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DUKE POWER COMPANY

POWER BUILDING

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WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
373-4083

July 24, 1981

Mr. James P. O'Reilly, Director
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

RECEIVED
JUL 31 1981
U.S. NUCLEAR REGULATORY COMMISSION

Re: Oconee Nuclear Station
Docket No. 50-269

Dear Mr. O'Reilly:

Please find attached Reportable Occurrence Report RO-269/81-11. This report is submitted pursuant to Oconee Nuclear Station Technical Specification 6.6.2.1.a(9), and describes an incident which is considered to be of no significance with respect to its effect on the health and safety of the public.

The Oconee NRC resident inspector and ONRR project manager were advised of the event by July 16, 1981. Other utilities with B&W designed NSSS have been advised as has the B&W RRG chairman. Duke and B&W are continuing to define the program to address the event, including actions necessary to repair the Unit 1 components.

Very truly yours,

William O. Parker, Jr.

RLG:scs
Attachment

cc: B&W Regulatory Response Group:

J. J. Mattimoe, SMUD, Chairman
J. H. Taylor, B&W
W. C. Rowles, TECO
D. C. Trimble, AP&L
G. Beatty, FPC
R. J. Wilson, GPU

Director, Office of Management and Program Analysis

Mr. T. M. Novak, U. S. Nuclear Regulatory Commission

Mr. Bill Lavallee, Nuclear Safety Analysis Center

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Duke Power Company

Oconee Nuclear Station

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Report Number: RO-269/81-11

Report Date: July 23, 1981

Occurrence Date: July 15, 1981

Facility: Oconee Nuclear Station, Seneca, South Carolina

Identification of Occurrence: Core Barrel Assembly Thermal Shield Bolts Broken

Conditions Prior to Occurrence: Defueled

Description of Occurrence:

During the visual examination of the Oconee 1 reactor vessel internal components on July 15, 1981, unexpected conditions were observed. The following table summarizes the results of the initial visual examination:

1. Four of 96 bolts connecting the thermal shield to the lower grid flow distributor flange were missing.

2. Approximately 80 per cent of the remaining thermal shield bolts were backed out from 0.1 to 0.5 inches.

3. Three bolt locking cups were missing.

4. One locking cup partially attached.

5. One guide block on the Y-axis was missing.

The above results are shown on Attachment 1. Attachment 2 is a photograph view of the lower portion of the internals.

This occurrence is considered to be reportable pursuant to Technical Specification 6.6.2.1.a(9) in that remedial actions and corrective measures are necessary to prevent the development of an unsafe condition.

The following discussions of pertinent portions of the internals are provided for background. Attachment 3 provides a cross-section view of the 177FA reactor internals.

The thermal shield is a 2-inch-thick cylinder surrounding the core barrel; it extends the length of the core region. Its function is to provide additional shielding against gamma and neutron flux effects on the reactor vessel wall in the core region to reduce gamma heating in the reactor vessel wall and radiation effects on the vessel materials. The bottom support is shown

in Attachment 4. The ID of the thermal shield is machined to clear the bottom flange of the core barrel and to engage the lower grid with a diametral interference fit. Ninety-six 1-inch-diameter, high-strength bolts secure the bottom end of the thermal shield to the lower grid plate. (The four missing bolts were from this location.)

The thermal shield's upper support (shown in Attachment 5) consists of a Stellite clamp and shim pad that are contoured to the thermal shield and core barrel curvature. Twenty of these assemblies are placed equal intervals around the top end of the thermal shield and secured to the core barrel by high-strength bolts (three in each assembly). The design restrains the thermal shield radially both inward and outward, and allows axial motion to accomodate longitudinal differential thermal growth between the core barrel and the thermal shield.

Attached to the exterior of the lower internals are 12 pairs of lateral restraint guide blocks. Each side of the blocks is about 3" x 6.5" x 5" and weighs about 18 lbs. Each pair of blocks straddles one of the 12 core support lugs. One of these 24 guide blocks was observed to be missing.

A visual examination of selected areas of the core internals and the reactor vessel was conducted. The examination was designed to carefully inspect important areas of the reactor vessel internals and the inside of the vessel, and to locate the missing parts.

