JERSEY CENTRAL POWER & LIGHT COMPANY

OYSTER CREEK NUCLEAR GENERATING STATION

Provisional Operating
License No. DPR-16

Technical Specification
Change Request No. 68
Docket No. 50-219

Applicant submits, by this Technical Specification Change Request No. 68 to the Oyster Creek Nuclear Generating Station Technical Specifications, changing sections 3.4 and 4.3 dealing with the Core Spray System.

JERSEY CENTRAL POWER & LIGHT COMPANY

BY Frank Kirfrahl
Vice President

STATE OF NEW JERSEY
COUNTY OF MORRIS

Sworn and subscribed to before me this 15th day of November, 1978.

Phyllis A. Kabis
Notary Public

PHYLLIS A. KABIS
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires Aug. 16, 1979

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF	)	
	)	DOCKET NO. 50-219
JERSEY CENTRAL POWER & LIGHT COMPANY	)	

CERTIFICATE OF SERVICE

This is to certify that a copy of Technical Specification Change Request No. 68 for the Oyster Creek Nuclear Generating Station Technical Specifications, filed with the U.S. Nuclear Regulatory Commission on November 15, 1978, has this 15th day of November, 1978, been served on the Mayor of Lacey Township, Ocean County, New Jersey by deposit in the United States mail addressed as follows:

The Honorable Lawrence J. McNally
Mayor of Lacey Township
P.O. Box 475
Forked River, New Jersey 08731

JERSEY CENTRAL POWER & LIGHT COMPANY

BY: [signature]
Vice President

DATED: November 15, 1978

JCP&L / GPU

Jersey Central Power & Light Company
Madison Avenue at Punch Bowl Road
Morristown, New Jersey 07960
(201) 455-8200

November 15, 1978

The Honorable Lawrence J. McNally
Mayor of Lacey Township
P. O. Box 475
Forked River, New Jersey 08731

Dear Mayor McNally:

Enclosed herewith is one copy of Technical Specification Change Request No. 68 for the Oyster Creek Nuclear Generating Station Technical Specifications.

These documents were filed with the U.S. Nuclear Regulatory Commission on November 15, 1978.

Very truly yours,

Ivan R. Finfrock, Jr.
Vice President

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Enclosure

JERSEY CENTRAL POWER & LIGHT COMPANY
OYSTER CREEK NUCLEAR GENERATING STATION
PROVISIONAL OPERATING LICENSE NO. DPR-16
DOCKET NO. 50-219

Applicant hereby requests the Commission to change Appendix A to the License as follows:

1. Sections to be changed:

   Sections 3.4 and 4.3.

2. Extent of changes:

   Inservice inspection of the core spray spargers is being augmented. Core Spray System 2 is being required to provide 3640 gpm to the reactor.

3. Changes requested:

   Replace pages 3.4-4, 4.3-5, and 4.3-8 with the attached pages.

4. Discussion:

   These changes are being made in response to concerns expressed by the PORC, GORB, and NRC staff upon review of the repair of the crack in the Core Spray System 2 sparger during the 1978 refueling outage.

Bases: This specification assures that adequate emergency core cooling capability is available when the core spray system is required. Based on the loss-of-coolant analysis for the worst line break, a core spray of at least 3400 gpm is required within 35 seconds to assure effective core cooling.*(1) Thus, if one loop becomes inoperable, the operable loop is capable of providing cooling to the core and the reactor may remain in operation for a period of 7 days provided repairs can be completed within that time. The 7 days is based upon the consideration discussed in the bases of Specification 3.2 and the pump operability tests of Specification 4.4. If repairs cannot be made, the reactor is depressurized and vented to prevent pressure buildup and no work is allowed to be performed on the reactor which could result in lowering the water level below the safety limit of 4'8".

Each core spray loop contains redundant active components. Therefore, with the loss of one of these components the system is still capable of supplying rated flow and the system as a whole (both loops) can tolerate an additional single failure of one of its active components and still perform the intended function and prevent clad melt. Therefore, if a redundant active component fails, a longer repair period is justified based on the consideration given in the bases of Specification 3.2. The consideration indicates that for a one out of 4 requirement the time out of service would be

$$\frac{\tau}{1.71} = \frac{30 \text{ days}}{1.71} = 17.5 \text{ days}$$

Specification 3.4.A.5 ensures that if one diesel is out of service for repair, the core spray system loop on the other diesel must be operable with no components out of service. This ensures that the loop can perform its intended function, even assuming one of its active components fails. If this condition is not met, the reactor is placed in a condition where core spray is no longer required.

When the reactor is in the shutdown or refueling mode and the reactor coolant system is less than 212°F and vented and no work is being performed that could result in lowering the water level to less than 4'8" above the core, the likelihood of a leak or rupture leading to uncovering of the core is very low. The only source of energy that must be removed is decay heat and one day after shutdown this heat generation rate is conservatively calculated to be not more than 0.6% of rated power. Sufficient core spray flow to cool the core can be supplied by one core spray pump or one of the two fire protection system pumps under these conditions. When it is necessary to perform repairs on the core spray system components, power supplies or water sources, Specification 3.4.A.7 permits reduced cooling system capability to that which could provide sufficient core spray flow from two independent sources. Manual initiation of these systems is adequate since it can be easily accomplished within 15 minutes during which time the temperature rise in the reactor will not reach 2200°F.

*Core Spray System 2 is required to deliver 3640 gpm.

TABLE 4.3.1

EXAMINATION SCHEDULE OF REACTOR COOLANT SYSTEM

Component	Sample	Extent	Inspection Process (See Note 1)	Inspection Frequency (See Note 2)
		100% safe end to pipe weld	RT & VT	a
7. Circumferential weld head to head flange	One	10% of weld length including 2 intersects with longitudinal welds	RT & VT	a
8. Longitudinal weld on head from flange weld to cap	One	Entire length	RT & VT	a
9. Integrally welded internal vessel components:				
Core spray piping	One	Entire accessible surfaces and welds	VT	a
Core spray sparger	One	Entire accessible surfaces and welds	VT	e
Shroud support ring	Partial	Any accessible surface	VT	a
Liquid poison sparger	Partial	Any accessible surface and/or welds	VT	a
10. Cladding on head	2 patches	Surface	VT	a

TABLE 4.3.1

EXAMINATION SCHEDULE OF REACTOR COOLANT SYSTEM

NOTES:

1. UT Ultrasonic examination

   RT Radiographic examination (UT acceptable alternate for RT)

   VT Examination by viewing

2. a. Inspect same sample twice during first 5 years of operation

   b. 100% inspect partial sample during at least two inspections such that 100% of the studs are inspected during the first 5 years of operation.

   c. Inspect partial sample during at least two inspections such that 10% of the penetrations are inspected during the first 5 years of operation

   d. Normal maintenance observations - Examination by viewing, where accessible, during maintenance

   e. Full inspections of the accessible surfaces and welds of both spargers and the repair assembly on core spray sparger no. 2 shall be carried out during each of the next five refueling outages beginning in 1979, subsequent inspections will be conducted at 5 year intervals.

3. The examination schedule of Table 4.3.1, extent of examination, inspection process, and inspection frequency shall be reviewed after the fourth year of operation and a revised specification for subsequent inservice inspection developed.

Technical Specification Change Request No. 68
Safety Evaluation

During the 1978 refueling outage a crack was discovered by inservice inspection in the sparger of core spray system 2. The crack and its repair are described by a Repair Proposal and Safety Evaluation. That information was presented to the NRC staff on November 3, 1978.

The PORC, GORB and NRC staff all agreed that augmented inservice inspection of the core spray spargers and of the repair assembly was desirable. This technical specification change would require that a full visual inspection of all accessible surfaces and welds of both core spray spargers and of the repair assembly be performed at each of the next five refueling outages, starting in 1979. At the completion of this period of augmented inspection the inspection interval would revert to that existing before the crack was discovered. Other changes could of course be made depending on the results of the augmented inservice inspection.

The safety evaluation of the sparger crack repair also determined that the performance of Core Spray System 2 would not be degraded by the crack (even if it should propogate around the pipe and open up to the maximum extent permitted by the repair assembly) if the Core Spray System 2 flow rate to the reactor were 3640 gpm rather than the 3400 gpm previously assumed. This technical specification change request would change section 4.4 and the bases to section 3.4 to require that the 3640 gpm be demonstrated during pump operability tests.

