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MEMORANDUM FOR: G. L. Madsen, Chief, Reactor Projects Branch, Division of Resident, Reactor Project and Vendor Inspection, RIV

FROM: R. L. Baer, Chief, Reactor Engineering Branch, Division of Resident and Regional Reactor Inspection, IE

SUBJECT: ARKANSAS NUCLEAR ONE-UNIT NO. 2, DOCKET NO. 50-368

Enclosed is Mr. Collins report on his special inspection made in regard to the linear indications discovered on the A and B reactor coolant pump safe end welds and snubber lug on steam generator No. 2 during the inservice inspection recently concluded at the subject facility.

The results of the inspection confirmed that the weld indications were innocous surface conditions engendered by the welding process and sufface preparations by the NSSS rather than crack indications, as reported by the licensee. Since the cause of the indications was established and restoration of the affected welds to acceptable code conditions was satisfactorily demonstrated during the inspection, we believe the problem can be considered resolved.

Robert L. Baer, Chief
Reactor Engineering Branch
Division of Resident and
Regional Reactor Inspection, IE

Enclosure: As stated

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

Report No. 50-368/81-17

Docket No. 50-368 License No. FRP-6

Licensee: Arkansas Power and Light Company
Ninth & Louisana Streets
Little Rock, Arkansas 72203

Facility Name: Arkansas Nuclear One - Unit 2

Inspection At: Plant Site

Inspection Conducted: Special Announced, May 14-16, 1981

Inspector: William Collins
W. J. Collins, Sr. Metallurgical Engr. 7-9-81
Date

Approved By: Cecil J. Baer
R. L. Baer, Chief
Reactor Engineering Branch, RRRI, IE 7/16/81
Date

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Background

On May 5, 1981 AP&L reported to the NRC that during the current ISI in progress, liquid penetrant testing (LPT) disclosed unacceptable crack indications on the O.D. surface of welds joining the "A" reactor coolant pump safe ends (both suction and discharge sides) to the primary piping. AP&L also reported that grinding procedures were initiated to determine cracking characteristics and effect removal. The weldments involved are shown in Figure 1.

On May 12, 1981 a telephone conference was held between cognizant AP&L plant personnel, the authorized nuclear code inspector, and the NRC staff to review available information concerning the cracking and AP&L's determination of the cause(s) and corrective actions. AP&L described the indications noting they were located in a number of areas randomly positioned around the weld circumference. Within these areas the indications occurred in groups having various lengths and orientation on the inconel weld surfaces as well as along the fusion zone between the weld and cast stainless steel safe ends. No indications were observed between the weld-to-carbon steel piping boundaries. All indications were removed by grinding and the maximum depth (0.276") of grinding to the effect removal did not violate the design minimum wall thickness. However, since no further evaluation was performed any explanation as to relevant causes of the crack indications could not be provided. Consequently, the staff required AP&L undertake the following course of action:

1. Perform chemical analysis (surface wipe samples) of the mirror insulation for potential contaminants that might have contributed to the problem.

2. Perform LPT of the "B" pump safe end welds to assess the generic implications of the indications.

3. Conduct a metallurgical evaluation of the "B" pump weldments if any crack indications are found.

4. Develop a LPT map and photographic record of crack indications if found on the "B" pump weldments.

5. Obtain the acceptance fabrication radiographs on all four reactor coolant pump welds from the NSSS for review.

6. If the "B" pump weld inspection reveals relevant indications, conduct LPT evaluation of welds on the two remaining pumps.

Following the above discussion AP&L further informed the staff that a LPT examination had also disclosed crack indications in an upper-side weld of a snubber lug forming an intergrally welded support to steam generator No. 2,

as shown in Figure 2. These indications were intermittently disposed linearly, ranging from 1/6" to 3/16" in length, along the edge of the weld to the vessel. At this time AP&L indicated a relief request would be submitted to change from a portion of the presently applicable ASME Section XI ISI Code (1974 Edition and Summer 1975 Addenda) to the later approved 1977 Edition and Addenda of the Code. Specifically, to permit use of the more definitive ISI acceptance criteria of the latter, as it relates to intergrally welded supports in evaluation of the snubber lug indications. On May 13, 1981 AP&L submitted their formal request for relief on this matter for staff consideration.