The following table summarizes the current status of components missing and those retrieved at the bottom of the reactor vessel:

	Weight (lbs)	Dimensions	Initially Missing	Retrieved	Still Missing (7/22/81)
Guide Block	18.0	3"x6.5"x5"	1	0	1
Guide Block Dowel	2.3	4.5", 1.5"D	1	0	1
Guide Block Bolt	0.902	4.1", 1.7"D, 1.0D	1	0	1
Guide Block Bolt Washer	0.085	2" OD, 1.0 ID	1	0	1
Thermal Shield Bolt Heads	0.582	1.375", 1.75D	5	3	2
Thermal Shield Bolt Shanks	0.669	5.125 1.0D	4	4	0
Thermal Shield Locking Clips	0.124	1.0"x2.5"x 1.75"	3	1	2

The retrieved components have been shipped to B&W, Lynchburg, for complete examination and determination of cause of failure.

The visual examination of the selected areas has revealed no other significant deficiencies. The following table summarizes the inspection results:

Thermal shield to lower grid joint	No distress of metal
Upper thermal shield restraint	Locking clips intact; no visual evidence of wear
Core guide blocks	Welds intact; indication of guide block and lug contact
Flow distributor, outside	No indication of impact damage
Incore instrument guide tubes	No indication of impact damage
RV guide lugs	Some indication of contact

Analysis of Occurrence

A preliminary evaluation has been made of the safety implications of the observed conditions. This safety evaluation considered the following:

1. Structural implications of the thermal shield bolt failures
2. Structural implications of the guide block failures.
3. Loose part implications, i.e., damage to the fuel, interference with CRD motion and damage to other RCS components due to loose parts.

Due to the function served by the thermal shield and the manner in which it is structurally considered in the accident analyses, the observed conditions are not believed to have significant public health and safety implication.

Each of the above three types of safety implications is discussed in detail below.

1. Thermal Shield Bolts

The thermal shield is not a principal load carrying member of the reactor internals; i.e., its function is to reduce radiation effects on the reactor vessel. In spite of this function, however, several consequences of joint degradation were considered at the upper and lower end of the thermal shield. If the upper restraint becomes loose, the thermal shield response due to fluid loadings will change with the most likely consequences being a reduction in natural frequency of the shield. This could lead to a significant increase in the cyclic stresses of the lower end attachment bolts. As looseness at the upper restraint develops, any significant metal-to-metal impact would be most likely detected by the loose parts monitoring system (LPMS). Detection becomes increasingly probable at higher frequencies. Should the lower attachment bolts fail, the shrink fit between the lower grid flange and the thermal shield could then loosen and vertical motion would be possible. In the upward direction, motion would be limited by the core barrel flange and stop. In the downward direction motion is limited since the thermal shield rests on the lower grid flange. Therefore, vertical motion is constrained in both directions but should significant vertical motion occur, metal-to-metal impact would also occur and the LPMS would indicate the condition before serious damage would occur. Before vertical motion and associated impacting could occur, numerous loose parts (i.e., bolts, locking cups, etc.) would also exist in the system and again the probability of detection by the LPMS is high.

Although not considered cridible, the extreme condition considered was complete failure of the lower grid flange to which the thermal shield is

attached. Even under this extreme condition, the core support assembly would remain in tact but the thermal shield could conceivably drop a short distance and then be restrained by the twelve core support lugs. These core support lugs are designed to accommodate the design weight of the core and thermal shield, which together, are 13 times the weight of the thermal shield alone. The failure of the lower grid flange is considered to be an extremely remote possibility but nevertheless one in which core cooling would be unaffected.

In summary, evaluation of failure consequences considerably more severe than those observed are not considered to represent a significant risk to public health and safety because of the purpose served by the thermal shield and the lack of adverse effect on core cooling.