Plant procedures for inservice inspection and core spray pump operability testing shall be appropriately modified when this technical specification change has been approved.

Since this technical specification change request would serve only to increase inservice inspection and to increase core spray pump operability requirements, it in no way reduces the safety of the Oyster Creek Station. It does not increase the possibility of any accident or malfunction of equipment nor does it introduce the possibility of any accident or malfunction of equipment not previously analyzed. It does not reduce any margin of safety of the plant. It can therefore be concluded that the change presents no significant safety considerations.

4.4 EMERGENCY COOLING

Applicability: Applies to surveillance requirements for the emergency cooling systems.

Objective: To verify the operability of the emergency cooling systems.

Specification: Surveillance of the emergency cooling systems shall be performed as follows:

Item	Frequency
A. Core Spray System	
1. Pump Operability	Once/month. Also after major maintenance and prior to startup following a refueling outage. Core Spray System 2 shall be demonstrated to be capable of delivering 3700 gpm to the core at a reactor pressure of 110 psi.
2. Motor operated valve operability	Once/month
3. Automatic actuation test	Every 3 months
4. Pump compartment water-tight doors closed	Once/week and after each entry
5. Core spray header ΔP instrumentation	
check	Once/day
calibrate	Once/3 months
test	Once/3 months
B. Automatic Depressurization	
1. Valve operability	Every refueling outage
2. Automatic actuation test	Every refueling outage
C. Containment Cooling System	
1. Pump operability	Once/month. Also, after major maintenance and prior to startup following a refueling outage.
2. Automatic actuation test	Every 3 months
3. Pump compartment water-tight doors closed	Once/week and after each entry.

REPAIR PROPOSAL NO. 320-78-1

OYSTER CREEK NUCLEAR GENERATING STATION

CORE SPRAY SPARGER NO. 2

Prepared by: E. J. Growney
J. S. Chardos

Approved by: T. M. Crimmins, Jr.
Manager, Generation Engineering

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1.0 INTRODUCTION

Scheduled in-service inspection of reactor internals during the Fall 1978 refueling outage at Oyster Creek identified an isolated linear indication in a portion of one of the two core spray system spargers (upper sparger, i.e., Core Spray System No. 2) inside the reactor vessel. Subsequent visual examinations and tests showed that the indication in the core spray sparger is a crack which extends at least 220° of the circumference of the 3-1/2" Schedule 40S sparger and, apparently, penetrates the wall over about 135° of the circumference.

The purpose of this proposal is to:

1. Describe the examinations and tests which characterize the observed crack.
2. Summarize results of evaluations of the consequences of the crack.
3. Describe the planned corrective actions and surveillance, and
4. Present the Safety Evaluation of the "as repaired" core spray system.

2.0 BACKGROUND

The Oyster Creek reactor vessel contains two independent core spray spargers which are fed by two separate core spray systems. Each of these systems is provided with fully redundant pumps, valves, power supplies, controls, and instrumentation. Each core spray sparger assembly consists of two 180^{o} segments of formed 3-1/2" Schedule 40S stainless steel piping, each of which contains 56 spray nozzles (112 nozzles total per assembly). The 180^{o} halves of each sparger assembly are connected at their centers to 5" Schedule 40 inlet piping. When the system is actuated, water from the core spray pumps is directed through a reactor vessel nozzle and a penetration in the core shroud to each half of the core spray sparger assembly. Each 180^{o} half of the spargers is supported at the location of the 5" inlet pipe connection which is welded to the shroud; and by three, approximately equally spaced support brackets on each side of the central inlet pipe connection. The support brackets consist of 3/8" thick vertical gusset plates, with 1-1/2" wide bearing pads, which support the sparger arms in the radial and vertical directions. The sparger arms are free to slide in a circumferential direction (relative to their inlet connection to the shroud) as required to accommodate any differential thermal expansion between the shroud and the spargers during injection of cool core spray water. A cross-section through the reactor vessel at the elevation of interest is shown in Figure 1. A plan view showing the upper core spray sparger (designated System No. 2) is presented in Figure 2.

In-service inspections performed during the Fall 1978 outage included visual examination of accessible portions of the core spray spargers using underwater television viewing and video tapes. These examinations included the accessible portion of the full 360° of both the upper (System No. 2) and lower (System No. 1) spargers, spray nozzles, support brackets, and inlet piping connections. The portion of each sparger which were visually examined included the half (from top center to bottom center of the 3-1/2" pipe) which faces the reactor centerline. Accessible portions of the 5" inlet piping between the reactor vessel core spray nozzles and the OD of the shroud were also examined.

The results of these examinations (performed during mid-October) revealed a single crack-like indication at orientation 208° (see Figure 2) in the upper sparger. A sketch of the indication is shown in Figure 3. As indicated in this figure the crack approaches near the toe of the nearby nozzle fillet weld and extends around the circumference of the sparger at least as far as the top center of the sparger pipe. The crack width appears greatest at a point below the "3 o'clock" position and becomes notably finer (tighter) as it approaches the top and bottom of the pipe.

Examinations of the support brackets, spray nozzles, and remaining accessible portions of both upper and lower spargers revealed no cracks or signs of vibration, fretting, or movement of the spargers relative to the supports.

Subsequent inspection efforts during the week of October 30, 1978 enabled the plant staff to view and record a picture of the bottom of the upper sparger at the location of the crack. This inspection revealed that the crack does approach near the nozzle fillet weld, follow the weld contour for a short distance, and then proceeds up the rear wall of the sparger pipe. This crack extension was visible for approximately 45° from bottom dead center of the sparger up the rear (or outside) of the sparger pipe. In this area, the crack appears to be as tight as it is at the bottom of the sparger on the inner radius. See Figure 4 for a sketch of this portion of the crack.

In order to further characterize the depth and length of the crack at the 208° location in the upper sparger, air was introduced into the sparger through an instrument line which is attached to the core spray piping near the core spray nozzle. The air was gradually fed into the sparger until bubbles were observed from the spray nozzles, indicating that all water was forced out of the sparger. During this process, air bubbles were observed to leak from the crack from near the bottom center of the sparger to a location approximately 45° from the top center of the sparger. No air bubbles were observed from the inaccessible back side of the sparger nearest the shroud inside diameter. This test demonstrated that the crack penetrates the wall of the sparger over an arc length of about 135°. Figure 5 shows a cross-section of the pipe at the crack location with the best estimate of the crack configuration.

No evidence of air leakage was detected from any other location on the sparger. Similar air tests of the lower sparger (System No. 2) were not performed because the spray nozzles are located on the top of this sparger.

(NOTE: The television inspection equipment used for the inspection is considered to have very good resolution. At the distances used for these inspections and under the same lighting and medium conditions, the equipment was shown to have a resolution of 400 lines/inch).

3.0 REFERENCES

3.1 MPR Drawing 1083-12-01, Rev. D.

3.2 C. M. Gordon, R. E. Blood, "Reactor Structural Materials Environmental Exposure Program" given at Symposium on Materials Performance in Operating Nuclear Systems, CONF-7308801-August 1973, M. S. Wechler and W. H. Smith, Editors, Iowa State U., Ames, Iowa.

3.3 Jersey Central Power & Light Company, Oyster Creek Nuclear Generating Station, Docket No. 50-219, Request for Amendment to Provisional Operating License No. DPR-16, Revision 1, to Technical Specification Change Request No. 49, May 30, 1978.

3.4 Exxon Nuclear Company, Oyster Creek LOCA Analyses Using the ENC NJP-BWR ECCS Evaluation Model, XN-NF-77-55, Revision 1, March 1978.

3.5 Exxon Nuclear Company, The Exxon Nuclear Company WREM-Based NJP-BWR ECCS Evaluation Model and Application to the Oyster Creek Plant, XN-75-55, Revision 2, August 1976.

3.6 Exxon Nuclear Company, Responses to NRC Questions Concerning NJP-BWR ECCS Evaluation Model and Application to the Oyster Creek Plant, XN-75-55, Revision 2, Supplement 1, September 1976.

3.7 Exxon Nuclear Company, Supplementary Information Related to the Exxon Nuclear Company WREM-Based NJP-BWR ECCS Evaluation Model and Application to the Oyster Creek Plant, XN-75-55, Revision 2, December 1976.