In view of the uncertainties as to the nature (causes) of the crack indications and their potential generic safety implications, a special inspection was made at the plant site to examine the affected welds, the NDE procedures and results, and follow-up on the above course of action to resolve the problem.

Persons Contacted

*J. H. O'Hanlan, Plant Superintendent, AP&L
R. Terwilliger, Superintendent, Plant Operations and Analysis, AP&L
S. Petzel, Supervisor, Production Engineering, AP&L (ISI Program Coordinator)
D. Payne, Authorized Nuclear Code Inspector, Factory Mutual Insurance Company
W. Johnson, NRC Senior Resident Inspector, RIV
L. Callan, NRC Resident Inspector, RIV

*Part time (exist interview only)

Inspection Summary

1. An inspection of the A and B pump weldments and chemical analysis (wipe samples) revealed no evidence of surface contamination to suggest corrosion played a role in causing the indications observed.

2. Optical aided visual examinations (VT) and PT of the "B" pump safe end welds revealed linear surface indications similar to those previously reported on the "A" pump welds.

3. Investigation by a combination of modified grinding procedures, VT and PT examination showed the safe end weld indications to be innocuous, nonrelevant surface conditions resulting from the fabrication process-not crack indications as initially reported.

4. The fabrication radiographs of safe-end welds on all four reactor coolant pumps were reviewed during the inspection. The radiographs provided unambiguous correlation that the indications were generic nonrelevant fabrication anomalies and that weld quality standards of ASME Code Section III were clearly satisfied by the NSSS.

5. The repair and nondestructive examinations of the "B" pump weldments and similar ground out areas on the "A" pump welds were witnessed during the inspection. A photographic record was made of the "B" pump weld indications by AP&L. All indications were effectively removed by controlled light grinding and final LPT of welds on both pumps was acceptable. A volumetric examination (UT) was performed on the "A" pump welds in accordance with plant ISI program requirements and procedures. The UT showed no reportable reflectors as expected.

6. An investigation of the snubber lug welds also showed the reported "crack indications" were of similar characteristics as the pump welds; engendered by the welding process during installation on the vessel. These were removed by blend grinding and PT cleared.

7. Based on the above, it was concluded that any further required course of action by AP&L was not warranted and the relief request may be withdrawn without further consideration by the staff.

Details, Observations and Findings

Following a radiological safety orientation required by AP&L the inspector entered ANO-Unit 2 with Messrs. Payne and Petzel to conduct a visual assessment of both "A" and "B" pump welds and the snubber lug on steam generator No. 2.

The pumps, welds and accessible piping were observed to have a very uniform oxidized surface characteristics of the materials expected behavior from temperature conditions during normal plant service. No evidence of surface deposits indicative of system leakage, or surface degradation from adverse environmental conditions was observed. A chemical analysis was performed on several wipe samples removed from the mirror insulation normally installed over the welds of concern. The results of this analysis showed the usual removal isotopic contamination and very low levels (<8 ug/ft^2) of Halogen/Sulfide concentrations which were considered insignificant as a potential source for corrosive attack of the inherently corrosion resistant materials involved. Accordingly, it was concluded that corrosion mechanisms due to synergistic environmental effects were not the common cause of the indications observed.

In addition to the above, the safe end welds on the "B" pump were examined by LPT methods. The LPT revealed several areas of linear indications having various lengths and orientation on the inconel weld external surface. Also, the weld-to-safe end fusion boundary exhibited linear disposed indications intermittently around the weld circumference. It was the inspectors concensus during the PT examination that penetrant characteristics did not reflect typical cracking conditions. Moreover, although the indications patterns were not extensive, they were indeed quite similar to the surface

discontinuities previously detected, and subsequently removed, on the "A" pump welds. After further surface cleaning and conditioning by controlled light grinding the indications were visually re-examined with the aid of an optical light microscope. It was determined that the weld surface indications were sharp grinding scratches not entirely removed during surface preparations by the fabricator. Also, the weld fusion zone indications were found to be code acceptable weld undercut conditions (<1/32" depth) which were partially masked by disturbed surface metal, apparently as a result of grinding to achieve good weld-to-piping transitions during fabrication.

