February 6, 2007

MEMORANDUM TO: Stacey L. Rosenberg, Chief
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

FROM: Sean E. Peters, Senior Project Manager **/RA/**
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF NOVEMBER 14, 2006, MEETING WITH THE PRESSURIZED WATER REACTOR (PWR) OWNERS GROUP (PWROG) TO DISCUSS CONTROL ROD SURVIVABILITY DURING A LOSS-OF-COOLANT ACCIDENT (LOCA)

On November 14, 2006, the U.S. Nuclear Regulatory Commission (NRC) and representatives of the PWROG held a Category 2 public meeting at NRC Headquarters, Two White Flint North, 11545 Rockville Pike, Rockville, Maryland. A list of attendees is enclosed.

The purpose of the meeting was to discuss the AREVA NP, Inc. (AREVA) and Westinghouse Electric Company (Westinghouse) findings on control rod survivability that demonstrate that all PWR control rods would survive a design-basis LOCA.

On April 13, 2006, AREVA filed an interim Title 10 of *The Code of Federal Regulations* (10 CFR) Part 21, "Reporting of Defects and Non-Compliance," report related to control rod performance during a LOCA event. This issue related to the historical Babcock and Wilcox control rod heat-up analyses performed for plants with full length silver-indium-cadmium (Ag-In-Cd) control rods clad with stainless steel. The issue was centered on the eutectic reactions between zirconium based thimble tubes and stainless steel or inconel sheath control rods, and the potential of the control rod failing and releasing molten Ag-In-Cd absorber material onto the fuel rods and into the primary coolant. If the Ag-In-Cd melt was released from the control rods during the LOCA, it could cause further eutectic reactions with the zirconium based fuel rods and could solidify when in contact with the primary coolant. This solidification could cause potential flow blockage of the core, which could impact two acceptance criteria of the 10 CFR Part 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors." These being Criterion 4, "Coolable geometry," and Criterion 5, "Long-term cooling."

To address these concerns, the PWROG initiated detailed assessments of the control rod performance for the various designs from the three PWR vendors (Westinghouse, Combustion Engineering, and Babcock and Wilcox). The PWROG found that:

1. The most limiting control rod design is the full length Ag-In-Cd in either a stainless steel or inconel 625 sheath from a eutectic reaction standpoint;

2. The oxide coating on the zirconium clad fuel rods that is developed during a LOCA provides margin to preclude the eutectic reactions between the control rods and fuel rods;

3. The coatings on the stainless steel sheath control rods provide additional margin to preclude the eutectic reactions;

4. The eutectic reaction time necessary to burn though the control rod is greater than the time spent at the peak clad temperature during a design-basis LOCA;

5. The zirconium based guide thimbles would react with either the stainless steel or inconel 625 sheath control rods and would be consumed within a few seconds at peak clad temperatures;

6. The eutectic reaction rates slow down dramatically as temperature is reduced; and

7. The heating rates for the control rods show that the maximum expected temperatures for the control rods are between 1700 and 1800 ^{o}F during the design-basis LOCA.

In the conclusion of the meeting, the PWROG representatives stated that based upon the assessments presented in the "White Paper," as long as the fuel continues to meet the 10 CFR 50.46 acceptance criteria, then the control rod survivability is ensured and the control rods will not melt nor expel the absorber. Furthermore, the PWROG indicated that it intended to submit its completed White Paper to the NRC staff by the end of the 2006 calendar year.

The meeting handouts are available in the NRC's Agencywide Documents Access and Management System as Accession No. ML070180426. Please direct any inquiries to Sean E. Peters at 301-415-1842, sep@nrc.gov.

Project No. 694

Enclosure: List of Attendees

cc w/encl: See next page

cc:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
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Pittsburgh, PA 15230-0355

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

ATTENDEES

MEETING WITH PRESSURIZED WATER REACTOR OWNERS GROUP

NOVEMBER 14, 2006

PWROG

William Slagle - Westinghouse Electric Corporation
Bob Schomaker - AREVA
Rob Sisk - Westinghouse Electric Corporation
Lewis Wells - Progress Energy
John Klingenfus - AREVA

NRC

Shih-Liang Wu
Paul Clifford
David Bessette
Mike Cash
Sud Basu
Sean Peters

ENCLOSURE

2. The oxide coating on the zirconium clad fuel rods that is developed during a LOCA provides margin to preclude the eutectic reactions between the control rods and fuel rods;
3. The coatings on the stainless steel sheath control rods provide additional margin to preclude the eutectic reactions;

4. The eutectic reaction time necessary to burn though the control rod is greater than the time spent at the peak clad temperature during a design-basis LOCA;

5. The zirconium based guide thimbles would react with either the stainless steel or inconel 625 sheath control rods and would be consumed within a few seconds at peak clad temperatures;

6. The eutectic reaction rates slow down dramatically as temperature is reduced; and

7. The heating rates for the control rods show that the maximum expected temperatures for the control rods are between 1700 and 1800 ^{o}F during the design-basis LOCA.

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