3.8 Safety Evaluation Report by the Office of Nuclear Reactor Regulation Regarding Review of the Exxon Nuclear Company Non-Jet Pump Boiling Water Reactor ECCS Evaluation Model Described in Exxon Topical

Reports XN-75-55, Revision 2, dated September 1976, XN-75-55, Revision 2, Supplement 2, dated December 1976, for Conformance to Appendix K to 10 CFR 50, USNRC, February 25, 1977.

3.9 Jersey Central Power & Light Company, ECCS Modification Core Spray Electrical Crossconnect, Oyster Creek Nuclear Generating Station, Docket 50-219, Attachment II, Revision 1, July 15, 1975.

4.0 PROBABLE CAUSE OF CRACK

The cause of the crack in the upper core spray sparger at orientation 208° has not been positively identified. However, on the basis of the information which is available, the most probable cause of crack initiation and propagation is as follows:

Crack Initiation and Propagation -- According to the GE specification to which the spargers were manufactured, the spargers were required to be in the solution annealed condition. Cold forming (which apparently was performed) was permitted without subsequent solution anneal provided the bend radius was not less than 20 pipe diameters (80 inches). The actual bend radius was 91 inches. Thus, the sparger material should be in the solution annealed condition with an acceptable amount of cold work. To confirm this, a review was made of all available manufacturing and material records at the sparger manufacturer's plant. These records show that (1) the material supplied was A312, Type 304, solution annealed stainless steel pipe which was rapidly cooled, (2) it was cold formed to the required radius of 91 inches, and (3) there is no evidence of any subsequent heat treatment. Welding and assembly of the spargers was performed after cold forming of the 3-1/2" pipes.

The susceptibility to intergranular stress corrosion cracking (IGSCC) has been shown to be increased by any local cold work that materials may receive as a result of cold straightening or bending during fabrication, fit-up, or installation. Tests performed by GE as part of the pipe cracking evaluation reported in NEDO - 21000 and actual service experience in BWR's have shown that stress corrosion cracks can initiate in the heat affected zones of welds in such pipes. Accordingly, stress corrosion is considered to be the most probable cause of crack initiation in the area of the local cold work or the heat affected zone of the weld.

As discussed above, visual examinations and air bubble tests indicate that the crack extends at least from the top centerline around the inboard side for about 220° on the sparger OD and penetrates the wall over an arc length of about 135°. Because the crack length appears to be longer on the OD of the sparger pipe than the ID, it can be inferred that the crack propagated from the OD of the sparger inward. Further, the location of the crack immediately adjacent to a radial support bracket and its location and extent over the inner half of the sparger are consistent with an applied loading which imposes a high bending moment at the crack location. The direction of the moment would be such that the portions of the sparger nearer the reactor centerline are in tension and the portions nearer the shroud in compression.

Possible sources of such a bending moment have been evaluated. Normal service loadings (thermal conditions, flow forces, vibratory loadings) result in very low applied loads and stresses, and are insufficient to explain any propagation. Initiation of core spray at reactor operating temperature would result in higher stresses; however, no such event has occurred to date. The most probable loading which could apply a high bending stress as described above are forces applied during sparger installation to force the sparger to conform to the location of the radial support brackets. For example, calculations show that deflection of the sparger of as much as 3/16" over two support spans would impose near yield level stresses in the area which is now cracked. This loading is considered to be the most probable cause of crack propagation and is consistent with all observations.

Visual examinations and review of video tapes of these examinations support the above hypothesis. These examinations indicate the following:

1. The crack in the upper sparger at location 208° is the only crack found in either of the two sparger assemblies.
2. The examinations show no signs of wear, fretting, vibration, or movement of any of the spargers in their support brackets as a result of service loadings.
3. Distinct marks are apparent on this sparger arm adjacent to the crack which could be the result of applied loads during installation.

5.0 EVALUATION OF PRESENT CORE SPRAY SPARGER CONFIGURATION

Analyses have been performed to evaluate the significance of the observed crack at 208° in the upper core spray sparger. Specifically, the potential effect of such a crack on the structural adequacy of the sparger and the hydraulic performance of the sparger and core spray system were analyzed. The potential for additional crack growth has also been evaluated. The results of these evaluations are summarized below:

A. Potential for Additional Crack Growth

As discussed in Section 4.0, the only type of loading which can be postulated which is consistent with the observed crack location and extent, and which can reasonably be expected to exist, is a bending moment load. There is no known mechanism (with the exception of core spray system actuation which has not occurred) that can impose a significant tensile load on the sparger in the circumferential direction (i.e., along the axis of the 3-1/2" sparger pipe). This makes it highly unlikely that any such crack could propagate around the full 360° circumference of the sparger. (It should be noted that even during a core spray actuation less than .02 square inches of sparger material cross-section would be required to withstand the axial force resulting from core spray differential pressure).

With regard to the possibility of initiation and growth of significant size cracks at other locations, the following is considered pertinent:

1. Inspections and air tests have revealed no additional cracks or crack-like indications. These inspections include the accessible portions of the spargers and 5" inlet piping, and covers the portions most likely to be affected by the same mechanisms which apparently led to the existing crack. If other cracks were to have occurred, there is high probability they would have occurred in these locations.
2. The effects of long-term neutron radiation have been shown to include the lowering of susceptibility to intergranular stress corrosion cracking (IGSCC) initiation in stainless steels. (See Reference 3.2). To summarize the reference document: Bend specimens were exposed to BWR water chemistry environment in the Dresden 1 reactor. The bend specimens located in the reactor core region had a lower incidence of cracks than control specimens situated out of the high neutron flux. With the type of loading on these specimens (or postulated on the spargers), the radiation serves to both relax the stresses and strengthen the material. The OCNGS core spray sparger piping is estimated to have seen a fluence of 10^{19} to 10^{20} NVT. In fluences of 1×10^{20} NVT, the yield strength of this material will roughly double thereby reducing the probability of plastic deformation and the possibility of IGSCC for the type of loading postulated in the sparger.
3. Observable cracks have not occurred in the balance of the sparger piping (as confirmed by inspection) and these spargers have been

in service for over 8 years. IGSCC is much less likely to occur in the future due to the radiation hardening effect as discussed. This logic leads to the conclusion that the existing crack occurred during the first few years of plant operation before significant radiation hardening occurred and that it is unlikely that additional cracking will occur.

B. Structural Evaluation of Sparger Configuration

Analyses have been performed to determine the effect of the observed crack on the structural adequacy of the sparger. These analyses demonstrate that even if the crack were to propagate through the sparger wall thickness over 360° of its circumference, the remaining "fixed" and "free" ends of the sparger (1) would be adequately supported for all anticipated loadings, (2) would not be over stressed, and (3) could not become loose parts. The main reasons for this are that (1) each piece of sparger would continue to be supported by two or more radial support brackets, and (2) gross circumferential motion of the "free" sparger segment is prevented by the core spray nozzles which are as close as 3/16" to adjacent support brackets. Loadings considered in this evaluation included flow forces, differential thermal expansion, pressure differential, and resulting jet forces during core spray actuation, dead weight, seismic, and vibratory loadings. On this basis, the present sparger configuration, even with a through-wall crack around the full circumference of the sparger, is considered structurally adequate to preclude any parts from becoming loose parts within the reactor.

C. Performance Evaluation of Sparger Configuration

An additional evaluation has been made to assess the potential effect of the crack at location 208° on core spray system performance. As in the structural evaluations, it was conservatively assumed that the crack at 208° in the upper sparger propagates through the cross section of the sparger as if the sparger were saw cut at that location. Were the system actuated, injection of cold core spray water would cool the sparger relative to the shroud. In the assumed condition, the resulting sparger contraction in the circumferential direction would tend to open the assumed "saw-cut" by about 0.4". Combined with the available clearance of approximately 3/16" between the nearby core spray nozzle at 208° and its support bracket at $208\text{-}1/2^{\circ}$, the "saw-cut" could open by about 0.6". Calculations indicate that approximately 20% of the 3400 gpm core spray design flow could enter the core through the postulated crack rather than through the core spray nozzles.