2. Guide Blocks

The guide blocks are attached to the lower RV internals and in the original design they were to provide lateral (side) restraint for seismic loadings. During recent analyses however, including the analysis of the effects of LOCA-induced asymmetric forces, no restraint was assumed at the bottom of the core support assembly and all stresses were found to be within ASME code allowables. Therefore, the guide blocks are not essential to assuring the integrity of the reactor internals under accident loads. Furthermore, it appears that the guide block failure is independent of the thermal shield bolt failures and would seem to be an isolated event based on the normal appearance of the dowel pins in the other 23 guide blocks. The single guide block failure appears to be an isolated event but even if this were not the case additional failures would not have significant safety consequences aside from the loose parts implications which are addressed below.

3. Loose Parts

The size of the loose parts which have resulted from these failures vary widely - from the locking clip or a fraction thereof to the guide block. (There is some question at this time as to whether the guide block might have been missing when the internals were last installed in 1976). Any loose parts in the lower head - lower internals region of the reactor vessel which are larger than the flow passages in the fuel assembly end fittings would be precluded from passing through the core or entering the remainder of the reactor coolant system. Pieces which are small enough to pass through the fuel assemblies and into the reactor coolant system are not large enough to seriously degrade the RCS pressure boundary with the possible exception of the steam generator tubing or tube to tube sheet joint. Impacts on the generator upper tube sheet from an object as small as 1.3 oz. has been detected by the Loose Parts Monitoring System. Even if not detected, however, the most significant consequences would be primary to secondary leakage which is detectable and would not interfere with an orderly shutdown.

In no case is it anticipated that fuel damage would occur due to either mechanical effects or flow blockage. This is because pieces which are small enough to pass through the fuel assembly end fitting would be expected to pass on through the core, and out of reactor vessel. Should a small piece lodge in a fuel assembly grid spacer, the effect would be quite localized and could conceivably cause localized fuel damage. Any fuel damage great enough to breach the cladding would be readily detected.

The remote possibility also exists that a larger piece could cause some flow blockage in the lower grid area but because the lower end of the active core operates at reduced heat rates, no fuel damage would be anticipated.

The possible effects of loose parts were considered in connection with interference between control rod pins and guide tubes. This is not considered likely because of the small diameter (1/8") coolant entry at the lower end of each guide tube. This would require not only a very small piece but also a precise flow direction to enter the guide tube. Furthermore, the velocity in the guide tube, immediately past the entrance decreases significantly so that a metallic object is not likely to be supported by the vertical fluid stream. However, although control pin interference is considered very improbable, if it were assumed to occur, it would very likely be detected during control rod exercise programs. This is not considered to be a problem because any pieces small enough to reach the upper plenum area would not be expected to lodge between a control pin and guide tube but rather pass on through the upper plenum.

If a loose part were to reside in the lower plenum of the reactor vessel, damage to the incore guide tubes or incore nozzles could occur if the part were located in a highly turbulent area. These, however, are not pressure boundary parts. Furthermore, repeated impacts from a loose part (approximately a 2 lb. RC pump impeller nut) have been detected in the past by the LPMS. Somewhat smaller parts than the pump impeller nut should also be detectable in this area.

In summary the effects of loose parts in the reactor coolant system do not represent a threat to public safety. Experiences in several operating reactors has proven this to be the case.

4. Conclusions

Failures of the type observed at Oconee 1 are not considered to represent a threat to public health and safety. Rather, they could lead to physical damage to the internals or possibly other components. As indicated above more extensive damage than that observed, could occur and still not be considered a risk to public and safety. However, as damage becomes more significant, it should be readily detected by the LPMS and an orderly shutdown could be accomplished. In view of the above, aside from assuring the

proper functioning of the LPMS, as an early indication of degraded conditions, there are no immediate actions required with regard to the other operating plants.

Apparent Cause of Occurrence:

The apparent cause of this occurrence has not been determined at this time. The program to determine the cause of this occurrence is discussed in the Corrective Actions section of this report.

Corrective Action:

Duke Power Company and Babcock and Wilcox are continuing to define the program to address this event. The following is a brief summary of the major activities planned or implemented.

1. Evaluate the loose parts monitoring system and implement hardware/procedural changes as determined necessary. Sensitivity checks of the Unit 1 LPMS are completed and the Unit 2 and 3 LPMS have been recalibrated.

