Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37379

March 6, 2000

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

Gentlemen:

In the Matter of) Docket No. 50-327
Tennessee Valley Authority)

SEQUOYAH NUCLEAR PLANT (SQN) - REQUEST FOR APPROVAL OF ALTERNATIVE TO AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) CODE REQUIREMENTS - REPAIR OF CANOPY SEAL WELD J-1 - UNIT 1

Pursuant to 10 CFR.50.55a(a)(3)(i), TVA is requesting the use of alternatives to the ASME code for repair of a lower canopy seal weld. While in the Unit 1 Cycle 10 refueling outage, boric acid residue was noticed on a control rod drive mechanism (CRDM) during reactor vessel disassembly. A closer inspection indicated that one CRDM (J-1) had signs of minor leakage (boric acid residue) at the lower canopy seal weld.

Repair options have been evaluated and it was determined that the most appropriate repair was the use of weld buildup rather than removing the defect and performing a weld repair. Weld buildup is considered by TVA to be an acceptable repair technique because the canopy seal weld does not provide structural integrity or act as a pressure retaining boundary for the threaded joint. Even though the subject welds do not provide structural strength or serve as a pressure boundary for the threaded joint, the weld buildup over the canopy seal is considered a repair under the rules of ASME Section XI, IWA-4000, because welding is performed on pressure retaining components.

SQN's CRDMs and thermocouple penetrations are Class A vessels as defined by ASME Section III, 1968 Edition. N-518.4 of the 1968 Edition of the ASME Section III code and NB-5271 of later editions of the Section III code require seal welds to receive either a magnetic particle or liquid penetrant examination. TVA has evaluated performance of these

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examinations and has determined that either examination would be impractical. The affected canopy seal welds are located in a high radiation area (approximately 2 rem/hour on contact and 700 millirem/hour general area) and access to the welds is difficult due to the limited clearance between the adjacent CRDMs.

Accordingly, TVA has used an alternative examination technique. The alternative examination involved 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, fracture mechanic analyses demonstrates that critical flaw size would be sufficiently large for detection using the enhanced visual examination.

This relief request is consistent with the relief request submitted during SQN Unit 1 Cycle 7 refueling outage on October 11, 1995, as approved by NRC on April 24, 1996. Similarly, Watts Bar Nuclear Plant submitted relief request for repair of canopy seals on September 20, 1997 and March 19, 1999, as approved by NRC on February 12, 1998, and August 25, 1999. Harris and Prairie Island Nuclear Plants have also pursued similar relief requests.

Structural Integrity Associates, Inc. (SIA) has previously performed the fracture mechanics analysis to support the alternative weld repairs docketed in our October 11, 1995 submittal. This analysis was subsequently submitted to NRC on December 19, 1995 (reference TAC No. M93835). SQN has contacted SIA about the J-1 seal weld repair. SIA has documented that their original analysis and design is applicable to location J-1 and other periphery vessel head penetrations.

If you have any questions about this change, please telephone me at (423) 843-7170 or J. D. Smith at (423) 843-6672.

Sincerely,

Pedro Salas
Licensing and Industry Affairs Manager

Enclosure
cc: See page 3

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ENCLOSURE
SEQUOYAH NUCLEAR PLANT - UNIT 1
REPAIR AND REPLACEMENT REQUEST FOR RELIEF

Summary: During the Sequoyah Nuclear Plant Unit 1 Cycle 10 refueling outage (U1C10 RO) activity of inspecting the reactor vessel head, boric acid residue was noticed on the control rod drive mechanism (CRDM) at the J-1 location (see Attachments 1, 2, and 3). The J-1 location is a dummy can and does not house an active CRDM. The American Society of Mechanical Engineers (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. Because of the physical space limitations, and in consideration of radiation exposure, Sequoyah 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 Sequoyah, Watts Bar 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: CRDM

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, 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 U1C10 RFO activity of inspecting the reactor vessel head, boric acid residue was noticed on a CRDM at the J-1 location 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 Company under Contract 91934. Westinghouse Engineering

Specification 678890 is certified to Paragraph N-141 of the ASME Boiler and Pressure Vessel Code, Section III. Paragraph 2.3.3(b) of this document references ASME Boiler and Pressure Vessel Code, Section III, "Nuclear Vessels," and Addenda. This is the 1968 Edition of ASME Section III and its Addenda. This establishes the Design Specification and the Construction Code for the CRDM's. The CRDMs are Class A vessels as defined by ASME Section III, 1968 Edition.

