Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

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MAR 1 9 1999

10 CFR 50.55a(a)(3)(i)

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of) Docket No. 50-390
Tennessee Valley Authority)

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - REQUEST FOR APPROVAL OF ALTERNATIVE TO AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) CODE REQUIREMENTS - REPAIR OF CANOPY SEAL WELDS

Pursuant to 10 CFR 50.55a(a)(3)(i) TVA is requesting the use of alternatives to the ASME code for repair and examination of one lower canopy seal weld as described in Enclosure 1 of this letter. During the reactor vessel disassembly in the Unit 1 Cycle 2 refueling outage, boric acid residue was noticed on a control rod drive mechanism (CRDM) and further review was conducted. That review determined that the lower canopy seal weld on one CRDM (Coordinate G5 in Attachment 3 of Enclosure 1) had indications of minor leakage (boric acid residue).

The repair of the canopy seal weld under the rules of ASME Section XI, Article IWA-4000, "Repair Procedures," would require the defect to be removed and restored to its original design condition. Repair options have been evaluated and a weld buildup rather than removing the defect and performing a weld repair was evaluated as the most appropriate repair. Weld buildup is considered by TVA to be an acceptable repair technique because the material used for the repair is stronger than the underlying base metal, is more resistant to degradation, and is highly ductile; thus, the load carrying capability of the repaired location is greater than the original component.

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WBN's CRDM penetrations are considered part of the reactor vessel and are thus classified as Code Class 1. Paragraph NB-5271, "Welds of Specially Designed Seals," of ASME Section III, requires seal welds to receive either a magnetic particle or liquid penetrant examination. TVA has evaluated performance of these examinations and has determined that either examination would be impractical. The affected canopy seal welds are located in a high radiation area (750-800 millirem/hour on contact and 100-150 millirem/hour general area) and access to the welds is difficult due to the limited clearance between the adjacent CRDMs. Therefore, TVA plans to use an alternative examination technique. The alternative examination involves using a remote video camera with a magnification of approximately 8X to perform a visual examination of the final weld at the enhanced magnification. In addition, TVA's contractor for repairing the weld is providing a fracture mechanics analysis which is expected to demonstrate full structural integrity of the weld for the life of the plant. Because data from the actual weld is needed for the analysis, it can not be finalized until the repair has been completed. This analysis will be submitted to the NRC upon receipt by TVA.

TVA's proposed alternative canopy seal weld repair and inspection methods have been implemented at Watts Bar Nuclear Plant as approved by NRC in a letter dated February 12, 1998. Similar weld overlay repairs have also been used at TVA's Sequoyah Nuclear Plant and other nuclear facilities.

TVA has evaluated the operability of the CRDM canopy seal welds following the weld repair utilizing the guidance provided in Generic Letter 91-18, Revision 1, "Information to Licensees Regarding NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions." TVA has determined that the CRDM housing will be fully operable following the repair and examination of the weld. Although TVA does not consider this to be a startup concern for Cycle 3, TVA is requesting NRC's prompt review and approval of the Request For Relief in Enclosure 1 in order to restore the canopy seal welds to full qualification in accordance with the TVA Corrective Action Program.

Enclosure 2 provides the commitment list. If you should have any questions, please contact P. L. Pace at (423) 365-1824.

Sincerely,

R. T. Purcell

R. T. Purcell

Enclosure
cc: See page 3

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cc (Enclosure):
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ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNIT 1
REPAIR AND REPLACEMENT REQUEST FOR RELIEF, 1-RR-2

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNIT 1
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Summary: During the Watts Bar Nuclear Plant Unit 1 Cycle 2 refueling outage activity of disassembling the reactor vessel, boric acid residue was noticed on the control rod drive mechanisms (CRDMs) (See Attachments 1 and 2). Further inspection shows that one CRDM has started leaking at the lower canopy seal weld (See Coordinates on Attachment 3). The ASME Code requires the defects be removed and the configuration of the material be reproduced in order to restore the canopy seal to its original design condition. Due to the physical space limitations and in consideration of radiation exposure, Watts Bar proposes as an alternative to perform a weld buildup over the leaking canopy seal weld (See proposed design in Attachment 4) rather than removing the defect and performing a weld repair. Also, an enhanced visual examination is proposed as an alternative to the liquid penetrant examination required by the original construction code for the final weld buildup.

TVA's proposed alternative seal weld repair and examination methods have been previously implemented at Watts Bar, TVA's Sequoyah Nuclear Plant Unit 1, and other utilities and provides an acceptable level of quality and safety. TVA requests authorization to use these alternatives in accordance with 10CFR50.55a(a)(3)(i).

