

May 19, 2010

MEMORANDUM TO: Robert Beall, Acting Chief  
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FROM: Tara Inverso, Project Manager/**RA/ Tara Inverso**  
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SUBJECT: SUMMARY OF THE PUBLIC MEETING TO DISCUSS THE §50.46(b)  
RULEMAKING TO MODIFY THE EMERGENCY CORE COOLING  
SYSTEM ACCEPTANCE CRITERIA AND THE PROSPECTIVE  
GENERIC LETTER RELATED TO FUEL CLADDING  
EMBRITTELEMENT

The U.S. Nuclear Regulatory Commission (NRC) held a Category 3 public meeting April 28-29, 2010 to discuss the rulemaking effort to modify the Emergency Core Cooling System (ECCS) acceptance criteria, and also to discuss the elements of a proposed generic letter related to fuel cladding embrittlement. The workshop was held in Rockville, MD at NRC headquarters. The meeting was attended by 54 individuals on day one and 46 individuals on day two, primarily representing industry representatives and NRC staff. Additional personnel participated in the meeting through audio teleconferencing and webinar. Since the NRC was not accepting public comments, a transcript of the meeting was not obtained.

The major areas of discussion are summarized as follows:

**1. Major ANPR Comments/NRC Responses and Draft Rule Language**

The NRC and industry representatives each made a presentation on the ten major comment topics of the Advance Notice of Proposed Rulemaking (ANPR), and the NRC response to these comments. These ten topics are discussed below.

**a) Adequacy/Completeness of Technical Basis**

The NRC staff discussed its belief that there is sufficient data and understanding of the cladding embrittlement phenomenon to proceed with rulemaking, develop detailed experimental procedures, and establish bounding post-quench ductility (PQD) analytical limits. The industry representatives' main concern with proceeding with rulemaking was the time frame in which regulatory guides would be available. The NRC accepted an action item to develop a schedule for the release of the regulatory guides based on Commission approval of the proposed rule

(predicted for late 2010). The regulatory guides would provide an acceptable means of compliance with the rule.

#### **b) Applicability Expansion (All Fuel Designs)**

The NRC discussed its plan to expand §50.46 to all LWRs, regardless of fuel design or cladding material. To address a comment that expansion could permit circumvention of open scientific scrutiny of new claddings, the NRC asserted that a licensee would need NRC approval to use a new cladding material. Thus the NRC would have the opportunity to scrutinize the demonstrated performance of the new fuel design under normal and upset conditions, along with the supporting materials characterization, degradation mechanisms, mechanical testing database, and in-reactor experience.

The industry expressed its desire to maintain a high level of information in the rule language, and the more involved details in lower tier documents (i.e., regulatory guides).

#### **c) Treatment of Uncertainty and Variability**

Two comments were received on the ANPR that suggest the existing ECCS regulations include significant conservatisms, and the new rule and regulatory guidance should not add excessive conservatism. The NRC staff stated that its intent is not to add new conservatisms, but the staff must account for uncertainties that exist in the current database and uncertainties that may arise during implementation.

Industry commented that it is important that, when the issue of uncertainty is addressed in rulemaking/regulatory guides, that the conservatisms that have gone into the testing methods be recognized. The NRC staff stated that variability will be addressed in the regulatory guides, and that the goal is to finish drafting the regulatory guides concurrent with the publication of the final rule.

Industry suggested that additional public workshops will be necessary to draft the associated regulatory guides.

#### **d) Approach to Ductility/Establishing Analytical Limits (and alternative approaches)**

The NRC discussed that, although brittle materials can retain strength, a strength based criterion requires detailed knowledge and interpretation of actual loading stresses under LOCA conditions. The NRC continues to assert that retention of ductility is the best guarantee against potential fragmentation of fuel cladding under various types of thermal shock, hydraulic and seismic forces.

There was considerable discussion between industry and the NRC staff regarding the selection of ductility as the best guarantee against fragmentation. The staff explained that the decision was made many years ago to use ductility as the performance metric to ensure gross failure of the core has not occurred. Currently, there is not an extensive research database which allows us to use any other metric (strain, load, etc).

Another considerable topic of discussion was the inclusion of a peak cladding temperature (PCT) limit of 2200°F in the draft rule language. The NRC staff explained that the basis of

maintaining 2200<sup>0</sup>F in the draft rule language extends beyond maintaining ductility. The staff feels that there are unknowns above that temperature that do not have associated performance metrics, and, as such, a PCT temperature limit must remain in the draft rule language.

#### **e) Oxygen Diffusion from Inside Surfaces**

The NRC staff and industry discussed oxygen diffusion from cladding inside surfaces. In response to the ANPR, one commenter suggested that the inclusion of a cladding ID oxygen source requirement is premature. The commenter also suggested any guidance be included in regulatory guidance, which would be more easily changed as science solidifies. The NRC indicated that the proposed rule would specify an analytical requirement to treat this ID oxygen source.