Upon completion of the above investigation, a close visual examination (optically aided) of the reported snubber lug crack indications was made by the inspector. It was determined these indications were in fact due to (1) Partial weld bead foldover in making the final weld pass at the vessel shell and (2) shallow fusion craters in weld bead start and stop points, that were not entirely removed following welding of the lug to vessel shell.

Concurrent with the above investigation, the fabrication radiographs of all four reactor coolant pump safe end welds were reviewed by the inspector. This included the fabricator's acceptance radiographs of the inconel "Buttering" welds on the carbon steel pipe ends as well as the completed inconel to safe end weldment. The radiographs provided good correspondence with the visual evidence that the indications were innocuous, nonrelevant fabrication anomalies, as described above, and were present on the safe end welds of all four reactor coolant pumps. The radiography also demonstrated that the NSSS had exceeded the weld quality acceptance standards of ASME Code Section III in weldment fabrications.

Following the above field investigations, an interim meeting was held with Messrs. Terwilliger et al, Johnson and Callan to discuss the inspector's observations and appropriate corrective measures to resolve the problem areas. The inspector indicated his examination suggested that the ISI-NDE examiners misinterpreted the initial LPT results and had apparently neglected to pursue further surface conditioning to determine the actual relevancy of the indications as prescribed by the approved LPT procedures (No. 4678-ESS-093). The inspector also noted that the coarse grinding wheels being employed in removing the "A" pump weld indications appeared to be a self-defeating approach in that such severe power grinding methods in and of itself promoted numerous spurious indications, sensitive to LPT, which may account for the excessive grindouts necessary to effect removal of the existing surface conditions. The inspector proposed, and Mr. Terwilliger agreed, that the grinding methods be modified to incorporate emergy cloth-type wheels and controlled directional light grinding techniques be exercised in removing the "B" pump weld indications. The inspector also stated that the radiography demonstrated the indications of interest were common to all four RCP safe

end welds and that the necessary ISI documentation of these repairs should also reflect the "baseline" conditions of the "C" and "D" RCP safe end welds to obviate concerns arising in future ISI intervals for these dissimilar metal welds.

Corrective Actions

All linear indications on the "A" and "B" RCP safe end welds and snubber lug were effectively removed by the modified grinding techniques. The exis[illegible] cavities on the "A" pump welds were blended to surrounding surfaces to elim[illegible] stress concentration effects. The depth of grinding for removal of indicat[illegible]ns was minimal (cosmetic) and did not violate the design minimum wall thickness. The entire welds were PT examined following repairs and found acceptable. A photographic record was made of the "B" pump welds and snubber lug conditions and of the repairs as required.

In addition to the above, a manual volumetric examination (UT) from the outside diameter was performed on the "A" RCP welds in accordance with plant ISI requirements and approved procedures. The UT evaluation resulted in no reportable reflectors as expected.