2. Determine and implement inspection plans for Oconee Units 2, 3 vessel internals, as appropriate.

3. Determine and implement plan for additional inspection of Oconee Unit 1 internals.

4. Develop and implement plan to remove Unit 1 thermal shield bolts.

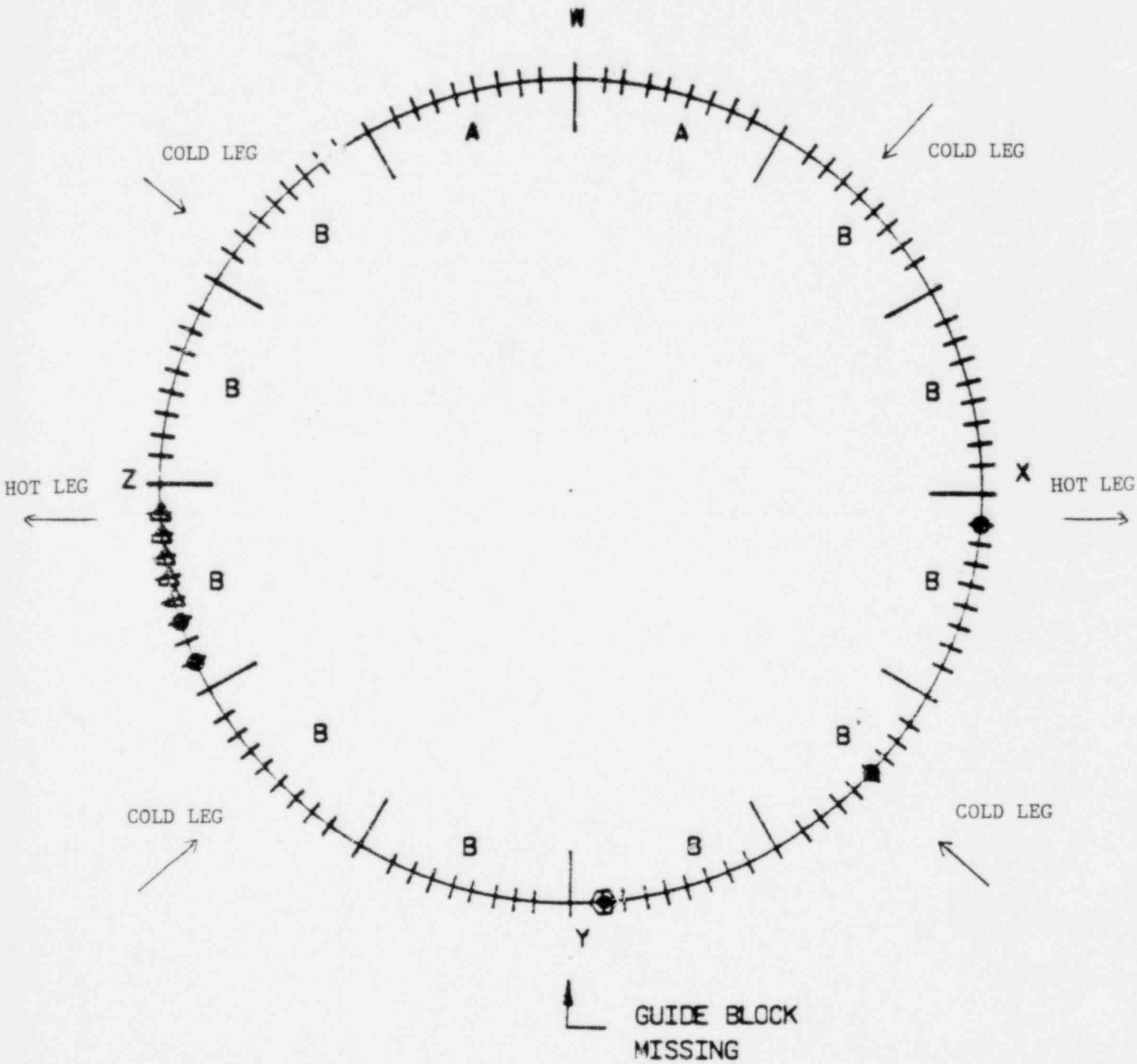
5. Examine failed bolts and determine cause of failure.

