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Westinghouse Electric Corporation
Water Reactor Divisions

NS-EPR-2523
Box 355
Pittsburgh Pennsylvania 15230

November 25, 1981

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U.S. NUCLEAR REGULATORY COMMISSION

Mr. Richard C. DeYoung, Director
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. DeYoung:

Subject: Reportable Item on Radiographic Testing of CRDM Adapter Welds

Reference: NS-TMA-2454, dated June 5, 1981

The referenced letter reported a potential significant deficiency (10CFR50.55(e)) for plants under construction and an unreviewed safety question (10CFR50.59) for operating plants involving the CRDM adapter welds on several plants. Attached is a report documenting the resolution of this issue.

All of the suspect radiographs on the affected plants were reviewed by Westinghouse. Of the 728 films reviewed, 35 were deemed not interpretable. Of these 35 welds, 28 were re-radiographed with acceptable results. The remaining seven welds are on two operating plants and cannot be re-radiographed. The attached report provides the basis of the Westinghouse conclusion that safe operation of these units can continue without additional testing.

If you have any question on this subject, please contact me or David Maire (telephone 412/373-5230) of my staff.

Sincerely,

for E. P. Rahe, Jr., Manager
Nuclear Safety Department

DGM/dlb

Attachment

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ROTTERDAM DRYDOCK REACTOR VESSEL
CROM WELD RADIOGRAPHY

November, 1981

Westinghouse Electric Corporation

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During the ASME Section XI preservice inspection of Duke Power Company Catawba Unit # 1 ultrasonic test indications were noted on some of the inconel tube to stainless steel flange welds on the reactor vessel head control rod drive mechanism (CRDM) housing welds. Radiographic film of these welds were retrieved from archives and reviewed to assist in the interpretation of the UT indications. During this review Duke Power noted that some elements of the radiographic technique used and the resulting film did not specifically comply with all of the requirements of ASME Section III (Winter 1971). Review of the film for McGuire Unit #2 revealed that generally the same conditions existed. Subsequent to the above, Westinghouse met with Duke Power to evaluate the radiographic procedure and questionable film. As a result of this review Westinghouse concurred that various radiographic/film conditions were not in strict compliance with ASME Code requirements.

The above reactor vessels were fabricated by Rotterdam Drydock (RDM). A review of engineering and quality assurance records showed that all vessels manufactured by RDM for Westinghouse used essentially the same radiographic technique for these welds, although some of the vessels were fabricated to Winter 1968 or earlier editions of ASME Section III. The affected units were identified as:

TVA - Sequoyah Unit #1

TVA - Sequoyah Unit #2

TVA - Watts Bar Unit #1

TVA - Watts Bar Unit #2

VEPCO - North Anna Unit #1

VEPCO - North Anna Unit #2

VEPCO - Surry Unit #2

Duke Power - McGuire Unit #2

Duke Power - Catawba Unit #1

Swedish State Power - Ringhals Unit #2

The Surry Unit 1 vessel was fabricated by RDM, however, the CRDM housing welds were fabricated and inspected by Babcock & Wilcox.

Westinghouse notified the NRC and the above utilities of the existing conditions.

An action plan for resolution of this issue was developed and the following actions were completed.

1. Acknowledging that all ASME Code parameters may not have been met, the affected film was reviewed to ascertain interpretability. The reviews were performed by Westinghouse personnel who are highly qualified and experienced in NDE techniques. In most cases the film exhibited sensitivities such that significant flaws would be detected. Attachment 1 provides a summary of these reviews.
2. A weld mock-up duplicating the configuration of the welds in question was fabricated. The mock-up was radiographed using the RDM technique in order to determine the capabilities of the technique. Information developed from this mock-up includes;
   A. A No. 17 (.017") penetrameter placed on the I.D. of the tube (source side) can be clearly defined, including the 2T hole. This meets criteria specified by all code editions utilized for source side penetrameters.

B. A 1/32" groove (.032") machined in the I.D. of the inconel portion of the tube is clearly discernable in the radiograph of that area.

C. A 1/16" (.063") diameter hole in the stainless steel portion of the tube is clearly discernible through a density area of 1.5% H&D in one film.

This information verifies that the technique (and interpretable film resulting from its use) is sufficiently sensitive to detect any flaw size of concern to the design. This is consistent with results of the RDM film review wherein porosity sizes of approximately 1/64" (.016") diameter were detected in some instances.