During the meeting, industry re-asserted that any specific details regarding oxygen diffusion from inside surfaces should remain in the regulatory guides. The NRC defended the draft rule language, asserting that it maintains that oxygen diffusion is a main factor in embrittlement. The time at temperature requirement was inserted to allow for a future model which could predict oxygen diffusion in the cladding. Further, the draft rule language specifically states “if an oxygen source is present.” Thus, if a plant can justify that an oxygen source is not present, it would not need to be included in the evaluation model.

#### **f) Breakaway Oxidation Requirements (periodic testing, acceptance criteria, and break spectrum)**

The proposed rule would state a requirement to ensure that the time the cladding is expected to remain above a phase transition temperature would not exceed a specified and acceptable limit which corresponds to the breakaway oxidation for the zirconium cladding.

The industry had questions regarding a requirement in the draft rule language to report any changes in the onset of breakaway oxidation, and wanted further information on whether it would be a pass/fail test or an actual measure of the time to breakaway oxidation. The NRC staff stated that it is still deliberating on that issue, but was leaning towards a deterministic approach. Industry suggested that this issue is an important one that needs to be well understood, and the industry/NRC staff need to work together to ensure the issue is addressed appropriately.

#### **g) Reporting Requirements**

The ANPR stated that revising the reporting requirements of the current rule was an objective of the rulemaking. After receiving multiple comments about the complexity of and burden imposed by the revised requirements, the NRC does not have plans to revise the reporting criteria in the proposed rule.

There was substantial discussion about whether or not the requirement in the draft rule language to report changes of breakaway time calculations should also be placed in the reporting requirements paragraph. The NRC staff asserted that the breakaway time report should belong to a more specific paragraph that applies only to zirconium based cladding. The reporting requirement paragraph is general, and would allow for the expanded applicability to new fuel/cladding designs.

#### **h) Consideration of Crud**

The proposed rulemaking would incorporate a recommendation submitted in a Petition for Rulemaking (PRM) which called for the thermal effects of crud to be considered in the ECCS evaluation models. The petitioner was on the phone and re-iterated his position.

Generally, the industry supported the draft rule language's addition to Appendix K which stated that "The thermal effects of crud that may be deposited on the fuel cladding during plant operation must be evaluated." One industry representative did suggest that there are many parameters that can affect the fuel cladding. Crud is one of them, but by specifically addressing it in Appendix K, the result could be arbitrarily advancing certain items to a level of higher importance.

#### **i) Rule Implementation**

Implementation of the rule was discussed by both NRC staff and industry. Currently, the NRC is proposing a staged implementation approach. In order to establish staged implementation, the NRC staff will need detailed plant-specific information.

The industry is very concerned about implementation of this rule, citing high costs and length of time to develop appropriate/adequate evaluation models. One industry member commented that this proposed rule will have a significant impact on plants which plan on conducting power uprates, since such plants are unsure of the manner in which power uprates will fit into the proposed rule.

#### **j) Fuel Rod Ballooning, Burst Node Survival, Fuel Fragmentation and Dispersal**

The NRC staff discussed its current sponsorship of research to investigate the balloon and burst phenomena on fuel cladding integrity. Fuel fragmentation and relocation phenomena are also planned for future research. The NRC staff asked for input on whether or not the new rule should be applicable to current licensed fuel burnup limits. This limitation would be imposed due to the NRC's evaluation of test data which could determine whether or not there is a burnup threshold whereby fuel pellet susceptibility to fragmentation necessitates new regulatory requirements.

The industry suggested, once again, that this information be placed in regulatory guides to allow room for science to advance without the need for rulemaking. The NRC asserted that this information belongs in the rule language, which is legally enforceable.

### **2. Industry Test Milestones**

The industry presented information on tests of the following: High temperature oxidation, PQD and breakaway oxidation round robin, the impact of limited inner diameter oxygen source on PQD, and breakaway oxidation. An estimated timeframe for the completion of these tests was provided.

### **3. Elements of a Prospective Information Request**

The NRC staff discussed its need for obtaining plant-specific information (relative to the research data) necessary to assure maintenance of current predicted safety margins. This information would be requested in the form of a generic letter.

There was a considerable amount of discussion between the staff and industry regarding this issue. The staff feels they have provided several opportunities for licensees to submit detailed, plant specific information, but have not received any. Industry stated that there are other ways to request this information without pursuing a generic letter. The NRC intends to pursue its plan to issue a generic letter in order to obtain the necessary plant specific information.

### **4. Action Items**

The following action items resulted from the public workshop:

#### **NRC Staff:**

1. Develop a schedule for the development of regulatory guides.
2. Consult with the Office of General Counsel on the potential need to re-open rulemaking as new materials are developed.
3. Work with industry to schedule the next public meeting.

#### **Industry:**

1. Provide alternatives to a generic letter.

#### **Enclosure:**

1. Attendee List

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Enclosure:

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 ADAMS Accession No. ML101180006 (Package with staff presentations)  
 ADAMS Accession No. ML101250316 (Package with industry presentations)  
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