6 Evaluate alternative design concepts and implement selected design.

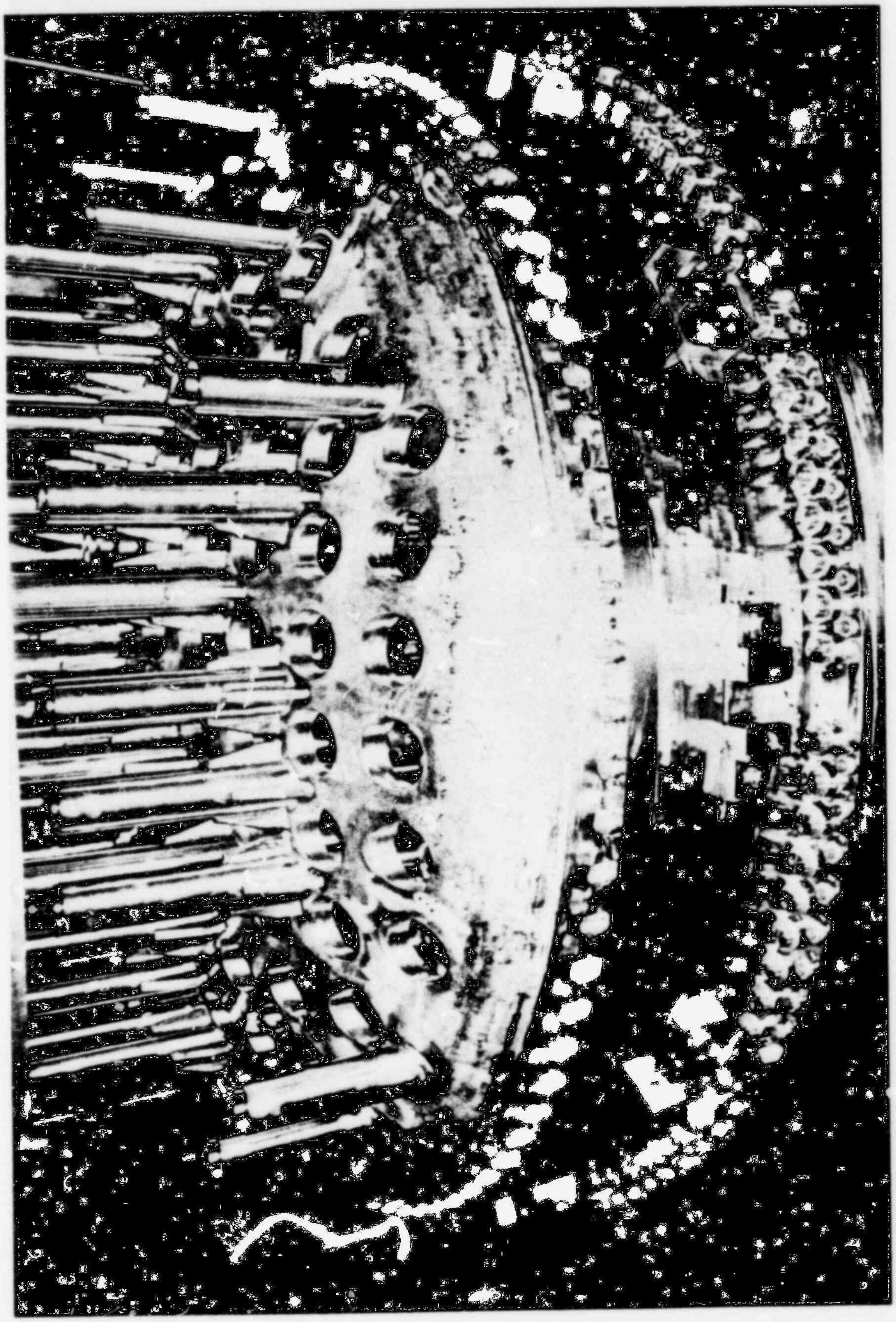
Specific work activities associated with each of the above items are progressing. Periodically, supplemental reports will be provided to keep the NRC advised of the status of completion of the corrective actions, and of any new developments that may occur.