Operation of the Core Spray System No. 2 in this condition would result in a reduction of flow through all nozzles in System No. 2 only. In addition, the sparger arms containing the crack would suffer flow reductions more significant than the other three sparger arms in the System No. 2 sparger assembly. This significant reduction in nozzle flow would most likely alter distribution of the core spray water beyond the limits which could be shown to be satisfactory, although core flooding capability would not be adversely affected.

6.0 PLANNED CORRECTIVE ACTIONS

While the structural evaluation results are acceptable, the performance evaluation discussed in Section 5.0 demonstrates that the present condition of the upper core spray sparger will most likely prevent achieving the design flow distribution. To assure that both of the core spray systems (System No. 1 and No. 2) will have full design capability, a structural support will be installed prior to startup of the reactor to preclude crack opening which would detrimentally affect sparger and system performance.

The additional structural support is shown on Reference 3.1 and consists of a 19" long clamp assembly which will be attached to the upper core spray sparger over and on either side of the cracked area at 208°. The clamp assembly will be machined, based on as-built dimensions of the sparger, to fit around the two spray nozzle bosses on either side of location 208°. A significant clamping force will be applied at installation by the use of four 3/4" bolts. The clamp assembly will prevent relative movement of the two sections of the sparger even if the crack were to propagate through the sparger cross section and will preclude any significant opening of the observed crack. The clamp assembly also strengthens the core spray sparger in the area of the crack.

The clamp assembly is fabricated from solution annealed and water-quenched Type 304 stainless steel (all parts). This material has been demonstrated by GE to have good resistance of IGSCC in the BWR environment. The clamping bolts will be positively locked using Class A-type locking cups and a special crimping tool.

The assembly is held in place by virtue of clamping forces applied with a coverage greater than 180°. The initial clamping forces applied will not result in an over-stress condition in the sparger. Once clamped in place, the jaws of the clamp are open 1/4" less than the OD of the sparger. To remove the clamp without removing the clamping bolts would require deforming the clamp or the sparger pipe. As a backup to the clamping forces, the clamp is restrained by two nozzles encompassed by the clamp. The amount of postulated movement, neglecting clamping forces, is dependent on the clearance between the bracket and the two nozzles. These clearances will be less than 1/32".

The clamp assembly has been evaluated with respect to loadings caused by flow, differential thermal expansion, pressure differential, and resulting jet forces during core spray actuation; dead weight, seismic, and vibratory loadings, and is considered structurally adequate.

During core spray initiation, the clamping forces of the assembly on the sparger could be reduced to one-half the initial value due to differential thermal shrinkage. The resulting clamping force would still be sufficient to hold the sparger together against internal differential pressure and frictional loads due to thermal contraction. Therefore, the crack would not become larger even when the sparger is subjected to the loads associated with a core spray initiation. The flow loss through the crack in this configuration is estimated to be below 1% of the system flow.

Conservatively, assuming that there is no clamping force on the pipe during core spray initiation, the maximum amount of pipe separation would be less than 1/16". This limit is assured by the limitations of less than 1/32" clearance between the brackets and the two nozzles encompassed by the clamp.

Upon completion of installation, the clamp will be checked by both underwater television inspection and measurement tools to ensure that the clamp is firmly attached to the sparger. This will ensure that the clamp is properly installed, will not come loose during reactor operation, and will provide a set of baseline measurements for confirmation of continued proper fit during future inspections.

The performance of the intact core spray system (System No. 1) is not affected by the addition of the repair clamp assembly.

The integrity of the core spray spargers and the supplemental clamp assembly will be monitored by augmented in-service examinations. The program and schedule for these supplemental inspections will be developed over the next several months and will include visual examinations using remote viewing equipment during the next scheduled refueling outage.

7.0 SAFETY EVALUATION

The core spray systems at OCNGS are the primary means of Emergency Core Cooling in the event of a loss of coolant accident and a simultaneous loss of off-site electrical power. The capability of these systems is analyzed and presented in docketed LOCA analyses (References 3.3 and 3.4) which are currently pending before the NRC. The model used for these analyses is described in References 3.5, 3.6, and 3.7 and has received NRC and ACRS approval (Reference 3.8).

A failure modes and effects analysis of Oyster Creek ECCS done in 1975 resulted in a modification to the core spray systems (Reference 3.9) which assures the operability of both of the systems even under the assumption of a single failure in each system. Consequently, two core spray systems would be available for all break locations with the exception of the situation in which the accident initiating break is in one of the core spray lines leading to the reactor vessel. Independent calculations have shown that for a core spray line break, spray is not required for cooling and merely the flow through the other system is adequate for reflooding the reactor vessel and keeping the reactor core cool.

LOCA analyses assume no credit for core spray cooling of the fuel bundles until the rated flow of 3400 gpm is achieved at a reactor pressure of 110 psi. Only after reactor pressure is reduced by blowdown or Automatic Depressurization System (ADS) operation to 110 psi or below, is a flow of 3400 gpm assumed even though actual flow would commence at a pressure of 285 psi and increase as reactor pressure is decreased. This is one of several conservative assumptions in the ECCS analysis and in the plant design.

The safety objective of this repair is to demonstrate that for all accident break locations and sizes that sufficient core spray flow and distribution are available to ensure that the assumptions of the docketed ECCS Analyses are not violated. This requires that the adequate quantity of core spray water be delivered to the core and that it be distributed in a way that assures at least the minimum required flow to each fuel bundle.

This demonstration can be accomplished in two ways:
First, without the repair, Core Spray System No. 2 flow quantity to the core can be assured, but its distribution cannot be guaranteed. Nevertheless, with the exception of one specific break, adequate core spray flow and distribution can be assured from System No. 1 even in the event of a single failure. (Reference 3.9). The one specific break for which this is not true is a break in the Core Spray System No. 1 outside the reactor vessel. However, analyses (Reference 3.4 and additional information supporting that submittal) show that spray distribution is not necessary in this case as long as the assumed volume of water reaches the core for reflooding purposes. This can be accomplished by Core Spray System No. 2 in its degraded condition.

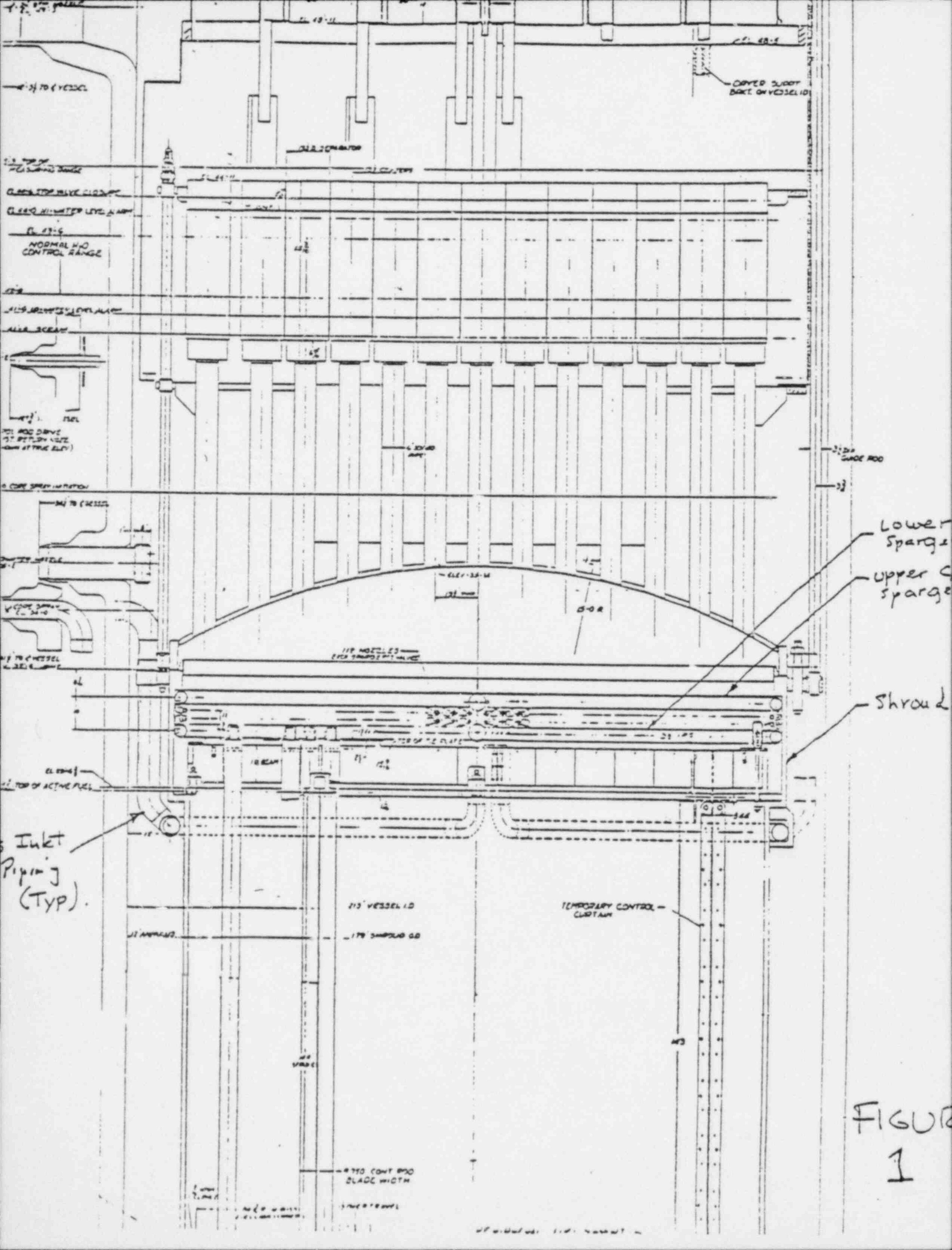
Second, to ensure an even greater reliability of core spray availability and performance and not reduce the margins of safety included in the station design and in its safety analysis, the repair discussed in Section 6.0 will restore Core Spray System No. 2 to its full design capability and will thus be able to supply not only the proper flow but also will be able to supply it with an adequate distribution.