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 1968 Edition of ASME Section III does not specifically address (either allowing or disallowing) these types of joints. Later editions of ASME Section III do address threaded joints and do not allow them 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 (approximately 2 Rem per hour on contact and approximately 700 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: SQN 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-504-1, "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.

SQN 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-504-1 are also used for guidance. Code Case N-504-1 allows repair by addition of weld material without removal of the underlying defect to be considered as a code repair. Code Case N-504-1 is endorsed by the NRC in Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI Division," Revision 12.

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 basis for this approach is that postweld 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 a 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.

SQN has performed a demonstration examination for the Authorized Nuclear Inspector (ANI) using the remote video equipment. That demonstration was performed prior to its use for examination of repair of canopy seal welds at SQN and the results were 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 same type of video equipment will be used in conjunction with this repair as was used in the repair during the U1C7 RFO. Since the same type of equipment will be used for the U1C10 RFO repair, this addresses the request for additional information by the NRC for the relief request for the U1C7 RFO.

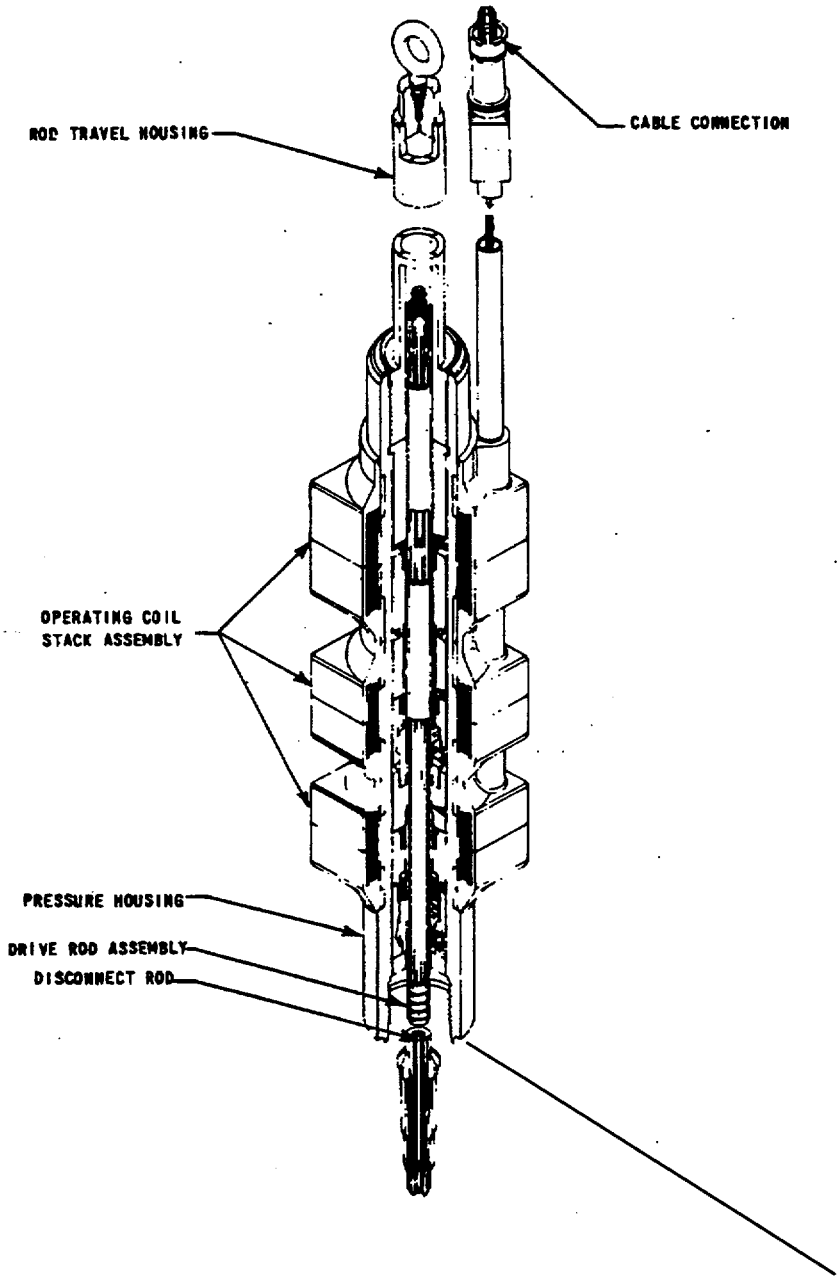
The proposed alternative weld overlay repair and visual examination requirements will be implemented in a work order using the repair and replacement program requirements in Standard Programs and Processes (SSP)-9.1, Part D, "Repairs/Replacements of ASME Section XI Components." This repair and replacement program includes requirements for delineating the weld procedure and postweld heat treatment and nondestructive examination (NDE) 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."