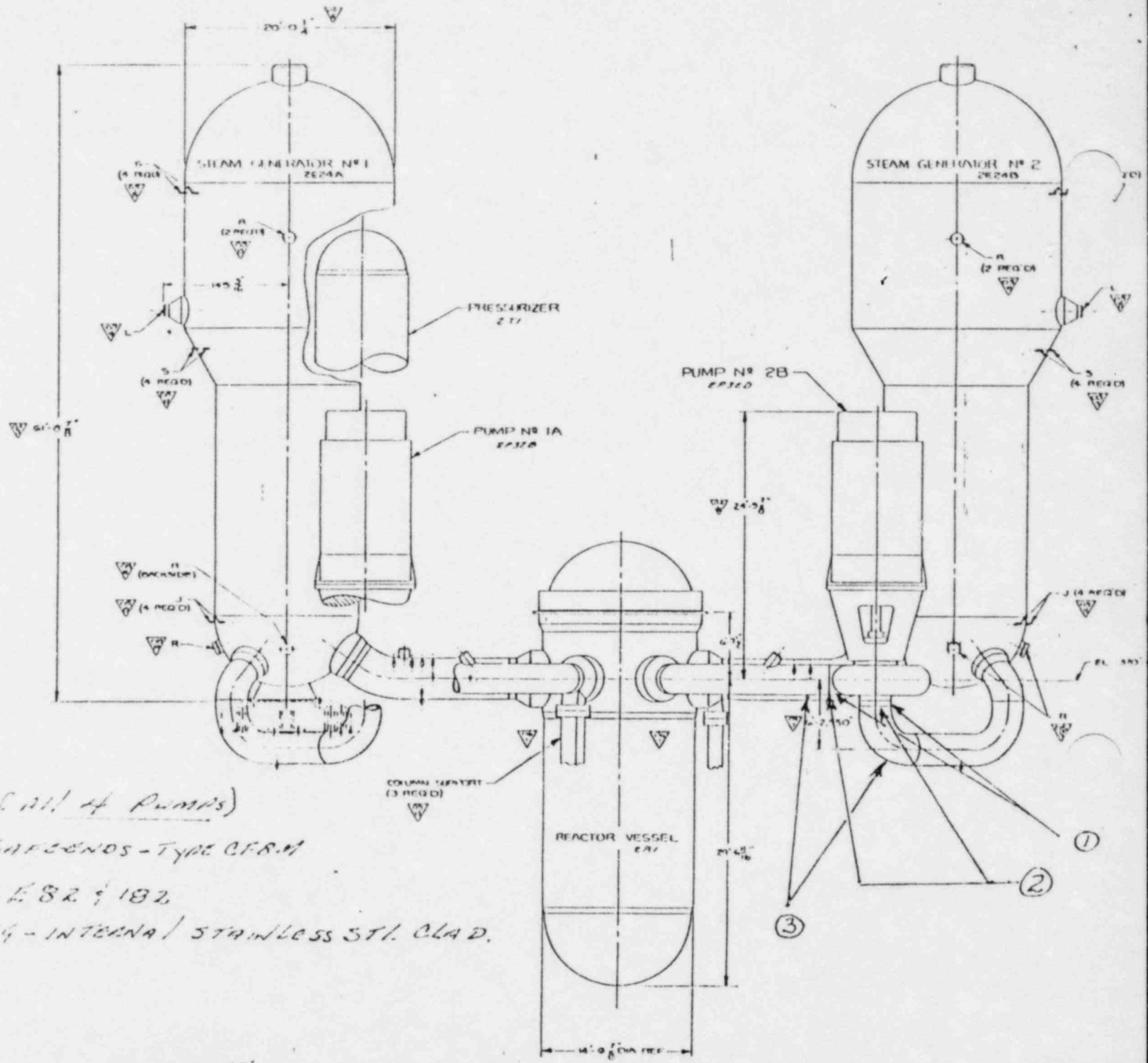
Management Interview

Management discussions were held at the completion of the inspection. Items discussed within the scope of this inspection are summarized below:

1. The inspector advised AP&L that the LPT procedure (No. 4768-ESS-093) developed by their ISI consultants, Combustion Engineering, was adequate and consistent with applicable ASME Code Section III provisions. However, the investigation results suggested the Level II and III NDE examiners had incorrectly interpreted the LPT results of weld surface conditions as unacceptable crack indications without recourse to further surface conditioning to determine their actual relevancy as prescribed in the LPT procedure. Terwilliger concurred with the inspectors analysis.

2. The inspector discussed his investigation results noting these confirmed the weld indications were innocuous, nonrelevent surface conditions resulting from the welding process and surface preparations during fabrication by the NSSS. The inspector noted that restoration of the affected welds to acceptable code conditions was satisfactorily demonstrated during the inspection. The inspector commented that the fabrication radiographs showed these troublesome surface indications were common on all four RCP safe end weldments and that the current ISI documentation should reflect this "baseline" condition for future ISI evaluation of the pump welds. Terwilliger indicated the ISI evaluation and results would be properly documented.

3. The inspector stated that since the investigation identified the nature of the indications, and satisfactorily repairs achieved, that no further required course of action by AP&L appeared warranted and that withdrawal of the relief request should be considered. Terwilliger acknowledged the inspector's conclusions and stated the relief request would be withdrawn from staff consideration.



NOTES: (TYPICAL of #1 & 4 PUMPS)

1 STAINLESS STEEL SAFE ENDS - TYPE CF8M

2 CLADDED WELDS - E82 & 182

3 CARBON STL. PIPING - INTERNAL STAINLESS STL. CLAD.

Figure 1.