Core Spray System No. 2 in the repaired condition is capable of supplying 3400 gpm spray flow at a reactor pressure of 110 psi. GE has provided analyses in which the leakage out the sparger crack was conservatively calculated to be less than 2.0% (61 gpm) by assuming the crack propagated 360° around the sparger and opened to 1/16" wide with no flow restriction from the clamp. The clamp assembly will reduce the leakage flow, prevent further crack opening, and diffuse the leakage and deflect it toward the shroud or along the sparger axially and away from the spray nozzle flow of both the upper and lower spargers.

GE hydraulic analysis of the cracked sparger indicates that the leakage out the crack does not result in reduced flows to nozzles in that arm as well as throughout the sparger ring. Attachment II, "Core Spray Evaluation", shows that to assure adequate distribution the flow in each nozzle must be raised to approximately the flow from that nozzle under the nominal condition. To accomplish this for the assumed 1/16", 360° crack, the system flow must be increased 240 gpm above the nominal 3400 gpm. In this condition, all nozzles would have flows between 0% and 6% above the nominal case and this would provide adequate distribution.

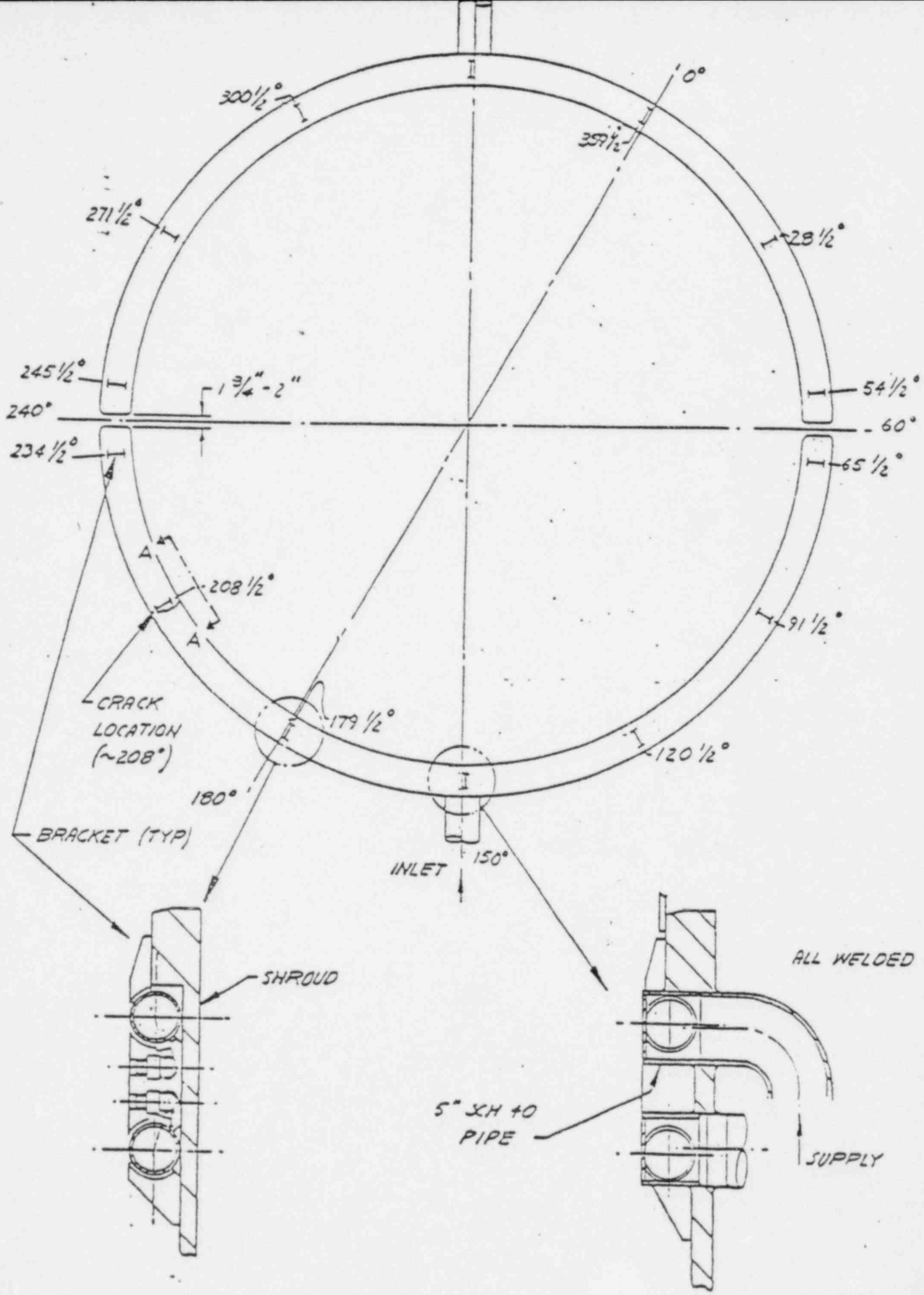
Core Spray System No. 2 has been demonstrated to be able to supply this flow at 110 psi reactor pressure assuming the worst single failure in the system. Therefore, adequate core spray flow from System No. 2 is provided as is adequate distribution over the core; and therefore, Core Spray System No. 2 is operable in the repaired condition even treating the repair conservatively.

A summary of these safety considerations, the safety significance of other features of the repair, and the conclusions concerning reactor safety are included in the attached Safety Evaluation (Attachment I). Attachment II, "Core Spray Evaluation", provides the bases for concluding that Core Spray System No. 2 sparger will provide adequate flow and adequate spray distribution to the reactor core.

