Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

February 3, 2003

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

Gentlemen:

In the Matter of) Docket No. 50-328
Tennessee Valley Authority)

SEQUOYAH NUCLEAR PLANT (SQN) - UNIT 2 - RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSEE IDENTIFIED MATERIAL WASTAGE (TAC NO. MB4579)

Reference: NRC letter to TVA dated January 3, 2003, Sequoyah Nuclear Plant Unit 2 - Request for Additional Information Concerning Licensee Identified Material Wastage (TAC NO. MB4579)

The purpose of this submittal is to provide additional information in response to the staff's referenced letter. Based on discussion with the staff during a conference call on January 3, 2002, TVA is providing the requested information to allow the staff to complete their review of the inspection results for SQN Unit 2.

Enclosure 1 provides additional information in response to staff's letter of request. Enclosure 2 provides photographs from the Unit 2 reactor vessel head inspection. Enclosure 3 provides schematic drawings of the reactor vessel. Enclosure 4 provides the unidentified leakage trend history for Unit 2.

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This letter is being sent in accordance with NRC RIS 2001-05. There are no commitments contained in this letter.

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

Enclosures
cc (Enclosures):
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U.S. Nuclear Regulatory Commission
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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT (SQN)
UNIT 2
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ADDITIONAL INFORMATION REGARDING
LICENSEE IDENTIFIED MATERIAL WASTAGE

NRC Question No. 1

There are apparently two leak sources: (1) through a reactor vessel level indication system (RVLIS) mechanical joint and (2) through a conoseal or canopy seal control rod drive mechanism penetration. What was the impact of these two separate leakage sources (i.e., what was the extent of the degradation)? How long have there been leaks from these two sources and how was that determined?

TVA Response

There were two leaks discovered as part of the head inspection found during the recent Unit 2 forced outage. These were the reactor vessel level instrumentation system (RVLIS) mechanical joint and a canopy seal leak at location J-11.

1. The RVLIS joint leak was the predominate contributor to the increase in radioactivity in containment. The RVLIS mechanical joint leak was at a compression fitting joint which is disconnected each outage to facilitate head removal. This joint sprayed onto the side of the control rod drive ventilation shroud and down onto the insulation that covers the reactor vessel flange bolting. The borated water then followed the insulation seam joint and dripped down onto the vessel head resulting in some wastage of the alloy steel (Mg-Mo) vessel head. The area of wastage is approximately 5 inches long, 1/2 inch wide and 1/8 inch deep.

2. The canopy seal leak at J-11 was minor and the dried boron residue traces did not reach the reactor vessel head, as confirmed by inspection using a video probe.

In August 2002 containment radioactivity trended upward at the same time a fuel assembly leak was identified. Based on trending it was conservatively decided that a reactor coolant system (RCS) leak existed in containment from start up of the May 2002 Unit 2 refueling outage. The unidentified leak rate trending data shows

that the leak was small, (less than 0.1 gpm) consistent with data scatter in the lower level of detection range.

NRC Question No. 2

It was communicated that degradation on the upper head is somewhat groove-like, about 5-inches long, and 1/8-inch deep. This morphology is not typical for wastage caused by boric acid; please provide more details to describe the morphology of the degradation. Is the extent of the degradation consistent with TVA's expectations with respect to head temperatures, exposure time, etc.?

TVA Response

As the water dripped through the insulation onto the reactor vessel head, it migrated down the head curvature and evaporated shortly after contact with the reactor vessel head (approximate operating temperature of 550°F). The temperature of the air at the insulation and control rod drive (CRD) shroud area where the leak spread is approximately 115°F to 135°F.

The morphology of the wastage area described in the TVA response to question 1 is consistent with EPRI tests where boric acid is dripped on a 600°F heated surface (Reference Boric Acid Corrosion Guidebook, Revision 1 - Test Reference EPRI-5). The corrosion is described as consisting of narrow troughs that coincide with the edges of the boric acid flow lines. The wastage rates associated with this test ranged from 1.2 to 1.9 inches/year.

Concentrated boric acid at approximately 212°F - 220°F is the point of maximum corrosion rate. However, if the metal surfaces are hot and the leakage rate very low, the solution can boil off quickly, leaving dry boric acid crystals that cause essentially no corrosion. (Reference Boric Acid Guidebook Revision 1 - Section 4.10.)

