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In Reply Refer To:
RII:JPO
50-338, 50-339
50-404, 50-405
50-280, 50-281

Virginia Electric and Power Company
Attn: W. L. Proffitt
Senior Vice President,
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P. O. Box 26666
Richmond, Virginia 23261

Gentlemen:

The enclosed IE Bulletin No. 79-26 is forwarded to you for information. No written response is required. If you desire additional information regarding this matter, please contact this office.

Sincerely,

James P. O'Reilly
Director

Enclosures:
1. IE Bulletin No. 79-26
2. List of IE Bulletins Issued In The Last Six Months

CCP

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NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

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IE Bulletin No. 79-26

BORON LOSS FROM BWR CONTROL BLADES

Description of Circumstances:

The General Electric Company (GE) has informed us of a failure mode for control blades which can cause a loss of boron poison material. Hot cell examinations of both foreign and domestic blades have revealed cracks near the upper end of stainless steel tubing and loss of boron from the tubes. The cracks and boron loss have so far been confined to locations in the poison tubes with more than 50 percent Boron-10 (B^{10}) local depletion. Observed crack sizes range from a quarter to a half inch in length and from one to two mils in width.

GE has postulated that the cracking is due to stress corrosion induced by solidification of boron carbide (B_4C) particles and swelling of the compacted B_4C as helium and lithium concentrations grow. Once primary coolant penetrates the cladding (i.e., the cracking has progressed through the cladding wall and the helium-lithium pressures are sufficient to open the crack), boron is leached out of the tube at locations with more than 50 percent B^{10} local depletion (local depletion is considered to be twice the average depletion). It was further found with similar cracking but with less than 50 percent local depletion of B^{10}, that leaching did not occur even though primary coolant had penetrated the cladding.

The cracking and boron loss shorten the design life of the control blade. According to the GE criteria the end of design life is reached when the reactivity worth of the blade is reduced by 10 percent, which corresponds to 42 percent B^{10} depletion averaged over the top quarter of the control blade. Because of the leaching mechanism, GE has reduced the allowance for B^{10} depletion averaged over the top quarter of the control blade from the 42 percent value to 34 percent.

The safety significance of boron loss is its impact on shutdown capability and scram reactivity. Although shutdown capability is demonstrated by shutdown margin tests after refueling, the calculated control blade worths used in the tests are based on the assumption that no boron loss has occurred. Reduction in scram reactivity due to boron loss could increase the severity of Critical Power Ratio (CPR) reductions during the plant transients and could increase the consequences of control rod drop accidents.

Because the locations of limiting Linear Heat Generation Rate (LHGR), CPR, and Average Planar LHGR (APLHGR) are not in controlled cells, local power limit monitoring is not affected by boron loss.

GE has evaluated the potential effect of boron loss on shutdown capability, CPR reduction and the consequences of control rod drop accidents. GE's evaluation is based on the hot cell result that no boron loss is observed until 50 percent local B^{10} depletion is attained. For each B_4C tube, complete loss of B_4C was assumed when the calculated B^{10} depletion exceeded 50 percent locally. For any blade expected to reach a B^{10} depletion greater than 34 percent during a cycle, GE assumed a B^{10} depletion distribution typical of blades at the previously defined end of design life.

Based on these evaluations GE arrived at the following conclusions:

(a) Control rod drop accident consequences are not sufficiently sensitive to small reductions in scram reactivity to be affected by boron loss before the end of design life of the blades involved.

(b) If no more than 26 percent of the control blades have experienced a 10 percent reduction in projected worth taking boron loss into consideration, there is a negligible effect on transient CPR reduction and MCPR limits.

(c) If any control blades have experienced more than 10 percent reduction in projected worth, taking boron loss into consideration, the shutdown margin should be demonstrated to be at least the sum of the shutdown margin required by Technical Specifications plus an increment sufficient to account for the potential for boron loss.

We have examined the bases for GE's conclusions, including the hot cell tests and the calculational assumptions. The preferred action is to replace all blades expected to have greater than 34 percent B^{10} depletion averaged over the upper one-fourth of the blade. However, based on our review we believe the relation between boron loss and B^{10} depletion (i.e., the observations to date show that boron loss does not occur until 50 percent local depletion of B^{10}) is sufficiently understood to justify BWR operation on an interim basis provided the following actions have been taken by licensees.

Action to be Taken by Licensees:

For all BWR power reactor facilities with an operating license:

1. The operating history of the reactor is to be reviewed to establish a record of the current B^{10} depletion averaged over the upper one-fourth of the blade for every control blade; the record is to be maintained on a continuing basis. This action is required on all reactors whether shutdown for refueling or operating.

2. Identify any control blades predicted to have greater that 34 percent B^{10} depletion averaged over the upper one-fourth of the blade by the next refueling outage.

   a. Describe your plans for replacement of identified control blades.

b. Describe measures which you plan to take justifying continued operations until the next refueling specifically addressing (1) any blade with greater than 42 percent depletion averaged over the upper one-fourth of the blade; and (2) the condition where you find greater than 26 percent of the control blades calculated to have greater than 34 percent depletion averaged over the upper one-fourth of the blade.

3. At the next cold shutdown or refueling outage, conduct shutdown margin tests to verify that:

   a. full withdrawal of any control blade from the cold xenon-free core will not result in criticality; and

   b. compliance with the shutdown margin requirement in a manner that accommodates the boron loss phenomenon (i.e., by including a plant specific increment in the shutdown margin that takes the potential loss of boron from control blades identified from evaluation of Item 1 into consideration).