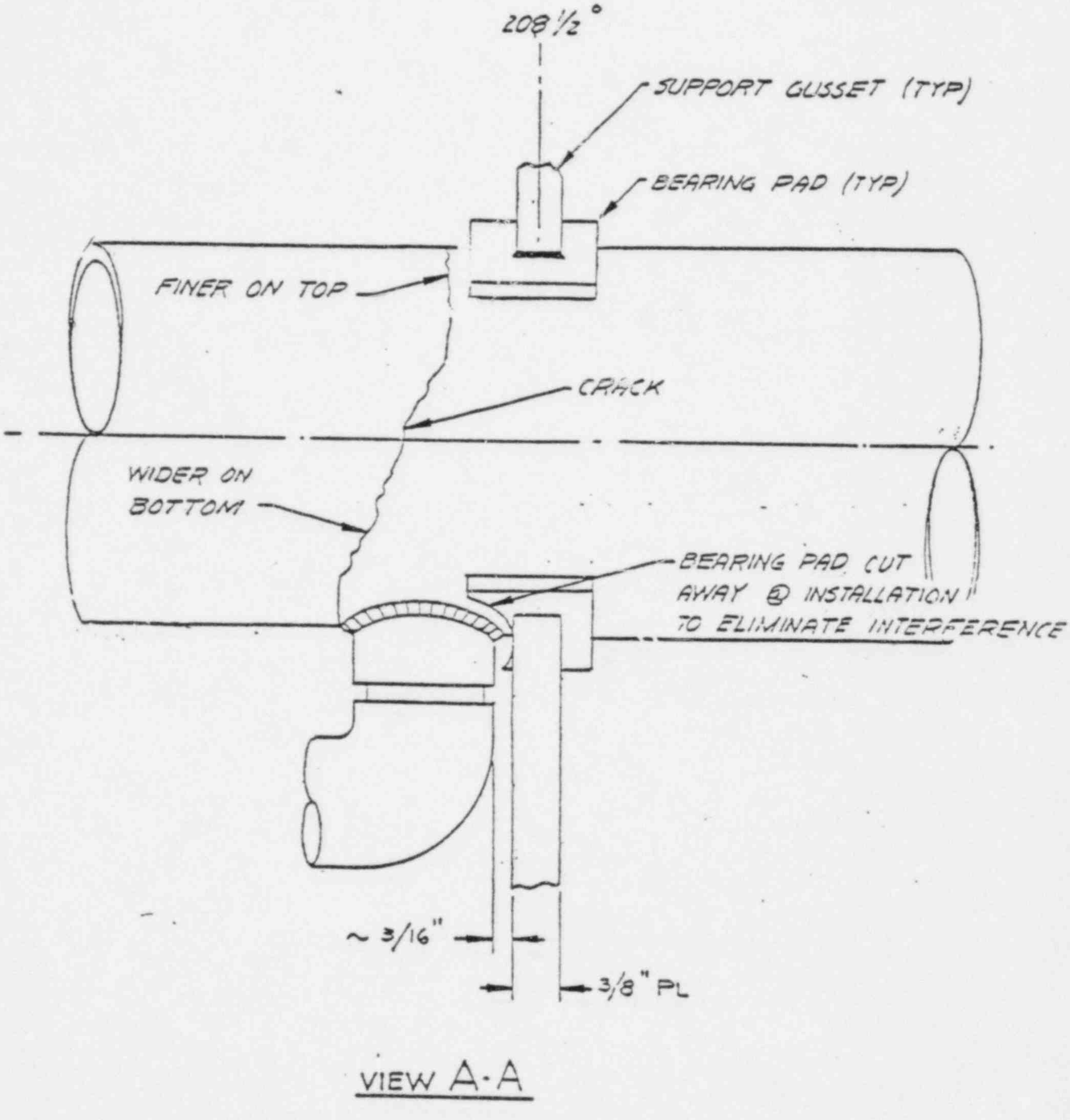


DRYER SUPPORT BRKT. ON VESSEL ID
NORMAL H2O CONTROL RANGE
GUIDE ROD
Lower
Sparge
Upper C
Sparge
Shroud
TOP OF ACTIVE FUEL
Inlet
Piping
(Typ).
213" VESSEL I.D
179" SHROUD O.D
TEMPORARY CONTROL CURTAIN
CONT ROD BLADE WIDTH