Unit: 1

System: Reactor Coolant - System 68

Component: Control Rod Drive Mechanism

Code Class: 1

Function: Vertically position a control rod in the nuclear core by raising or lowering an interconnecting drive shaft.

Code Requirement: ASME Section XI, 1989 Edition, IWA-4110(a), "This Article provides rules and requirements for repair of pressure retaining components and their supports, including appurtenances, subassemblies, parts of a component, and core support structures, by welding, brazing, or metal removal."

Code Requirements From Which Relief is Requested: For repair of the defect, relief is requested from the following ASME Section XI, 1989 Edition, IWA-4000, Repair Procedure requirements:

a. Paragraph IWA-4120(a), "Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later Editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used. If repair welding cannot be performed in accordance with these requirements, the applicable alternative requirements of IWA-4500 and the following may be used: (1) IWB-4000 for Class 1 components."

b. Paragraph IWA-4130(a)(2), "Repair operations shall be performed in accordance with a program delineating essential requirements of the complete repair cycle including ...(2)... below: (2) the flaw removal method, method of measurement of the cavity created by removing the flaw, and dimensional requirements for reference points during and after the repair;"

c. Subarticle IWA-4300, "Defect Removal," in its entirety.

For examination, relief is requested from the following ASME Section III, 1971 Edition, through Winter 1971 Addenda, Paragraph NB-5200, "Examination of Weld" requirements:

d. Paragraph NB-5271, "Welds of this type (welds of specially designed seals, i.e., canopy seal welds) shall be examined by either the magnetic particle or liquid penetrant method."

Basis for Relief:

During the Unit 1 Cycle 2 Refueling Outage (U1C2 RFO) activity of disassembling the reactor vessel, boric acid residue was noticed on a control rod drive mechanism (CRDM). Further inspection shows that one CRDM has started leaking at the lower canopy seal weld. See Attachments 1, 2 and 3 for configuration and location of the CRDM and canopy seal weld.

The CRDMs are part of the nuclear steam supply system procured from Westinghouse Electric Corporation under Contract 54114. The CRDM housings, as part of the reactor vessel, are within the reactor coolant system as defined by the Final Safety Analysis Report (FSAR). The 1971 Edition, Addenda through Winter 1972 of ASME Section III establish the design specification and the construction code for the CRDMs. The 1971 Edition, Addenda through Winter 1971 of ASME Section III establish the design specification and the construction code for the reactor vessel.

The CRDMs are fabricated in sections with threaded joints providing the pressure-retaining capabilities. Since the

threaded joint provides pressure retention, the canopy seal weld is not pressure retaining and is for leakage control. The 1971 Edition, Addenda through Winter 1972 of ASME Section III does not allow threaded joints as the only seal as described in Paragraph NB-3671.3. Paragraphs NB-3227.7 and NB-4360 address the design of canopy seal welds and qualification requirements for welding specially designed welded seals, respectively. Paragraph NB-5271 requires that seal welds receive either a magnetic particle or liquid penetrant examination.

Due to physical space limitations and in consideration of the need to keep worker dose as low as reasonably achievable (750 - 800 millirem per hour on contact and 100 - 150 millirem per hour general area), removal and repair of the defect is not the most favorable method of repair. In addition, if the defect was removed, it would be impossible to reproduce the configuration of the canopy seal to its original design condition as required by IWA-4000.

Alternative Repair Requirements: WBN will apply the following alternative weld overlay repair requirements:

a. A weld overlay repair designed under the requirements of ASME Section XI, 1989 Edition, Paragraph IWB-3640, "Evaluation Procedures and Acceptance Criteria for Austenitic Piping," and Appendix C, "Evaluation of Flaws in Austenitic Piping," will be used as an alternative repair method. Guidance will also be taken from ASME Section XI Code Case N-504, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," and NUREG-0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping, Final Report," Revision 2.

WBN will apply the following alternative examination requirements:

b. An enhanced visual examination using a remote video camera with a magnification of approximately 8X will be used to monitor the repair and to perform a visual examination of the final weld at the enhanced magnification.

Justification For The Granting Of Relief: TVA's Code of Record for Repairs and Replacements is ASME Section XI, 1989 Edition. IWB-3640 and Appendix C of the 1989 Edition of ASME Section XI will be used to perform

the required fracture mechanics and to design a weld overlay repair of the flawed canopy seal weld. Portions of Code Case N-504 are also used for guidance. Code Case N-504 allows repair by addition of weld material without removal of the underlying defect to be considered as a code repair. Code Case N-504 is endorsed by the NRC in Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI Division," Revision 11.