Considering the amount of wastage and the assumption that the RVLIS leak occurred shortly after start up, the amount of wastage is indicative of a corrosion rate of 0.02 inches/month.

NRC Question No. 3

What is the trend of reactor coolant system (RCS) unidentified leakage since the last refueling outage and how well does the amount of boron recovered correlate to the known trend of RCS unidentified leakage? What is the location of insulation seams in the vicinity of this degradation? What is the distance between the leaking RVLIS mechanical joint and the top of the

reactor vessel head? What is the approximate temperature of this joint with respect to ventilation in the area and the leak path for the leaking RCS fluid given ventilation in the area.

TVA Response

Unit 2 unidentified leakage noted since startup following the May 2002 refueling outage has been low (see enclosure 3 and the information in TVA's response to NRC Question 1).

As can be seen from the enclosed photographs (see enclosure 2), the RVLIS connection protrudes through the CRD shroud above the insulation over the vessel flange bolting. The RVLIS leak resulted in a spray pattern on the vertical insulation. The process fluid that remained in liquid form then progressed to the insulation seam joint and dripped on the reactor vessel head. The distance from the RVLIS mechanical joint to the reactor vessel head is approximately 4 feet.

The temperature of the air at the insulation and CRD shroud area where the leak spread is about 115°F to 135°F.

NRC Question No. 4.

Explain why the Westinghouse fatigue evaluation focuses on one additional startup and shutdown cycle.

TVA Response

The Westinghouse fatigue evaluation was originally prepared with minimal information regarding the material loss on the reactor head. Subsequently, Westinghouse included in its evaluation, allowances for sharp corners which increased the stress concentration factors and affected the fatigue life of the reactor head. As a result Westinghouse included conservative operational restrictions on the number of heatup and cooldown cycles and recommended blending any sharp edges in the depressed area.

Further visual examination indicated there were no abrupt corners. This provided the basis for the relaxation of any operational restrictions and the removal of the recommendation to blend the area. The text regarding sharp edges was left in the evaluation to stress the importance of removing any sharp edges.

NRC Question No. 5

How was the extent of the degradation evaluated? For example, it looks like some borated water could have contacted the RV flange bolts. How was this assessed if the bolts were not removed for inspection?

TVA Response

Extent of condition associated with the RVLIS mechanical joint leak was evaluated by a visual inspection of the exposed reactor vessel flange and flange bolting. The original visual inspection documented the extent and appearance of boric acid deposits. The affected portion of the head, flange and accessible bolt threads were visually inspected for material condition. The boric acid in the flange area was dry and loose with no signs of active corrosion that would have affected the bolting.

The canopy seal weld leak at J11 and other accessible canopy seals were inspected using a video probe through two inspection ports in the CRD shroud. In addition, the areas under the insulation at J-11 were inspected with a video probe to verify that no boron traveled onto the reactor head.

NRC Question No. 6

What caused Tennessee Valley Authority to inspect the RV head? Was there a licensing commitment, TS requirement, or some other vehicle that cased them to inspect? What was the amount of unidentified leakage at the time of shutdown? When was the last time TVA inspected the head and what did the inspection consist of (e.g., bare metal visual)? What would have been the consequences had the inspections not been performed, the borated water leakage identified, corrected, and cleaned up?

TVA Response

Proactive measures taken at the onset of the forced outage included inspections of lower containment and the pressurizer compartment looking for potential leakage. Inspection of the reactor vessel head was a result of conservative management decision making which took into account the trend of containment activity data and the fact that two different inspection teams did not find a leak that could account for the activity being seen.

A 100 percent bare metal visual inspection of the reactor vessel head was performed in the May 2002 Unit 2 refueling outage. TVA has committed to follow the MRP plan for head inspections in addition to the ASME Section XI required examinations.

If the leak had not been found during this forced outage and operation continued until the October 2003 refueling outage, some additional wastage of the reactor vessel head would have occurred. Given the limited data available, however, we do not believe that it is possible to arrive at any credible estimate of additional leakage consequences.