FIGUR
1

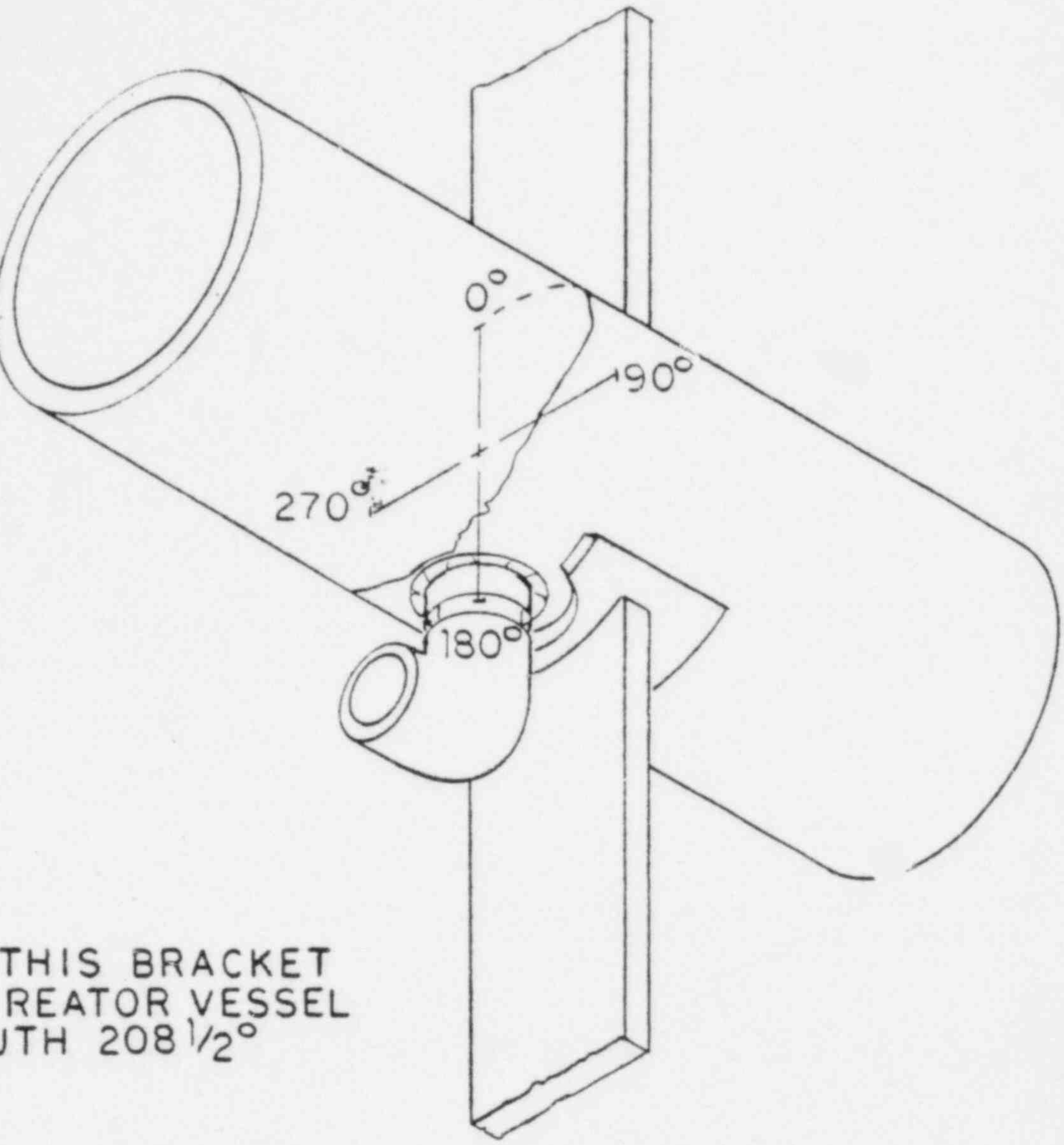


PLAN VIEW & UPPER CORE
SPRAY SPARGER
FIGURE 2



Sketch of the Crack in the
Upper Core Spray Sparger

FIGURE 3



NOTE: THIS BRACKET IS AT REATOR VESSEL AZIMUTH 208 1/2°

FIGURE 4

SKETCH OF THE CRACK IN THE UPPER CORE SPRAY SPARGER BOTTOM VIEW

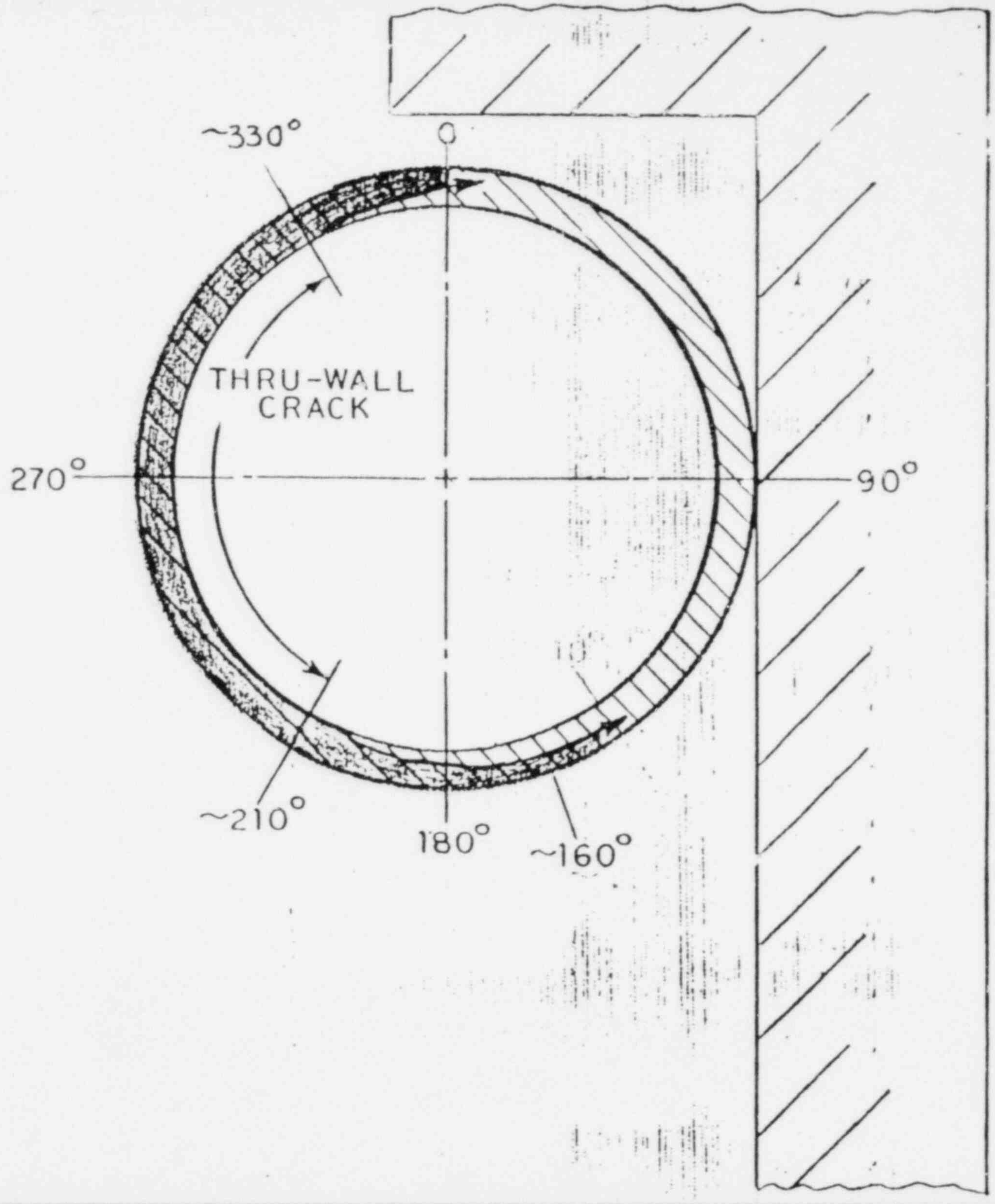


FIGURE 5

CROSS-SECTION CHARACTERIZATION

OF THE CRACK

ATTACHMENT I

to

REPAIR PROPOSAL NO. 320-78-1

OCNGS CORE SPRAY SPARGER NO. 2

SAFETY EVALUATION

November 2, 1978

TITLE	PAGE	REVISION NO.	DATE

SAFETY EVALUATION SUMMARY

1. Change/Test/Experiment subject:

   Core Spray Sparger Repair Proposal

2. Personnel Responsible for Safety Evaluation:

   J. Knubel

3. Systems/Subsystems/Components affected:

   Core Spray System II/Sparger

4. Conclusion:

   The repair does not present an unreviewed safety question if it can be shown that Core Spray System II can deliver 3640 gpm to the reactor at a Reactor Pressure of 110 psig.

5. Technical Specifications affected:

   None

6. FDSAR Section affected:

   None

7. A. What Plant Procedures were reviewed in the Evaluation: 610.3.005
   610.4.002

   B. What changes if any are recommended

   Change Procedure 610.4.002 to assure System II flow is at least 3640 gpm with a reactor pressure of 110 psig.

8. Recommendations

   A core spray flow of 3640 gpm at a reactor pressure of 110 psig must be shown for this not to be considered an unreviewed safety question as defined in 10 CFR 50.59.

9. Comment

   None

Safety Evaluation Submitted by:

J. Knubel (signature)

J. Knubel

Nov 2. 1978

Date

Revised Nov. 9, 1978 JK

I. Subject and Purpose of Proposed Change/Test/Experiment

A. Core Spray Sparger Repair Proposal

B. The purpose of the proposed modification is to repair the cracked core spray sparger in such a fashion that the structural integrity of the sparger and core spray performance is assured.

II. Description of Proposed Change/Test/Experiment

A. System affected - Core spray system

B. Subsystem/component affected - System II sparger.

C. Reference Drawings

1. MPR SK-1083-12-01

2. GE 104R858 (Fig. 1)

3. Sketch (Fig. 2)

4. Sketch (Fig. 3)

D. This system and its components are described in the following documents:

1. Plant system description Vol. 1

2. FDSAR Chapter VI-6

3. Technical Specifications Sections 3.4 and 4.4

4. Amendments 18 & 30 to the FDSAR

III. Effect on Safety

A. The safety functions of this system are defined in:

1. Technical Specification Section 3.4

2. Oyster Creek LOCA analyses using ENC NJP-BWR ECCS evaluation Model XN-NF-77-55 Rev. 1 and Rev. 2.

3. JCP&L Co. ECCS modification core spray electrical crossconnect. Attachment II Rev. 1 July 15, 1975.

B. The safety function of this system and components is to provide adequate cooling flow to the reactor core under a spectrum of Loss of Coolant Accidents. The purpose of the sparger is to distribute the core spray water to the fuel bundles in such a fashion that hot spots do not occur which could result in a peak cladding temperature exceeding 2200°F. |

C. 1. The addition of the bracket assembly to the core spray sparger will hold the sparger in such a way that if the crack were to propogate 360°, the maximum opening that could occur would be 1/16". This is based on the clearances of the bracket to nozzles and takes no credit for clamping forces. The bracket assembly is constructed entirely of type 304 solution annealed stainless steel which is the same material as the sparger. The bracket is held in place by four (4) 3/4" bolts that are pre-loaded and locked in place at 3 points by Class A type locking caps. Structural evaluations considering normal operation (water/steam flow, thermal cycling, and vibration) and accident conditions (core spray hydraulic forces, differential thermal contraction and seismic forces) have shown that the bracket will limit the opening of the crack to less than or equal to 1/16 inch and that the bracket will remain in place. The choice of materials, design, bolt preloading and use of locking caps assures the bracket itself will not come loose. In order for the bracket to be forcibly removed from the sparger the bracket or pipe would have to be deformed at least 1/4 inch and this would require a force on the order of 5000 lbs. There is no conceivable mechanism that could apply this type of force to the bracket.

A 360° crack 1/16" wide on a sparger would conservatively divert less than 2% (61 gpm) of system core spray flow through it. This in itself would not affect the ability of the core spray system to provide 3400 gpm to the core at a reactor pressure of 110 psig, but some nozzle flow would be diverted through the crack. General Electric has calculated that the minimum flow from each nozzle will be at least equivalent to that obtained at 3400 gpm from an uncracked sparger if the system flow is 3640 gpm.

In addition the installation of the bracket will not interfere with the core spray distribution pattern from System I or II and will not allow water from the crack to directly impinge on spray from the sparger nozzles.

2. The addition of the bracket will not increase the probability of the initiation of an accident as described in the FDSAR.

3. The addition of the bracket does not change the consequences of the events in the safety analyses of the FDSAR.

4. No margins of safety as described or defined in the bases of the Technical Specification will be reduced.

D. FDSAR or Tech Spec changes: None.

E. Plant Procedures

610.3.005

610.4.002

IV. Conclusions

A. The purpose of the modification is to repair the cracked core spray sparger in such a fashion that the structural integrity of the sparger and core spray performance is assured.