IWB-3640 provides criteria for acceptance of flaws without repair in ductile, austenitic materials. The basis for such acceptance is the evaluation of the structural adequacy of the flawed component after considering the predicted flaw growth over the evaluation period. The acceptance criteria is based upon the net section collapse (limit load) criteria which are defined in detail in Appendix C of Section XI. Also, NUREG-0313, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping, Final Report," Revision 2, is used for guidance. The use of NUREG-0313 will result in the repair design of the canopy seal weld to be based upon conservative treatment of applied stresses, and includes allowance for continued flaw growth, as required by Section XI.

The material used for the repair is Inconel 625 weld material which has a tensile strength of approximately 110 kips per square inch (ksi). The Inconel weld material is stronger than the underlying base material (304 stainless steel) with a tensile strength of 75 ksi, more resistant to degradation mechanisms such as stress corrosion cracking, and is highly ductile. The load carrying capability of the repaired location will be greater than the original component.

Liquid penetrant examinations that are required by NB-5271 will not be performed because of space limitations, which prevent examiners the needed access to successfully perform the examination and in consideration of maintaining worker dose as low as reasonably achievable. As an alternative, TVA will use a remote video camera with a magnification of approximately 8X and perform a visual examination of the final weld at the enhanced magnification. The entire process of the repair will be recorded on video tape. The basis for this approach is that post-weld liquid penetrant examinations are surface examinations, and provides minimal assurance of repair integrity when compared to an enhanced visual examination. Additionally, fracture mechanics analyses have been performed for other plants which demonstrates that the critical flaw size (i.e., the flaw size, which would lead to the incipient collapse of the repair under code allowable applied stress conditions) is significantly

larger than a flaw that would be reliably detected by the enhanced visual examination.

The fracture mechanics analysis assumes that an initial defect is completely through the repair membrane. Thus, there is large margin of safety in the analysis. TVA considers the fracture mechanics analysis, coupled with the enhanced visual examination, suitable to provide an acceptable alternative to the code required liquid penetrant examination.

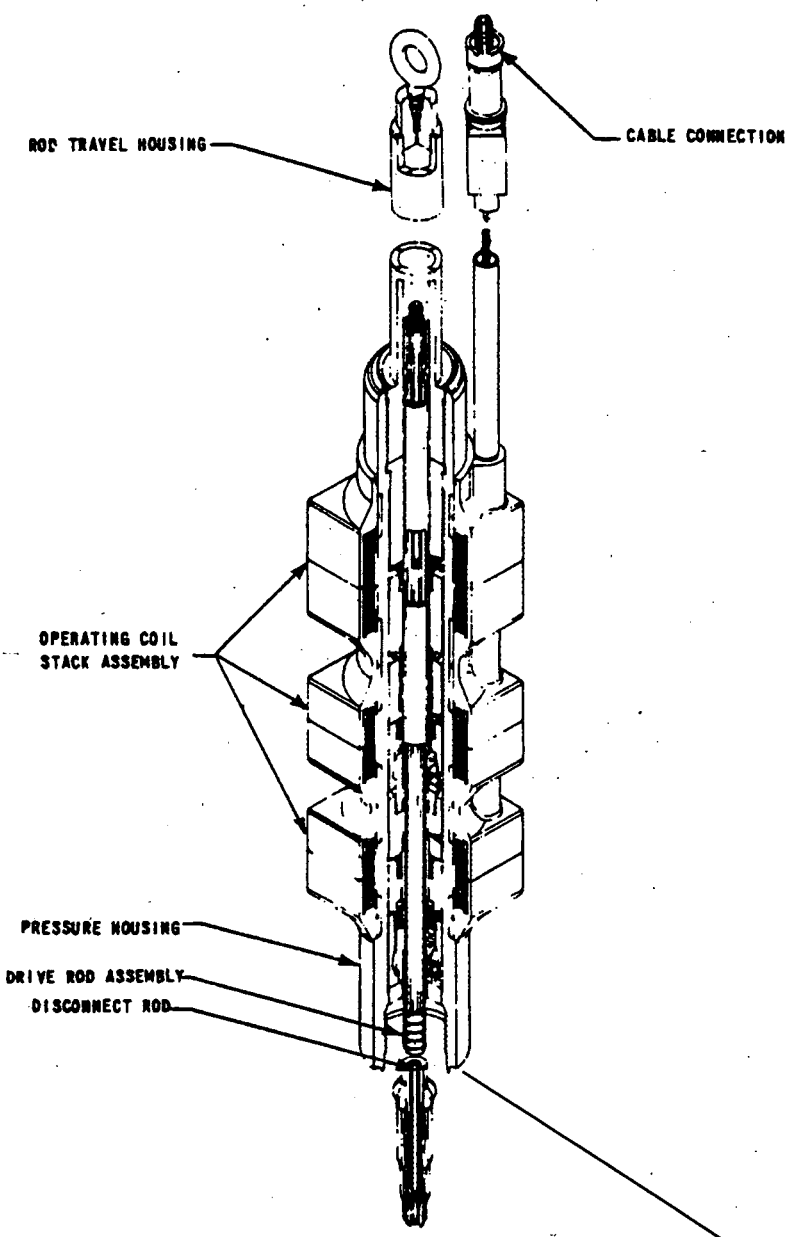
TVA has performed a demonstration examination for the Authorized Nuclear Inspector using the remote video equipment at Sequoyah Nuclear Plant's (SQN) Unit 1. That demonstration was performed prior to its use for examination of repair of canopy seal welds at SQN and the results documented in a letter to the NRC dated April 3, 1996. The demonstration was performed using a machinist scale to determine if a 1/32 of an inch graduation could be distinguished and was found acceptable.

