

NUCLEAR MANAGEMENT AND RESOURCES COUNCIL

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January 31, 1994

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
M/S P1-37  
Washington, DC 20555

**SUBJECT:** Alloy 600 CRDM Penetrations

The purpose of this letter is to respond to Mr. William T. Russell's letter to NUMARC dated November 19, 1993, regarding the Alloy 600 CRDM vessel head penetration cracking issue. Mr. Russell's letter addresses the flaw acceptance criteria submitted by NUMARC on July 30, 1993, and provides NRC staff's safety evaluation of the three PWR Owners Groups' CRDM safety assessments submitted by NUMARC on June 16, 1993. This letter also transmits supplemental safety assessments developed by the owners groups (Attachment A). Please note that the Westinghouse assessment is considered proprietary as indicated by their enclosed affidavit. A non-proprietary version of their report is included for filing in the Public Document Room.

Regarding the flaw acceptance criteria, the three pilot plants identified in Mr. Russell's letter had indicated their intent to conduct penetration inspections contingent upon NRC staff acceptance of these criteria. Mr. Russell's letter accepted the industry flaw acceptance criteria to assess axial cracking (less than 45° from the axial direction). He also noted that circumferential stress analyses had not yet been submitted and, therefore, indicated that based on information submitted to date, flaw acceptance criteria for circumferential cracks should not be pre-approved. Circumferential flaws proposed to be left in service without repair would be evaluated by the staff on a case-by-case basis. We remain concerned that the NRC staff may conduct these reviews in a manner that would unnecessarily impact planned outage schedules.

The enclosed supplemental safety evaluations summarize the circumferential stress analyses for flaws initiating on the outer surface of CRDM nozzles in the presence of a postulated throughwall ID-initiated crack. The evaluations confirm that circumferential cracking at CRDM nozzles is highly unlikely. Additionally, stress analyses indicate that should a circumferentially oriented crack occur it would take longer than the 40 year licensed lifetime of the plant before it would threaten the structural integrity of the

thinnest nozzle in service. Therefore, neither the potential for circumferential cracking nor the existence of circumferential cracks pose an unreviewed or immediate safety issue.

These supplemental assessments illustrate the fundamental understanding of cracking. The staff's review of these assessments should prove beneficial in any further consideration of the acceptance criteria provided for circumferential flaws. The flaw acceptance criteria are consistent with ASME Section XI criteria for acceptance of circumferential flaws in pipes. Margins incorporated in the submitted criteria are equal to or exceed the margins in Section XI.

Although the presence of a circumferential crack is considered highly unlikely, it is conceivable that minor circumferential indications such as craze cracking could be detected. If a circumferential crack is detected, the licensee would assess this indication for acceptability with Alloy 600 crack growth information, generally obtained from test and field experience, to determine the need for repair prior to plant restart. Utilizing the flaw acceptance criteria would assure that Section XI criteria for piping is met for the assessed penetration through the end of the inspection interval.

It should be noted that circumferential IGSCC cracks are not a new phenomena. Such cracks have been observed in the heat affected zone of welds in BWR primary piping and safe ends. Furthermore, the methodology to evaluate circumferential flaws in the acceptance criteria is consistent with that used by the staff in NUREG 0313, Rev. 2, *Technical Report on Material Selection and Processing Guidelines in BWR Coolant Pressure Boundary Piping, January 1988*. Both BWR and PWR approaches are based on ASME Section XI and use of fracture mechanics and appropriate crack growth laws to evaluate flaws. In both cases, the flawed component is considered acceptable for service provided code intended safety or design margins are maintained through the end of the inspection interval.

Regarding the previously submitted safety assessments, Mr. Russell's letter noted that these assessments did not address the circumferential J-groove flaw discovered at Ringhals or stresses from possible straightening of CRDM penetration tubes during fabrication. The NRC staff further recommended consideration of enhanced leakage detection.

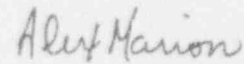
With respect to the Ringhals weld indication, based on data interpretation by Ringhals personnel, it is our understanding that this indication is fabrication related and is not related to the PWSCC phenomena experienced at Bugey 3. Therefore, this issue is not a subject of this CRDM penetration assessment program. The issue of stresses from tube straightening is addressed in each of the attached supplemental safety assessments or

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their respective cover letters. Consideration of leakage detection, other than the NRC accepted method of Generic Letter 88-05 boric acid leakage walkdown inspections, was addressed in our letter to Mr. Russell dated September 22, 1993.

We are prepared to meet with Mr. Russell and members of his staff, as necessary. Any questions regarding this issue should be directed to me or Morris Schreim of the NUMARC staff.

Sincerely,



Alex Marion  
Manager, Technical Division

MS/cma

c: Mr. William T. Russell, NRC/ADT

## ATTACHMENT A

- 1) ABB Combustion Engineering Report CEN-614, "Safety Evaluation of the Potential for and the Consequence of Reactor Vessel Head Penetration Alloy 600 OD-Initiated Nozzle Cracking," December 1993.
- 2) B&W Report BAW-10190, Rev.1, "External Circumferential Crack Growth Analysis for B&W Design Reactor Vessel Head Control Rod Drive Mechanism Nozzles," January 1994.
- 3) Westinghouse Report WCAP-13525 Appendix I Addendum 1, RV Closure Head Penetration Alloy 600 PWSCC (Phase 2)," December 1993 [Proprietary]
- 4) Westinghouse Report WCAP-13603 Addendum 1, RV Closure Head Penetration Alloy 600 PWSCC (Phase 2)," December 1993 [Non-Proprietary]



