company, and NEI. The comments included the observation that the NRC Standard Review Plan (SRP) specifies acceptance criteria that specifically address the impact of fuel crud deposits during normal operation. This commenter also pointed out that pressure drop monitoring for reactor coolant flow is required, implying that this monitoring would detect any interference with coolant flow resulting from crud deposition. Another commenter stated that the monitoring of coolant chemistry indicators and core power distribution measurements would provide indication of

possible heavy crud deposition or movement. The same commenter stated that visual inspection of fuel assemblies during refueling outages has found no evidence of heavy crud deposits.

One commenter stated that the petitioner's postulated scenario leading to rapid core melt is not supported by any technical or scientific data. Another commenter asserted that the single high crud event at River Bend was the only event of this type in over 1,000 reactor-years of boiling water reactor operation and that, even with the unusual crud buildup in that case, the core would have remained in a configuration that could be cooled.

#### ANALYSIS OF REQUESTED ACTION:

The staff has evaluated the advantages and disadvantages of the rulemaking requested by the petitions with respect to the four NRC Strategic Performance Goals as follows:

1. Maintaining Safety: The NRC staff believes that the requested rulemaking would not make a significant contribution to maintaining safety because current regulations and regulatory guidance already address consideration of crud-related parameters for core cooling, because no existing data suggests that the crud normally present on reactor fuel can significantly interfere with coolant flow, and because the cause of the single event noted by the petitioner is known and has been corrected.
2. Enhancing Public Confidence: The proposed revisions would not enhance public confidence. First, the NRC staff has concluded that the petitioner's contentions lack an adequate technical basis. Second, current regulations and guidance already address the effects of crud on core cooling. The petitioner's request in effect would require that consideration be given to abnormally heavy crud deposits as a potential source of coolant flow obstruction, which is a condition that has never been observed. The staff does not believe that such unnecessary regulatory action, without technical justification, would enhance public confidence in the safety of nuclear power.
3. Improving Efficiency, Effectiveness, and Realism: The proposed revisions would decrease efficiency, effectiveness, and realism because licensees would be required to generate additional information as part of the development of their ECCS evaluation models and the NRC staff would need to evaluate the licensee's data and analysis. The NRC staff believes that this additional consideration is of marginal safety value because the petitioner's scenarios are not supported by a technical basis. The additional NRC staff and licensee effort would not improve efficiency or effectiveness. In addition, the NRC resources expended to promulgate the rule and supporting regulatory guidance would be significant with little return of value.
4. Reducing Unnecessary Regulatory Burden: The requested rule would increase licensee burden by requiring significant additional testing and analysis of ECCS effectiveness with little expected benefit.

Section 10 CFR 50.46 already requires a nuclear power plant applicant/licensee to address the impacts of the core geometry change on cooling in ECCS analyses and transient analyses. The staff does not believe that crud buildup to the levels postulated by the petitioner are reasonable. The petitioner's hypothetical discussion of fuel clad performance with severe levels of crud was not supported by modeling, experimental results or operational data sufficient to demonstrate that fuel with high crud levels will actually behave in the manner postulated by the petitioner. The staff believes that there are other phenomena the petitioner failed to consider that would tend to reduce metal-water reactions and counteract autocatalytic reactions even if the extreme conditions postulated by the petitioner could be reached. The operating experience at several nuclear power plants that have experienced fuel failures shows that fuel degradation has progressed in a manner which is controllable. The one event (River Bend) identified by the petitioner as evidence of the likelihood of high crud levels occurred only once at that plant and has not been repeated there, or at any other plant in the United States. Finally, technical specifications for monitoring of reactor coolant activity and the requirements in 10 CFR Part 20 to maintain occupational exposures as low as reasonably achievable (ALARA) have resulted in licensee operational practices for early identification of coolant activity increase due to crud deposits before they build to the levels postulated by the petitioner. The staff does not believe that the petitioner's hypothetical discussion of a mechanism preventing early detection of abnormal activity levels is credible. For these reasons, the staff has determined that the petitioner's contentions have not been substantiated, and recommends that the subject petitions for rulemaking be denied.

COORDINATION:

The Office of the General Counsel has no legal objection to the denial of these petitions.

RECOMMENDATION:

That the Commission:

- (1) Approve denial of the subject petitions for rulemaking and publication of the *Federal Register* Notice (Attachment 1) of the denials.
- (2) Note that:
  - a. a letter is attached for the Secretary's signature (Attachment 2), informing the petitioner of the Commission's decision to deny his petitions.
  - b. the appropriate Congressional committees will be informed.

***/RA William F. Kane Acting For/***

William D. Travers  
Executive Director  
for Operations

Attachments: 1. Federal Register Notice  
2. Letter to Petitioner

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William D. Travers  
Executive Director  
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**Accession Number: ML030090134(package); ML030070489(Commission paper); ML030070507 Federal Register Notice(Attachment 1); ML030080171 Letter to Petitioner (Attachment 2)**

\*See previous concurrence

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