The leak would have been discovered during the refueling outage when the insulation and RVLIS connection are removed as part of the vessel disassembly. Borated water inspections of the accessible head and canopy seal welds performed as a scheduled refueling outage activity would have identified and evaluated any degradation at this particular location.

NRC Question No. 7

What was the root cause for leakage occurring in the RVLIS mechanical fitting and how will you confirm that there will not be any additional leaks of this nature?

TVA Response

At this time TVA is conducting a root cause analysis. Following completion, TVA plans to submit the results of the analysis.

ENCLOSURE 2

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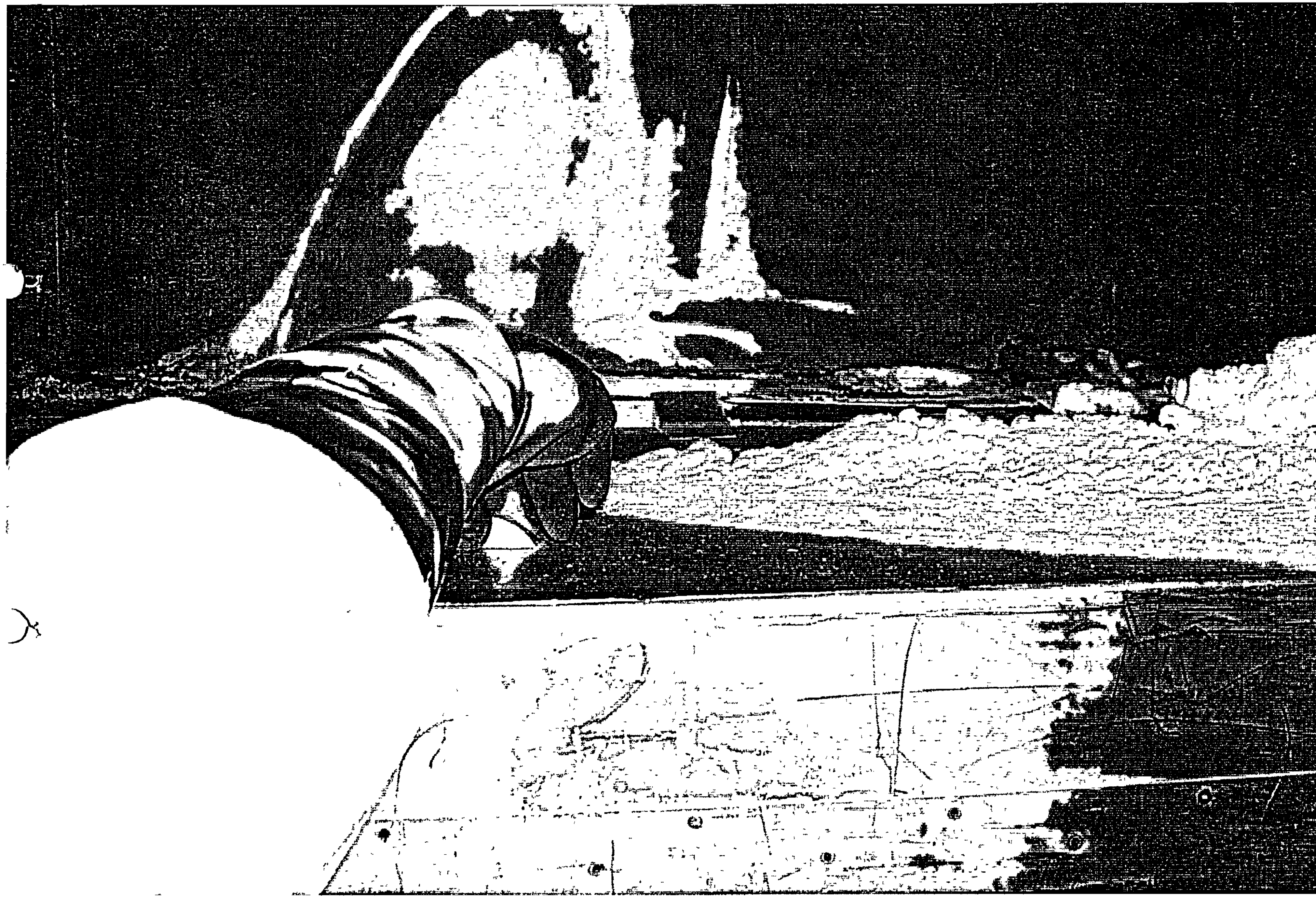
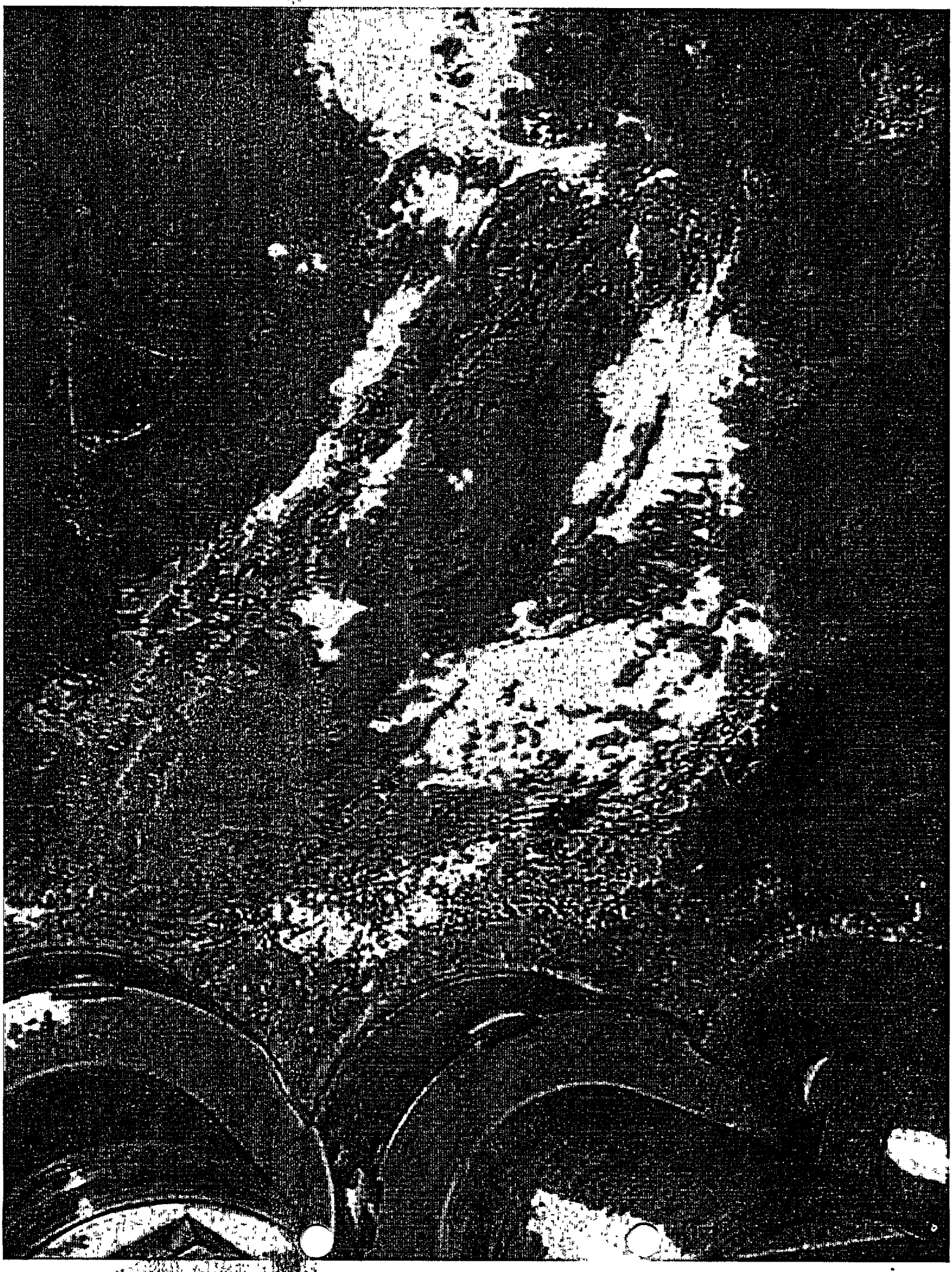
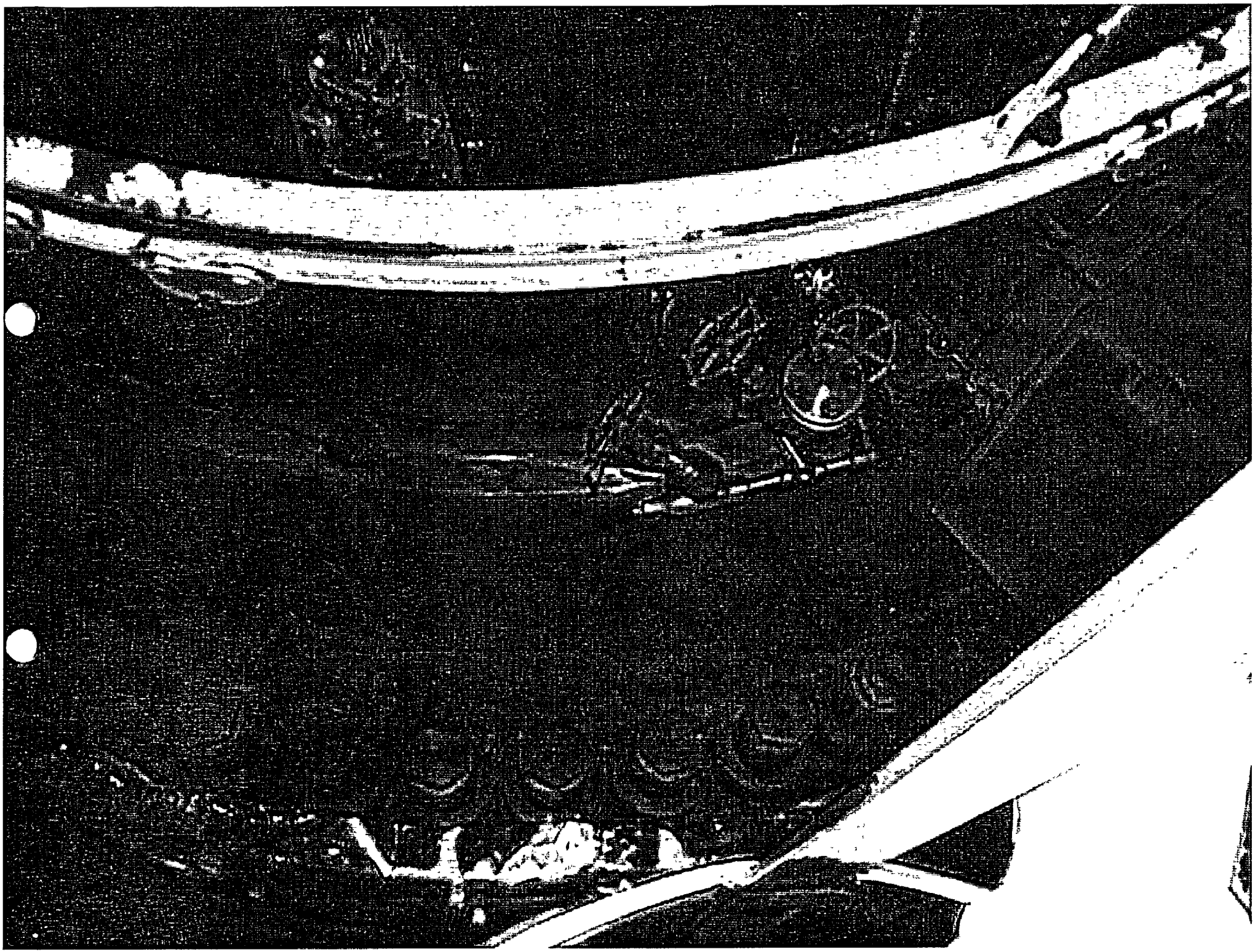
PHOTOGRAPHS FROM THE UNIT 2 INSPECTION