B. If it can be shown that core spray system II can deliver 3640 gpm to the reactor at a reactor pressure of 110 psig, the performance of that core spray system considering a 360° 1/16" inch wide crack is adequate.

With the proposed modifications the structural integrity of the core spray sparger is assured.

ATTACHMENT II

to

REPAIR PROPOSAL NO. 320-78-1

OCNGS CORE SPRAY SPARGER NO. 2

CORE SPRAY EVALUATION

November 13, 1978

TITLE	PAGE	REVISION NO.	DATE

OYSTER CREEK CORE SPRAY EVALUATION

I. Introduction

During in-service inspection, a crack was found in one arm of the upper core spray sparger at the Oyster Creek Nuclear Power Plant. An evaluation was performed to determine the capabilities of the core spray system with the repair clamp installed on the cracked sparger. This supplement provides detailed results of previous analyses and quantitative support for the position that acceptable core spray distribution would be maintained.

II. Discussion

The flow distribution along both halves of the core spray header was determined for several conditions. The individual nozzle flows for the rated system flow of 3400 gpm were determined for the intact spargers to provide a base case for comparison. The nozzle flows were also calculated for the case of one cracked sparger (1/16-inch circumferential gap) with a system flow of 3700 gpm and for both spargers intact with a system flow of 3700 gpm. The nozzle flows for all cases were normalized by the average flow for each nozzle type for the rated flow of 3400 gpm. These results are shown in Figure 1. The calculated nozzle flows for the rated flow condition have been compared with measured nozzle flows and there is very good agreement. Note that there is considerable variation in the nozzle flow along each sparger arm. For the 3400 gpm case, the variation between the nozzle nearest the inlet and the end nozzle is on the order of 35%. For the 3700 gpm cracked sparger case, the maximum variation in nozzle flows occurs along the cracked arm and is only on the order of 40%. This is not a very significant deviation from the intact sparger condition and indicates that the presence of the crack does not significantly alter the performance of the sparger. Notice also for the 3700 gpm cracked sparger case that all of the nozzle flow rates are greater than for the rated flow condition; the system flow has been increased so that there are no decreases in nozzle flow rates. Also, shown in Figure 1 is the flow distribution for a system flow of 3700 gpm with an intact sparger. This represents the conditions which would exist if the crack remained at or near its present size so that there was no significant crack flow.

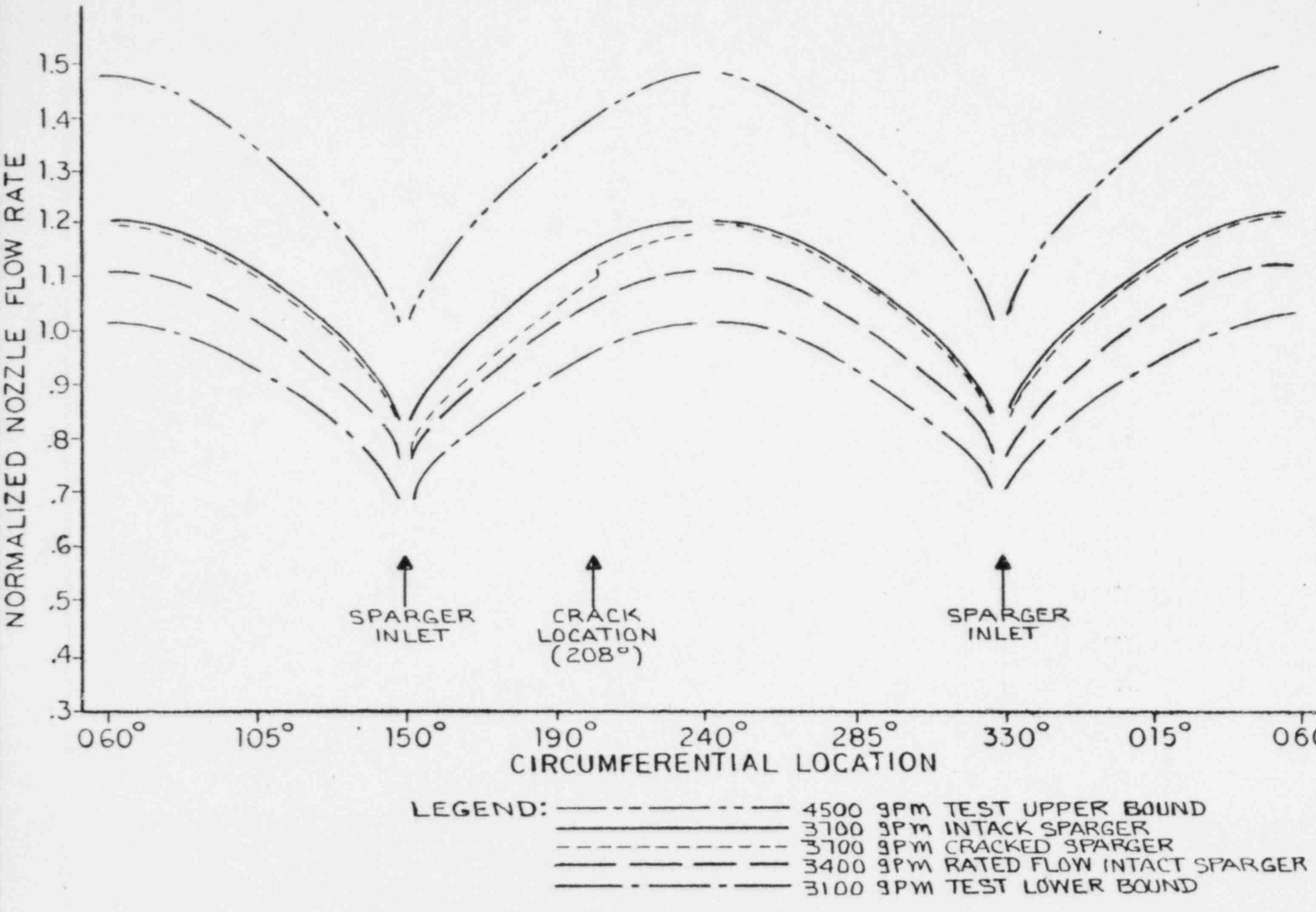
It has been determined that assuming a 1/16-inch 360° crack that minimum input flow required to achieve this is 3640 gpm. The table below compares the effects of various crack sizes and system flows on nozzle flows, nozzle flow variations, and crack flows:

Crack Size (Inch)	Flow Rate (gpm)	Min. Nozzle Flow Change (%)	Max. Nozzle Flow Change (%)	Crack Flow (gpm)
.032	3600	2	6	31
.063	3640	0	6	60
.063	3700	1.4	9	61
.125	3800	-3	13	117

During verification of the Oyster Creek sparger design, the spray distribution across the core was measured for system flow rates of 3100, 3400, and 4500 gpm. Acceptable spray distribution was measured in all cases. Nozzle flow distribution curves for the 3100 and 4500 gpm cases are shown in Figure 1 to demonstrate the range of flow rates which provide acceptable performance. The variation in nozzle flow rates between the nozzle nearest the inlet and the end nozzle for the 4500 gpm system flow is on the order of 45%. This is greater than the variation existing in the 3640 or 3700 gpm cracked sparger case. The fact that acceptable spray distribution was measured for system flow rates of 3100, 3400, and 4500 gpm also indicates that at least within this range the sparger design is not very sensitive to flow variations and acceptable spray distribution is achieved.

III. Conclusion

Test measurements and this analysis have shown nozzle flow variations along the sparger of the same order as would exist in the cracked sparger with a system flow of 3640 gpm. Test measurements have also shown the sparger is not sensitive to changes in the system flow and provides acceptable spray distribution with system flows from 3100 to 4500 gpm. Based on this, it is concluded that the nozzle flow variations that could exist with a system flow rate of 3640 or 3700 gpm if the crack increased to a 1/16-inch circumferential gap are within defined acceptable limits and that acceptable core spray distribution would be maintained.



OYSTER CREEK NUCLEAR GENERATING STATION
NORMALIZED NOZZLE FLOW RATE AS A FUNCTION
OF CIRCUMFERENTIAL LOCATION
FIGURE 1