4. Perform a destructive examination of the most highly exposed control blade at the end of the next cycle and provide results of the examination within one calender year after removal of the blade. The results to be reported should include:

   a. Tube number or identification.
   b. The evaluation of each crack in the tubing.
   c. The calulated B^{10} depletion versus elevation for each tube.
   d. The measured B^{10} loss versus elevation for each tube.
   e. The maximum local depletion for tubes having no cracks.
   f. The maximum local depletion for tubes having no loss of boron.

   Alternately, the results of a destructive examination of a blade of similar fabrication and operational history may be provided within one year of the date of issuance of this Bulletin. If the highest local B^{10} depletion is less than 50 percent, this examination can be deferred until the next refueling.

5. Submit within 45 days of the date of issuance of this Bulletin, a written report of the findings as to Items (1) and (2). For facilities in a refueling outage, and all other facilities at their next refueling outage, submit the written report on Item (3) within 30 days after plant startup following the outage. A written report on Item (4) is requested within one year after removal of a control blade for destructive examination

Reports should be submitted to the Director of the appropriate NRC Regional Office and a copy should be forwarded to the NRC Office of Inspection and Enforcement, Division of Reactor Operations Inspection, Washington, D.C. 20555.

For all BWR facilities with a construction permit and all other power reactor facilities with an operating license or construction permit, this Bulletin is for information only, no written response is required.

Approved by GAO B180225 (R0072); Clearance expires 7/31/80. Approval was given under a blanket clearance specifically for identified generic problems.

LISTING OF IE BULLETINS
ISSUED IN LAST SIX MONTHS

Bulletin No.	Subject	Date Issued	Issued To
79-26	Boron Loss from BWR Control Blades	11/20/79	ALL OLs for Action All CPs for Information
79-25	Failures of Westinghouse BFD Relays in Safety-Related Systems	11/02/79	All Power Reactor Facilities with an OL or a CP
79-24	Frozen Lines	9/27/79	All Power Reactor Facilities with an OL or a CP
79-23	Potential Failure of Emergency Diesel Generator Field Exciter Transformer	9/12/79	All Power Reactor Facilities with an OL or a CP
79-22	Possible Leakage of Tubes of Tritium Gas Used in Timepieces for Luminosity	9/5/79	Each Licensee who Receives Tubes of Tritium Gas in Timepieces for Luminosity
79-21	Temperature Effects on Level Measurements	8/13/79	All PWR's with an Operating License
79-20	Packaging Low-Level Radioactive Waste for Transport and Burial	8/10/79	All Materials Licensees who did not receive Bulletin No. 79-19
79-19	Packaging Low-Level Radioactive Waste for Transport and Burial	8/10/79	All Power and Research Reactors with OLs, Fuel Facilities except uranium mills, and certain materials licensees
79-18	Audibility Problems Encountered on Evacuation of Personnel from High-Noise Areas	8/7/79	All OLs for Action All CPs for Information
79-17 (Rev. 1)	Pipe Cracks in Stagnant Borated Water Systems at PWR Plants	10/29/79	All PWRs with Operating License
79-17	Pipe Cracks in Stagnant Borated Water Systems at PWR Plants	7/26/79	All PWRs with Operating License

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Bulletin No.	Subject	Date Issued	Issued To
79-16	Vital Area Access Controls	7/26/79	All Holders of and applicants for Power Reactor Operating Licenses who Anticipage loading fuel prior to 1981
79-15 (Supp. 1)	Deep Draft Pump Deficiencies	7/18/79	All Power Reactor Licensees with a CP and/or OL
79-15	Deep Draft Pump Deficiencies	7/11/79	All Power Reactor Licensees with a CP and/or OL
79-14 (Supp. 2)	Seismic Analyses for As-Built Safety-Related Piping System	9/7/79	All Power Reactor Facilities with an OL or a CP
79-14 (Correction)	Seismic Analyses for As-Built Safety-Related Piping System	7/27/79	All Power Reactor Facilities with an OL or a CP
79-14 (Rev. 1)	Seismic Analyses for As-Built Safety-Related Piping System	7/18/79	All Power Reactor Facilities with an OL or a CP
79-14	Seismic Analyses for As-Built Safety-Related Piping System	7/2/79	All Power Reactor Facilities with an OL or a CP
79-13 (Rev. 2)	Cracking in Feedwater System Piping	10/17/79	All PWR's with an Operating License
79-13 (Rev. 1)	Cracking in Feedwater System Piping	8/30/79	All PWR's with an Operating License
79-13	Cracking in Feedwater System Piping	6/25/79	All PWR's with an OL for action. All BWRs with a CP for information

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ISSUED IN LAST SIX MONTHS

Bulletin No.	Subject	Date Issued	Issued To
79-06C	Nuclear Incident at Three Mile Island - Supplement	7/26/79	To all PWR Power Reactor Facilities with an OL
79-05C	Nuclear Incident at Three Mile Island - Supplement	7/26/79	To all PWR Power Reactor Facilities with an OL
79-02 (Rev. 2)	Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts	11/8/79	All Power Reactor Facilities with an OL or a CP
79-02 (Rev. 1) (Supp. 1)	Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts	8/20/79	All Power Reactor Facilities with an OL or a CP
79-02 (Rev. 1)	Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts	6/21/79	All Power Reactor Facilities with an OL or a CP
79-01A	Environmental Qualification of Class 1E Equipment (Deficiencies in the Environmental Qualification of ASCO Solenoid Valves)	6/6/79	All Power Reactor Facilities with an OL or a CP