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USNRC

Ms. Annette L. Vietti-Cook  
Secretary of the Commission  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

February 21, 2002 (2:04PM)

OFFICE OF SECRETARY  
RULEMAKINGS AND  
ADJUDICATIONS STAFF

Attention: Rulemakings and Adjudications Staff

Reference: Federal Register 52065, Vol. 66, No. 198, October 12, 2001

Subject: Comments on the Petition for Rulemaking to 10 CFR Part 50 addressing the Impact of  
Crud on Core Cooling during a Postulated Large Break Loss of Cooling Accident  
(LBLOCA)

Dear Ms. Vietti-Cook:

A notice of receipt of a petition for rulemaking to 10 CFR Part 50 was published for public comment in the Reference. The petitioner requests that the U.S. Nuclear Regulatory Commission amend 10 CFR 50.46(a)(1)(I) and Appendix K to Part 50 to address the impact of crud on core cooling during a large break loss of coolant accident (LBLOCA).

The Attachment contains the comments of the Westinghouse Electric Company regarding this petition for rulemaking. Westinghouse has performed poolside and laboratory examinations of crud deposits on fuel rods used in pressurized water reactors (PWRs), including cases where the presence of abnormally high levels of crud could be detected during normal operation. The characteristics of the crud found in PWRs are such that it would be virtually impossible for any significant amount of it to contribute to flow blockage in the event of a LBLOCA. Operational data from one PWR in which all of the crud was released at once due to a water chemistry change showed only a very small change in reactor flow, supporting this expectation. It is therefore concluded that the proposed revisions to § 50.46 and Appendix K to Part 50 are unnecessary.

The Westinghouse Electric Company appreciates the opportunity to comment on this petition for rulemaking. If there are any questions regarding these comments, please contact Mitch Nissley at (412) 374-4303.

Very truly yours,

H.A. Sepp, Manager  
Regulatory and Licensing Engineering

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SECY-02

## ATTACHMENT

### Comments of the Westinghouse Electric Company Regarding The Petition for Rulemaking Published in Federal Register 52065

#### Petitioner's Request

The petitioner requests that the U.S. Nuclear Regulatory Commission amend 10 CFR 50.46(a)(1)(I) and Appendix K to Part 50 to address the impact of crud on core cooling during a large break loss of coolant accident (LBLOCA). The petitioner hypothesizes that crud could be dislodged from the fuel during a LBLOCA, causing extensive blockage in regions with flow restrictions due to spacer grids or ballooned and burst fuel cladding.

#### Detection of Crud During Normal Operation of Pressurized Water Reactors (PWRs)

Several PWRs have experienced axial offset anomalies (AOA) due to buildup of boron within crud deposits, in portions of the reactor core which experience subcooled boiling. AOA is characterized by axial power distributions that are more skewed to the bottom of the core than would be expected. These AOA are detectable, and are closely monitored to ensure that adequate shutdown margins can be maintained. In extreme cases, reductions in operating power level have been required to maintain adequate shutdown margin. Operation with high levels of crud also increases personnel doses during steam generator inspection and maintenance. Therefore, there is a large incentive to avoid significant buildup of crud within the core, for both economic and ALARA reasons.

In one PWR with a history of significant amounts of crud, a significant change in the water chemistry (abnormally low pH) was introduced early in the shutdown of the reactor. The resulting chemical shock caused essentially all of the crud to become dislodged from the fuel rods, as evidenced by the visual appearance of the rods after shutdown, and the record low dose rates during the outage. A very small amount of the crud released apparently accumulated at the grids initially, as evidenced by an increase in reactor vessel pressure drop of about 1 psi, and a corresponding reactor coolant system flow rate decrease of less than 2%. This event demonstrated that, even in a worst-case scenario where all of the crud is dislodged at once in a highly crudded plant, the effects on reactor flow are very small.

#### Crud Morphology and Expected Behavior During a LBLOCA

Westinghouse Electric Company has performed crud scrapes during poolside examinations of irradiated PWR fuel at a number of licensed facilities. Crud scrapes involve attempts to physically remove crud from the cladding surface, using methods ranging from light to aggressive physical abrasion. The objective is to obtain samples that can be studied in a laboratory to determine characteristics such as thickness, composition and structure.

Experience has shown that crud on PWR fuel is about 50-80% porous (i.e., only 20-50% of theoretical density), and not structurally sound. It is very difficult to obtain intact flakes of any size for further characterization. The bulk of the crud comes off of the fuel rods as powder. Videotapes of poolside crud removal campaigns and subsequent laboratory examinations support these observations.

Release of crud into the coolant would be expected to some degree in a LBLOCA. However, very little of the crud would be in the form of flakes, and those flakes would likely break up rather than block flow. The vast majority of the crud would become suspended particles that would not impact core flow. These expectations are supported by observations from the previously discussed PWR water chemistry transient during shutdown.

### **Conclusions**

- Crud on PWR fuel rods can cause axial offset anomalies that may require reductions in operating power level, in order to maintain adequate shutdown margins. Crud can also increase personnel doses during steam generator inspection and maintenance. Therefore, there is a large incentive for licensees to minimize crud buildup on fuel rods, for both economic and ALARA reasons.
- Operational data from one PWR with a history of crud has shown that the release of all of the crud at once has negligible effect on core flow resistance.
- Crud on PWR fuel rods is very fragile, disintegrates very easily, and is thus not structurally sound. Crud scraping campaigns have shown that only a few flakes remain intact, with the majority of the removed crud being characterized as powder. While some crud may potentially be released into the coolant during a LBLOCA, it is expected that there would be a limited number of flakes, and the majority of the flakes would be expected to break up into small particles rather than contribute to blockage. This expectation is supported by the operational data discussed above.
- Based on these considerations, it is concluded that the proposed revisions to § 50.46 and Appendix K to Part 50 are unnecessary.