LOWER THERMAL SHIELD

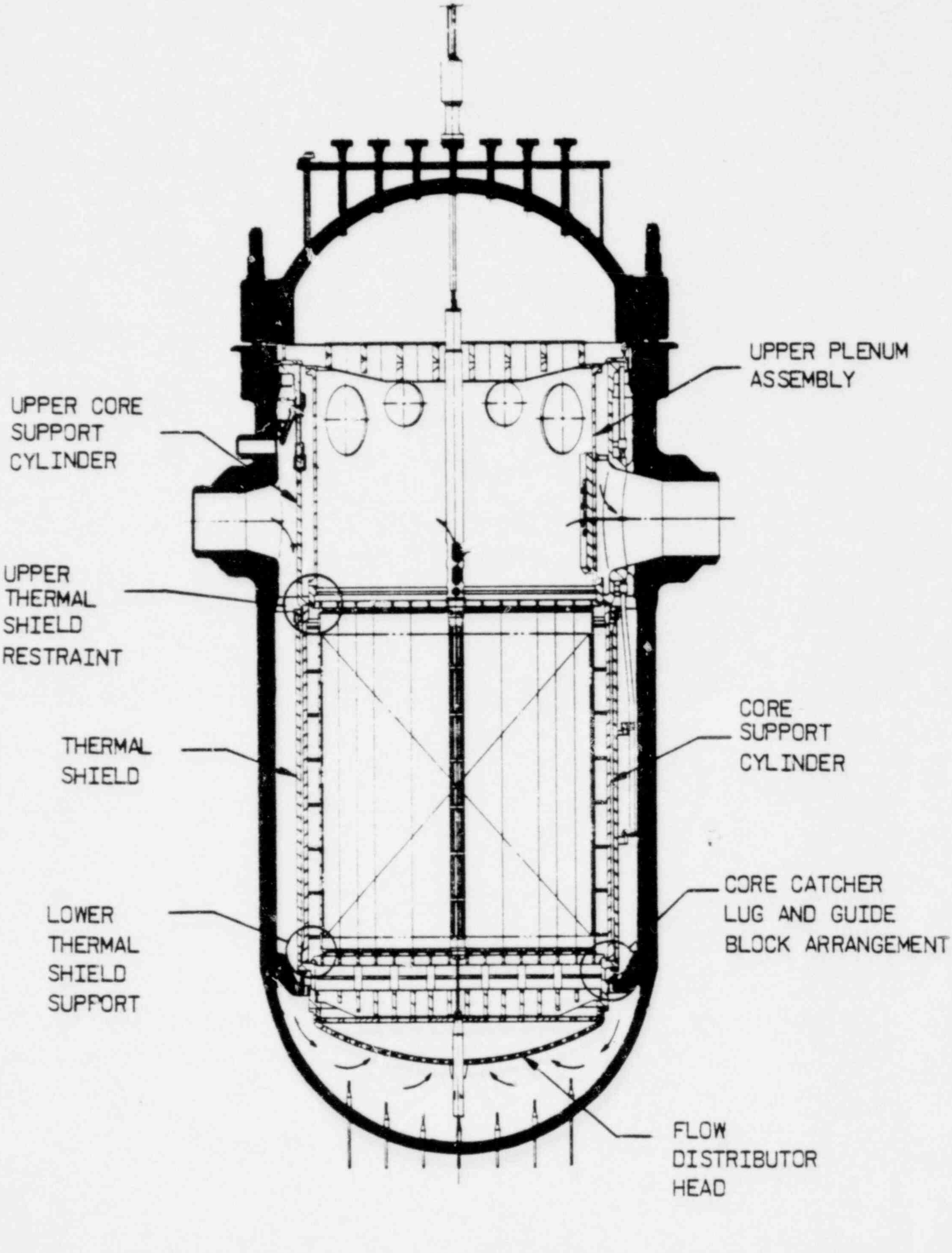
- ● BOLT MISSING
- ⬡ BOLT HEAD MISSING
- A ALL BOLTS FLUSH
- B ALL BOLT HEADS ~ 0.1" TO 0.2 OUT
- △ BOLT HEADS 1/4" TO 1/2" OUT