SQN submitted a similar request for relief during the U1C7 RFO which was approved by the NRC. Structural Integrity Associated (SIA) performed the design and analysis in support of that repair. SQN has contacted SIA about the J-1 canopy seal weld repair. SIA has documented that their original analysis and design is still valid and acceptable for this repair, as well as the balance of the periphery reactor vessel head penetrations. This validation is applicable to the additional information requested by the NRC in support of the 1996 relief request.

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).

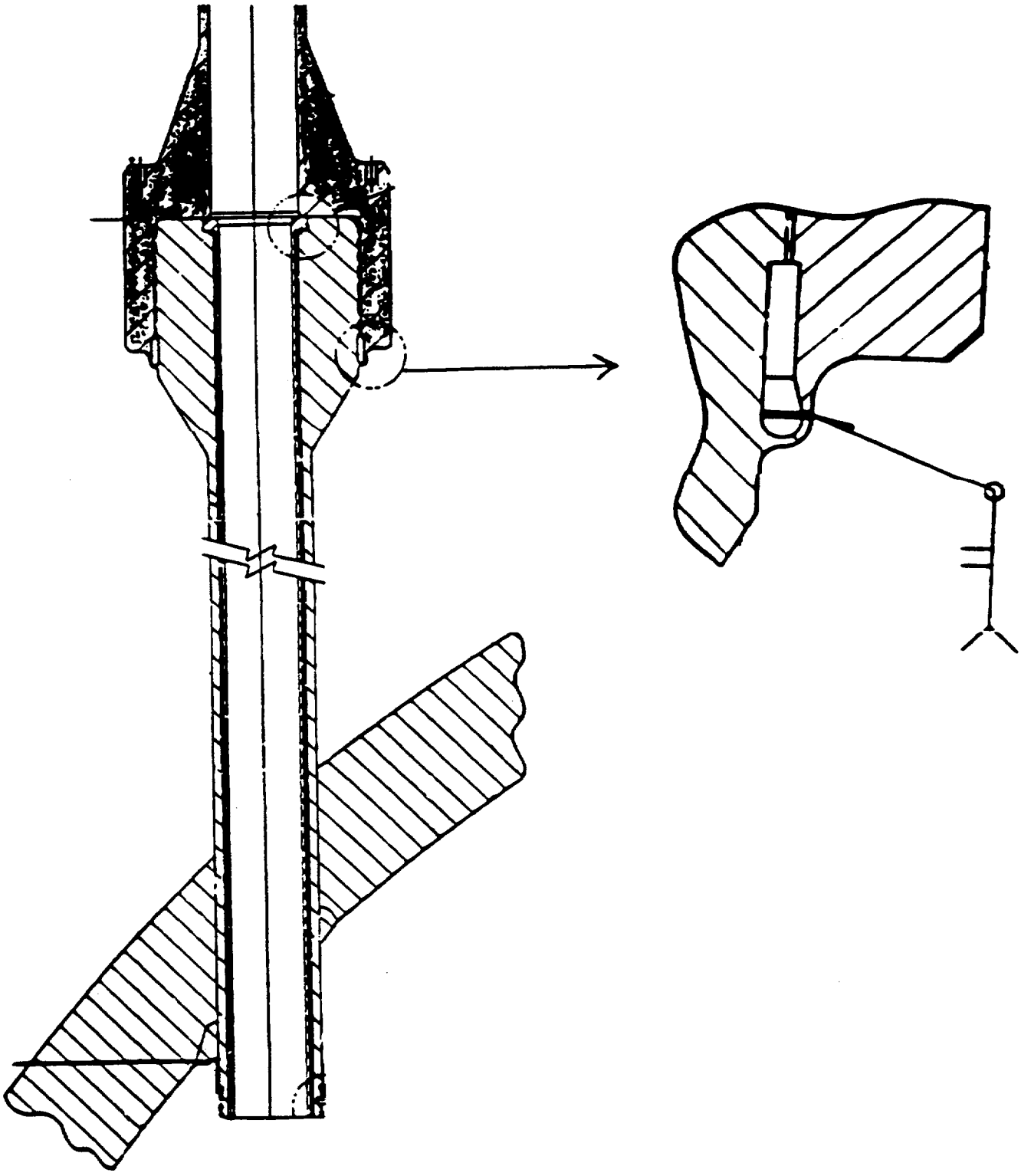
ENCLOSURE 1
ATTACHMENT 1

FULL LENGTH CONTROL ROD DRIVE MECHANISM



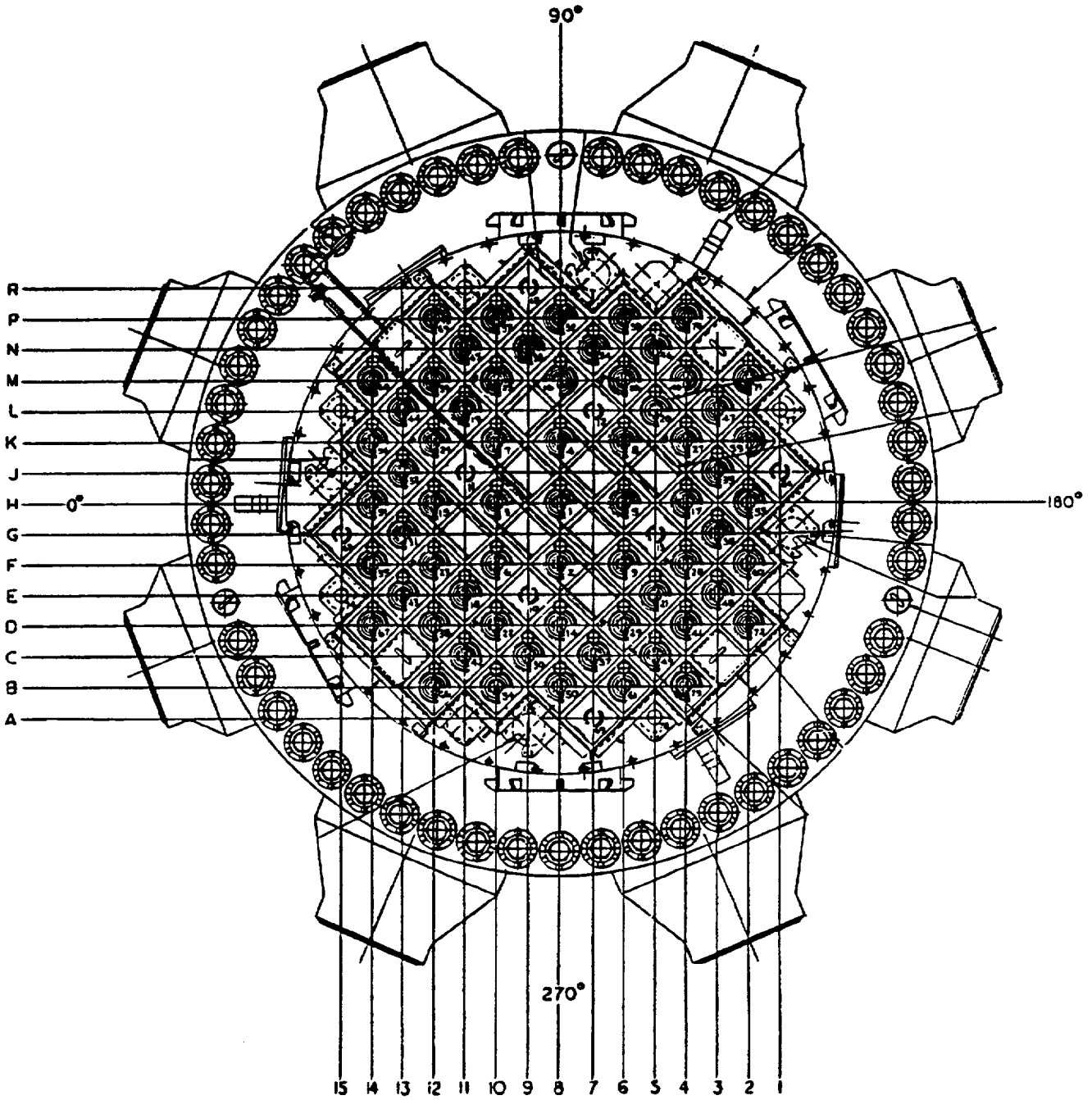
ENCLOSURE 1
ATTACHMENT 2

TYPICAL LOWER CANOPY SEAL WELD DETAIL



ENCLOSURE 1
ATTACHMENT 3

LOCATION OF CRDM TO BE REPAIRED



CRDM with Lower Canopy Seal Weld Overlay Repair
Location
J-1

ENCLOSURE 1
ATTACHMENT 4

LOCATION OF CRDM TO BE REPAIRED