3. Welds for which the radiographs were not interpretable on three non-operating plants were radiographed again in the field by Westinghouse. The results of these new radiographs are acceptable and are included in Attachment 1.

4. The radiographic technique utilized by other reactor vessel manufacturers for these welds was reviewed. The techniques utilized by other fabricators are different from that used by RDM and comparable problems were not present.

These actions support the conclusion that no significant defect is present in the welds under consideration. This is based on;

1. The radiographic technique used by the fabricator has been shown by mock-up to provide adequate sensitivity levels, even with some variation from code parameters.

2. No rejectable defects are discernible in reshot film and original film found to be interpretable. This is a total of 721 welds of 728 welds reviewed. The remaining 7 films were deemed not interpretable based on film densities.

Of the seven CRDM housing films which were deemed not to be interpretable, two housings are installed in North Anna Unit 1 and five are installed in North Anna Unit 2. These two units are operating plants and cannot be re-radiographed. Westinghouse has concluded that safe operation of these units can continue without additional testing based on the following.

1) The results of the very extensive radiographic review reported herein demonstrate that the manufacturing processes used by RDM provide a sound weld which is free of significant defects.
2) Other non-destructive tests performed during fabrication and pre-service inspection revealed no unacceptable indications.
3) A fracture mechanics evaluation of this weld indicates that a very large flaw would be necessary to cause failure of the weld. A through-wall circumferential flaw extending over 20 percent of the circumference will remain stable under the worst case loading, as would a three inch through-wall axial flaw, or a 360 degree inside surface crack extending 30 percent through the wall.
4) Based on previous evaluations of these materials in other applications, the leak before break mechanism would apply.
5) The as-built wall thickness of this weld is in excess of the minimum ASME Code requirement.
6) The two component hydrotests, the plant cold hydrotest, and plant operation to date have been acceptable.

In summary, the radiography performed on the CRDM adapter welds on reactor vessels fabricated by RDM does not meet all of the requirements of the ASME Code, however adequate assurance exists that the welds are sound and that safe operation of the plants can continue.

Attachment 1

STATUS RDM CRDM FILM REVIEW

Sequoyah #1	All films are interpretable and exhibit no signifiant indications.
Sequoyah #2	On film identified as EAF-303, 309 and 313 (housings 13, 5 & 1) the weld areas could not be positively identified. Re-radiography of these seams was acceptable and all other film exhibits no significant indications.
McGuire #2	Eleven films exhibit densities such that proper weld evaluation cannot be performed. In addition film cannot be located for position number 42. These film are identified as:

EAT-116 (59)	EAT-123 (25)
EAT-121 (60)	EAT-118 (32)
EAT-100 (005)	EAT-119 (47)
EAT-139CO (12)	EAT-117 (54)
EAT-110A (20)	EAT-111 (68)
EAT-122 (22)	(42)

Re-radiography of these seams was acceptable. Remaining film exhibit no significant indications.

STATUS RDM CROM FILM REVIEW (CONTINUED)

Catawba #1	Thirteen films exhibit densities such that proper weld evaluation cannot be performed. These are identified as; EAW-43 (17) EAW-36A (31) EAW-58 (45) EAW-46 (28) EAW-53 (59) EAW-48 (26) EAW-41 (57) EAW-61 (23) EAW-37 (49) EAW-45 (22) EAW-40 (40) EAW-54 (16) EAW-60 (32) Re-radiography of these seams was acceptable. Remaining film exhibit no significant indications.
Watts Bar #1	All films exhibit no significant indications.
Watts Bar #2	All films exhibit no significant indications.
North Anna #1	Two films exhibit densities such that proper evaluation cannot be performed, identified as EAL-105B (housing 44) and EAL-138B (housing 003). Remaining films exhibit no significant indications.

STATUS ROM CROM FILM REVIEW (CONTINUED)

North Anna #2	Five films exhibit densities such that proper evaluation cannot be performed, identified as; EAM-101 (03) EAM-104 (04) EAM-102 (09) EAM-132 (030) EAM-103 (06) Remaining films exhibit no significant indications.
Surry #2	All films exhibit no significant indications.
Ringhals #2	All films exhibit no significant indications.