ENCLOSURE 3

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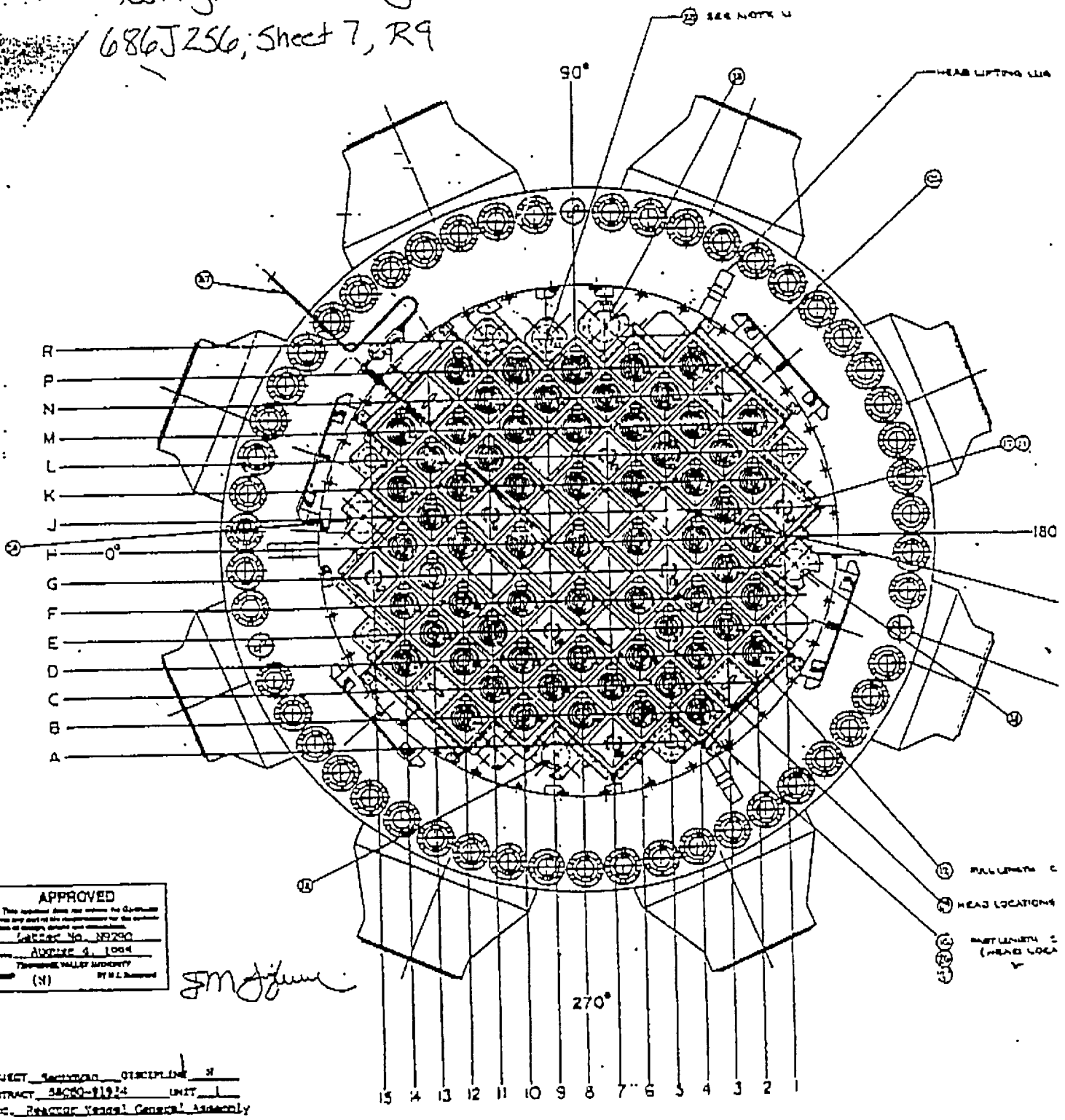
SCHEMATIC DRAWING OF SEQUOYAH REACTOR VESSEL