## Westinghouse Owners Group

### Domestic Utilities

Alabama Power  
American Electric Power  
Carolina Power & Light  
Commonwealth Edison  
Consolidated Edison  
Duquesne Light  
Duke Power

Georgia Power  
Florida Power & Light  
Houston Lighting & Power  
New York Power Authority  
Northeast Utilities  
Northern States Power  
Pacific Gas & Electric

Portland General Electric  
Public Service Electric & Gas  
Rochester Gas & Electric  
South Carolina Electric & Gas  
Tennessee Valley Authority  
TJ Electric

Union Electric  
Virginia Power  
Wisconsin Electric Power  
Wisconsin Public Service  
Wolf Creek Nuclear  
Yankee Atomic Electric

### International Utilities

Belgian Utilities  
Kansas Electric Power  
Korea Electric Power  
Nuclear Electric plc  
Nuklearna Elektra  
Spanish Utilities  
Swedish State Power Board  
Taiwan Power

OG-94-03

January 10, 1994

Mr. Morris Schreim  
Nuclear Management and Research Council  
1776 Eye Street  
Suite 300  
Washington, DC 20006-2496

Subject: Westinghouse Owners Group  
**Transmittal of Report: WCAP-13525 Appendix I Addendum 1 [Proprietary]  
and WCAP-13603 Addendum 1 [Non-Proprietary] Entitled "RV Closure  
Head Penetration Alloy 600 PWSCC (Phase 2)"**

Reference: WOG letter OG-93-03 dated 1/15/93

Dear Mr. Schreim,

Enclosed are:

1. Ten (10) copies of WCAP-13525 Appendix I Addendum 1 Entitled "RV Closure Head Penetration Alloy 600 PWSCC (Phase 2)" [Proprietary]
2. Ten (10) copies of WCAP-13603 Addendum 1 Entitled "RV Closure Head Penetration Alloy 600 PWSCC (Phase 2)" [Non-Proprietary]

Also enclosed are:

1. One (1) copy of the Application for Withholding, CAW-94-563 [Non-Proprietary] with Proprietary Information Notice.

2. One (1) copy of Affidavit CAW-94-563 [Non-Proprietary].
3. One (1) copy of the Copyright Notice.

These reports supplement the Westinghouse Owners Group technical documentation and basis for the Safety Evaluation Report WCAP-13565 recently sent to the NRC through NUMARC. Also these reports address the issue of OD circumferential cracking in the RV head penetrations.

This information is being provided in support of the Joint Owners Group submittal being prepared by NUMARC.

**THE FOLLOWING PARAGRAPHS MUST BE INCLUDED IN YOUR LETTER TO THE NRC.**

*Enclosed are:*

1. *Ten (10) copies of WCAP-13525 Appendix I Addendum 1 Entitled "RV Closure Head Penetration Alloy 600 PWSCC (Phase 2)" [Proprietary]*
2. *Ten (10) copies of WCAP-13603 Addendum 1 Entitled "RV Closure Head Penetration Alloy 600 PWSCC (Phase 2)" [Non-Proprietary]*

*Also enclosed are a Westinghouse authorization letter CAW-94-563, accompanying affidavit, Proprietary Information Notice, and Copyright Notice.*

*As Item 1 contains information proprietary to the Westinghouse Electric Corporation, it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.790 of the Commission's regulations.*

*Correspondence with respect to the copyrighted or proprietary aspects of the items listed above or the supporting Westinghouse Affidavit should reference CAW-94-563 and should be addressed to Mr. N.J. Liparulo, Manager, Nuclear Safety and Regulatory Activities, Westinghouse Electric Corporation, P.O. Box 355, Pittsburgh, PA 15230-0355.*

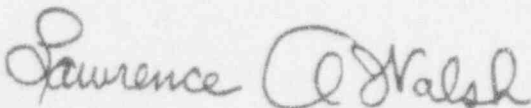
These reports are being provided for NRC information and any internal review deemed necessary for use in conjunction with the Safety Evaluation Report. The Westinghouse Owners Group is not requesting a formal review and approval for which review fees would be charged. Should NUMARC or any branch of the Nuclear Regulatory Commission determine that a formal review should be performed, the Westinghouse Owners Group Chairman must be contacted for concurrence. Failure to receive concurrence from the Westinghouse Owners Group Chairman prior to the initiation of a review will result in a challenge by the Westinghouse Owners Group of any and all review fees associated with these documents.

With respect to penetration tube straightening during fabrication, the question has been asked if stresses induced during operation contribute to PWSCC. Westinghouse's judgement is that the additional stress produced by straightening is negligible with respect to any penetration cracking due to PWSCC. The following items provide the basis for this judgement.

1. Peak stresses due to straightening are remote from the penetration attachment weld area by at least 1.5 tube diameters.
2. Penetration deformation and stress due to any needed straightening are measured to be small in magnitude.
3. The penetration temperatures at that elevation where the peak stress due to straightening occurs is lower than that at the attachment weld elevation where the peak stress to produce PWSCC occur.

Please direct any questions or comments to Mr. Dave Boyle at (412) 374-6690.

Very truly yours,



Lawrence A. Walsh, Chairman  
Westinghouse Owners Group

SAB/LAW/dac

enclosures

cc: WOG Steering Committee (1L)  
Westinghouse Owners Group Primary Representatives (1L)  
WOG Materials Subcommittee Representatives (1L)  
William T. Russell, NRC (1L)  
C.K. McCoy, Georgia Power (1L)  
J.P. O'Hanlon, Virginia Power (1L)  
N.J. Liparulo, W (1L)