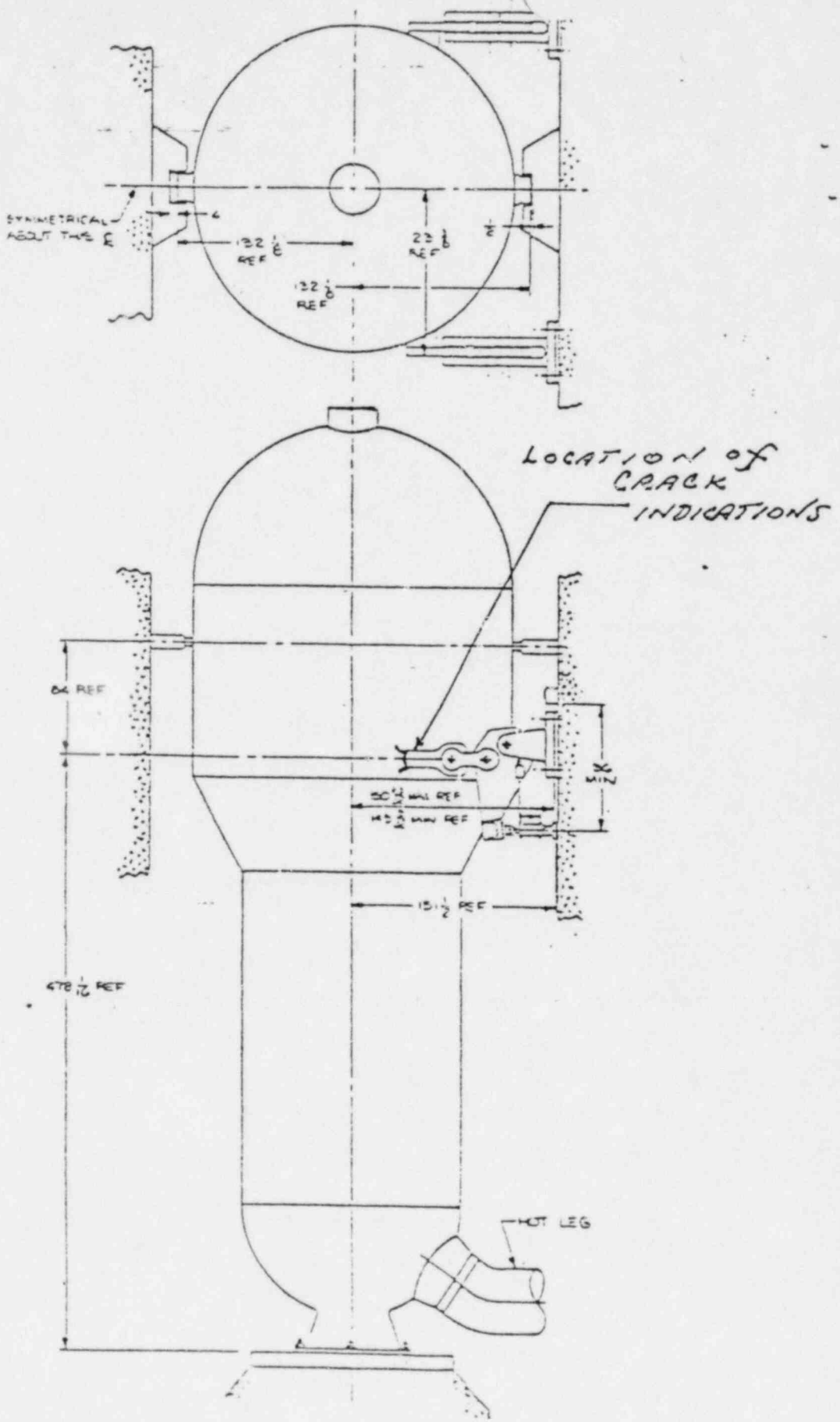

SYMMETRICAL ABOUT THIS ℄
132 ½ REF
23 ½ REF
132 ½ REF
LOCATION OF CRACK INDICATIONS
84 REF
X MIN
130 ½ MIN REF
131 ½ MIN REF
131 ½ REF
478 ½ REF
HOT LEG

FIGURE 2