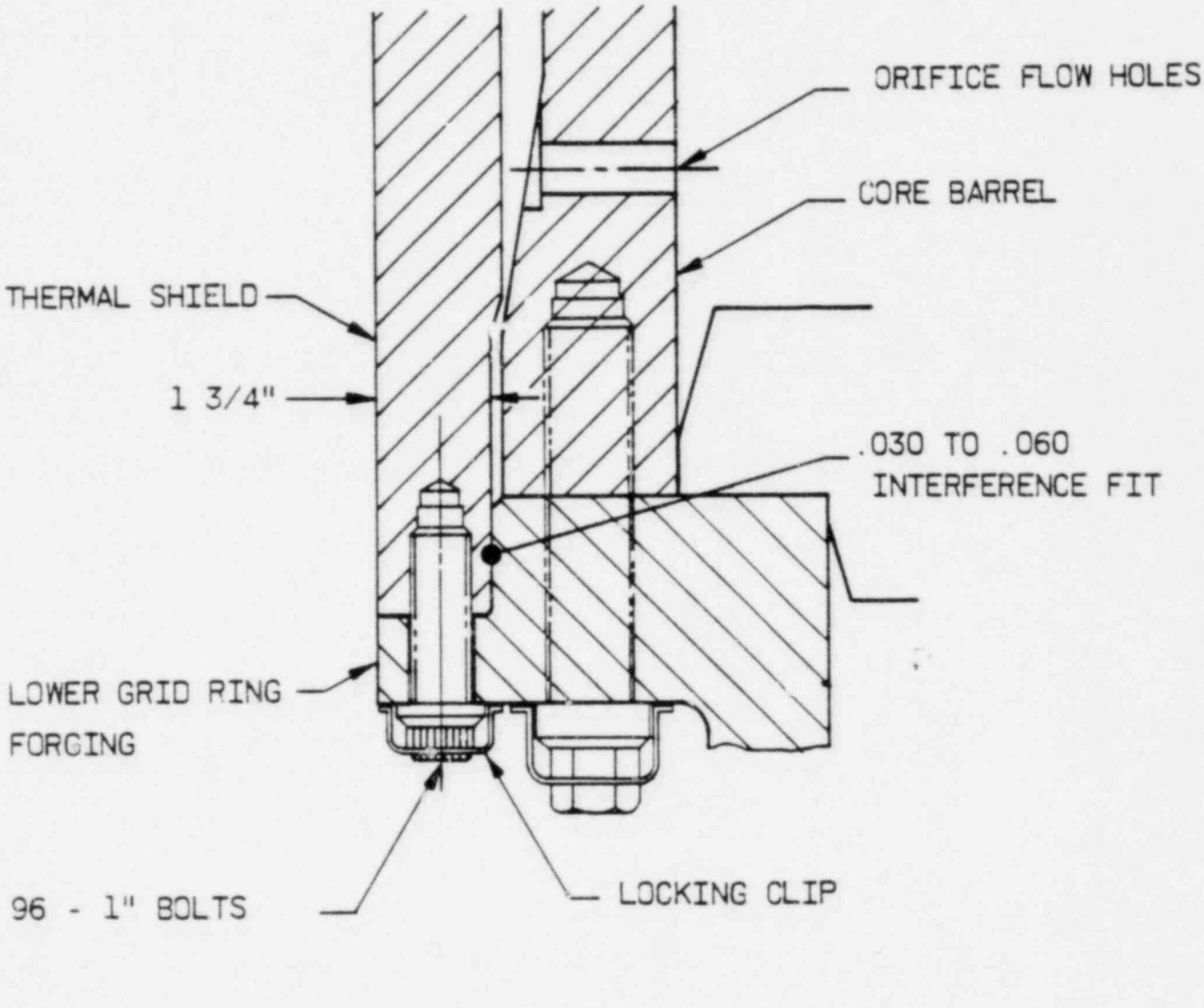
Attachment 2



CROSS SECTION OF 177FA REACTOR INTERNALS



THERMAL SHIELD LOWER SUPPORT



UPPER THERMAL SHIELD RESTRAINT