The proposed alternative weld overlay repair and visual examination requirements will be implemented in a work order using the repair and replacement program requirements in Standard Programs and Processes (SSP)-9.1, Part D, "Repairs/Replacements of ASME Section XI Components." This repair and replacement program includes requirements for delineating the weld procedure and post weld heat treatment and nondestructive examination to be used after the repair per Paragraph IWA-4130(a)(3); "Inspection" per Subarticle IWA-4140; "Material" per Subarticle IWA-4200; "Welding and Welder Qualifications" per Subarticle IWA-4400; and "Records" per Subarticle IWA-4800. The design of the weld overlay repair and the safety evaluation per 10 CFR 50.59, is documented in a Design Change Notice (DCN) in accordance with SPP-9.3, "Plant Modifications and Design Change Control." The nondestructive examination method which revealed the flaw and the description of the flaw, and a suitability evaluation of the repair meeting the requirements of Paragraphs IWA-4130(a)(1) and (4) is considered within the DCN.

Conclusion: Based on the above discussion, the alternative weld overlay repair and visual examination provide an acceptable level of quality and safety. Authorization to implement the proposed alternatives is requested in accordance with 10CFR50.55a(a)(3)(i).

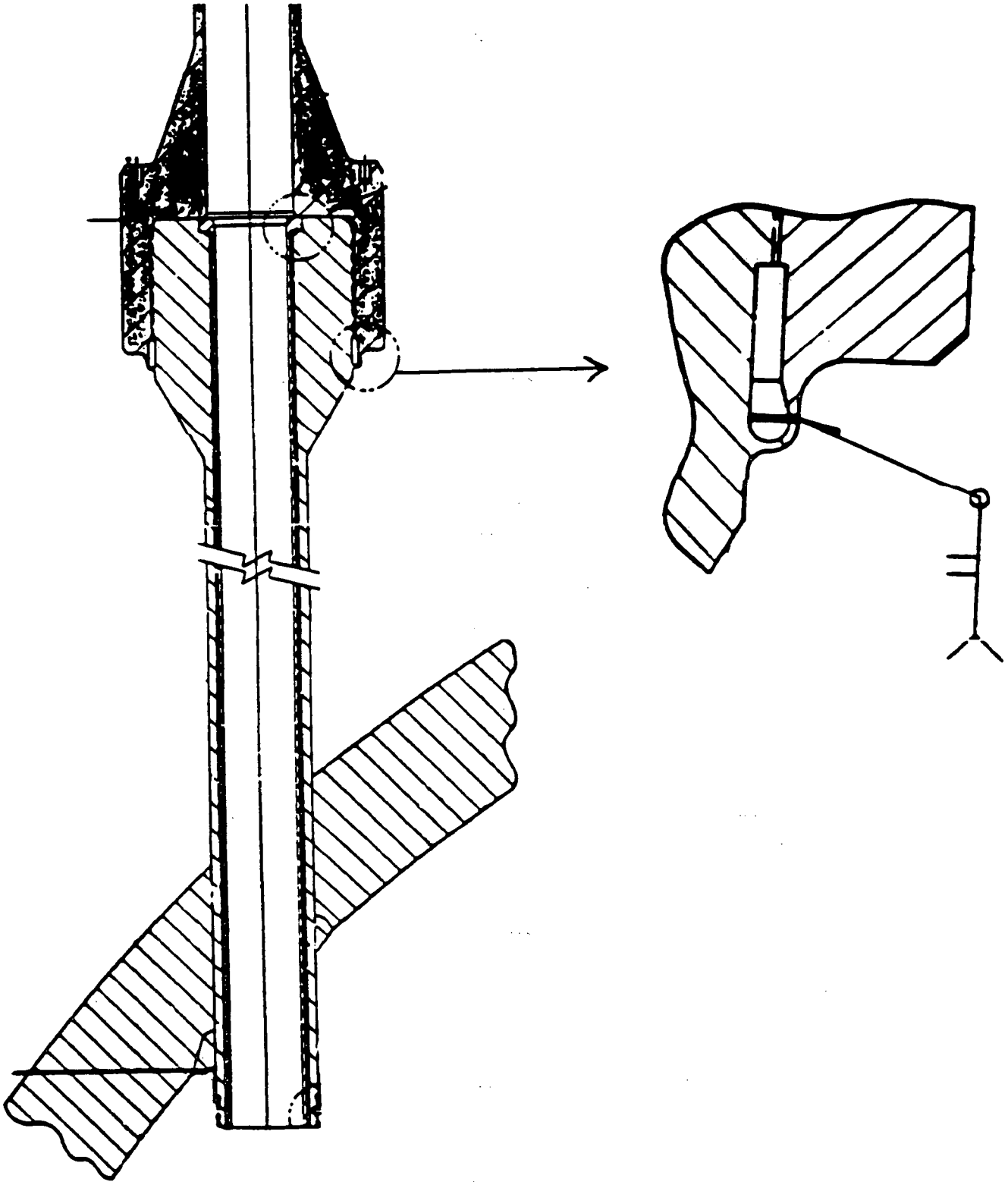
ENCLOSURE 1
ATTACHMENT 1

FULL LENGTH CONTROL ROD DRIVE MECHANISM



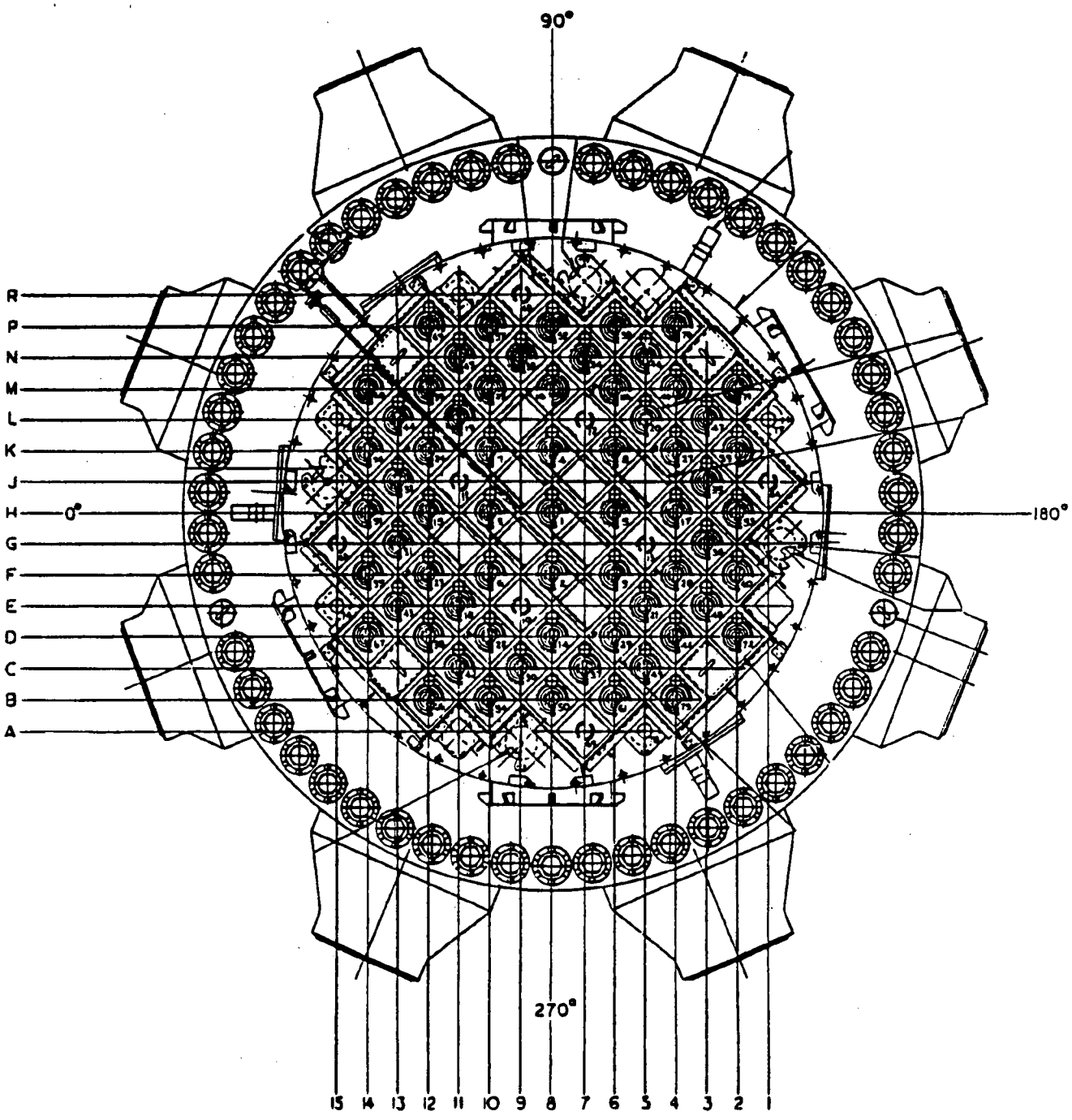
ENCLOSURE 1
ATTACHMENT 2

TYPICAL LOWER CANOPY SEAL WELD DETAIL



ENCLOSURE 1
ATTACHMENT 3

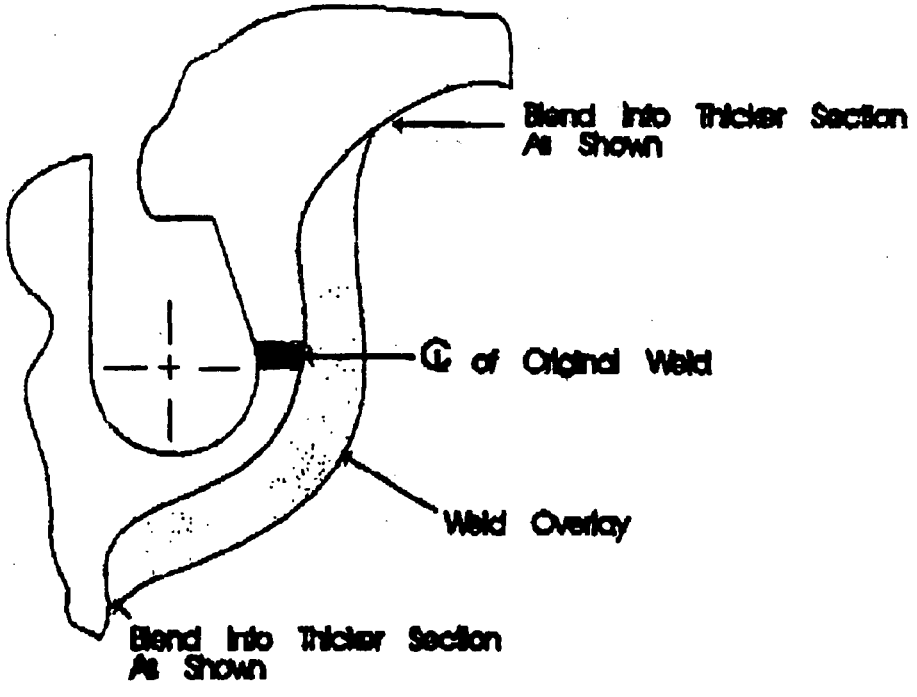
LOCATION OF CRDMs TO BE REPAIRED



CRDMs with Lower Canopy Seal Weld Overlay Repairs	
CRDM #	Location
13	G5

ENCLOSURE 1
ATTACHMENT 3

LOCATION OF CRDMs TO BE REPAIRED



ENCLOSURE 2

WATTS BAR NUCLEAR PLANT UNIT 1
REPAIR AND REPLACEMENT REQUEST FOR RELIEF, 1-RR-2
COMMITMENT LIST

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TVA will provide the fracture mechanics analysis to NRC upon receipt from the vendor.