Watts Bar Drawing
686J256, Sheet 7, R9



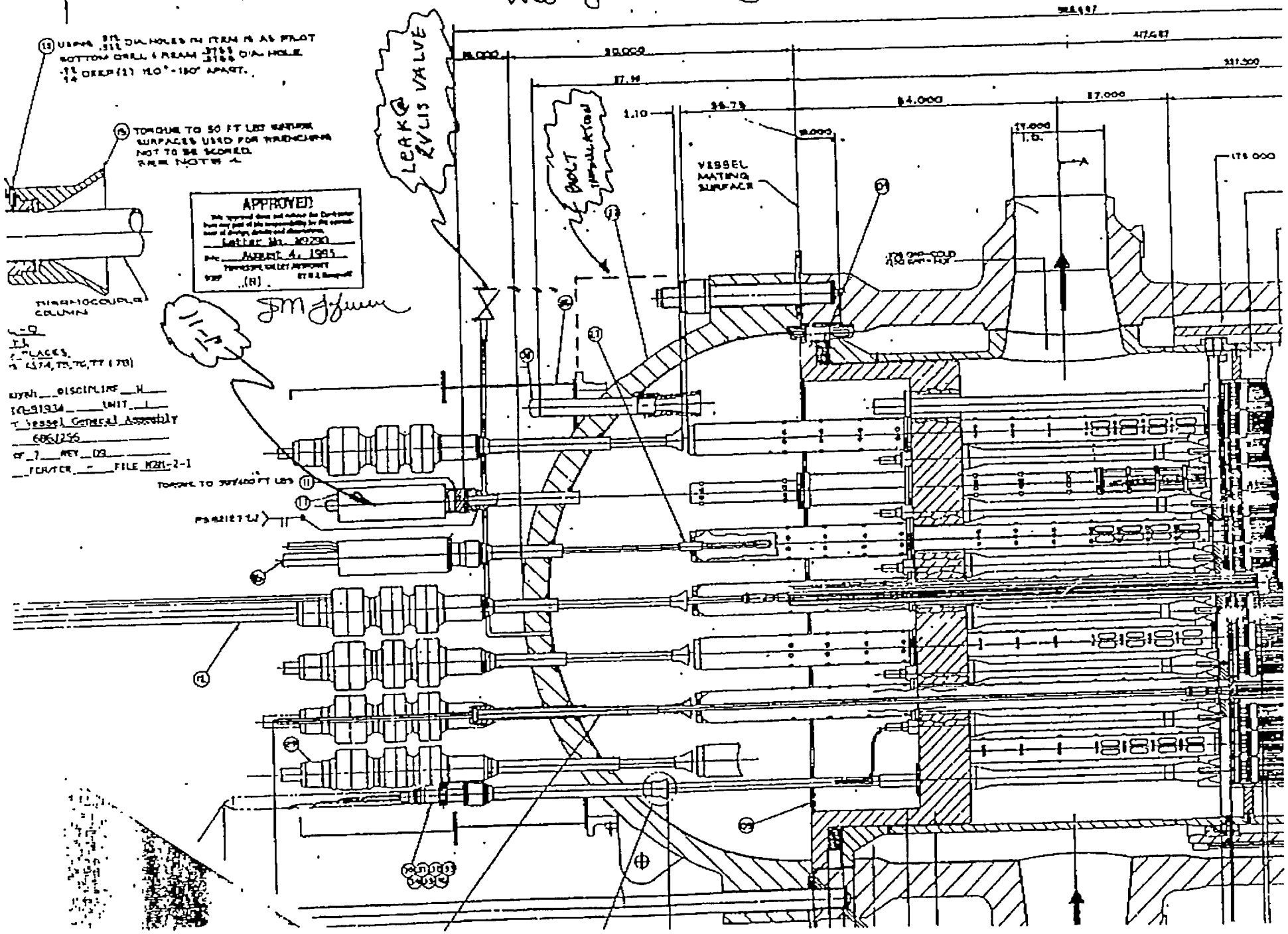
APPROVED
Contract No. NR750
August 4, 1994
(N)

PROJECT Sequoyah DISCIPLINE M
CONTRACT 88C60-919214 UNIT 1
DESC. Reactor Vessel General Assembly
DWG/DOC NO. 686J256
SHEET 7 OF 7 REV 09
DATE 8/4/95 EQUIP'D. - FILE N24-2-1

PLAN VIEW WITH HEAD ASSEMBLED

40 39 38 37

Westinghouse Drawing 686J256-Sheet 4, R9



ENCLOSURE 4

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UNIDENTIFIED LEAKAGE TREND HISTORY

U2C12 RCS UNIDENTIFIED LEAKAGE

Data obtained from SI-137.0 Performances