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DATA REPORT

QUICK LOOK INSPECTION RESULTS

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Prepared by:
TMI-2 Technical Planning Department
GPU Nuclear, Inc. - Bechtel National, Inc.

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DATA REPORT

QUICK LOOK INSPECTION RESULTS

Technical Planning Department


Director, Technical Planning

INTRADEPARTMENTAL REVIEW AND APPROVAL

Responsible Engineer

Victor R. Fribe

Manager, Data Management
and Analysis

Victor R. Fribe

Supervisor, Technical and
Administrative Services

Donald W Butler

Manager, Disassembly &
Defueling Planning

Gordon R Shillman

SUMMARY

In July and August of 1982, a series of video inspections was made of the damaged internals of the TMI-2 reactor. These inspections, which were collectively dubbed "Quick Look", took place during three entries to the reactor building over a 3-week period. The "Quick Look" afforded the first view of the extent to which the accident damaged the fuel and other components inside the reactor. More than 6 hours of videotape footage were shot during the inspections.

The videotapes showed extensive damage to the fuel, to the extent that a void more than 5 feet deep was found at the top center of the core. At the bottom of the void, a layer of rubble was observed. A panel of experts, the Quick Look Videotape Review Group, was convened to review the tapes and interpret the video images.

This group consisted of individuals who were familiar with damaged fuel phenomena, fuel and internals design details, and the details of conduct of the Quick Look inspections. This report presents the conclusions and interpretations of that group.

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SECTION 1.0 INTRODUCTION

1.1 OBJECTIVE

This data report describes the results and interpretations of the Quick Look inspections performed to examine the extent of damage to the reactor core of TMI-2.

1.2 BACKGROUND ON QUICK LOOK

The technical plan for reactor disassembly and defueling contains a pre-head-lift examination (PHLE) involving the removal of a control rod drive mechanism (CRDM) and the insertion of a television camera through the empty CRDM nozzle. Because of limited overhead clearances, the PHLE requires either the availability of the polar crane or a complex hoisting, rigging, and cutting scheme to remove the CRDM with missile shields still in place. Either method involves considerable time and expense to make preparations.

Early in 1982, the Technical Assistance and Advisory Group (TAAG) laid the groundwork for an alternative to the PHLE, a simpler Quick Look examination that could be performed by inserting a miniature television camera through a leadscrew support tube. This technique could be used merely by removing a CRDM leadscrew rather than the entire CRDM mechanism and would not require the use of the polar crane nor removal of the missile shields. Although the area the camera could access inside the reactor was somewhat limited because of the geometry of the CRDM and control rod guide assembly, the effort was considered worthwhile because the camera could observe the condition of the control rod guide assembly, the upper grid assembly of the plenum, and the tops of fuel elements, including whether fuel pins were present.

After some discussion of potential drawbacks and feasibility, a test in the Unit 1 reactor confirmed that the camera could indeed be maneuvered into the desired areas within the reactor. As a result, the Quick Look inspection was scheduled to be performed after the Decontamination Experiment was completed and as soon as the necessary preparations could be made.

1.3 PHYSICAL ARRANGEMENTS

The inspection crew and its equipment were set up on the work platform atop the reactor head service structure. This location provides easy access to the top ends of the CRDM assemblies. Refer to Figure 1 for a diagrammatic representation of the physical arrangements.

The camera, which is 1-1/4 inches in diameter and 14 inches long (see Figure 2) was lowered through the 1-1/2-inch diameter hole within the CRDM made available by removal of the leadscrew. The camera was suspended by its cable, which provided power and carried the signal. The camera cable is marked with color-coded tape at key elevations so that the camera position relative to various reactor internal locations was known as the camera was lowered into the reactor (see Figure 3). An additional 1/32-inch "tilt" cable was attached near the forward end of the camera. By pulling up on the small "tilt" cable, the camera can be articulated away from the vertical.

The inspection team consisted of four members in addition to the health physics technician: a technical director, a TV control unit operator, a TV camera manipulator, and a cable handler (see Figure 4). These functions were performed by the following individuals:

Technical Director:	Noman Cole, MPR Associates (QL-1 and 2) David Buchanan, GPU Nuclear (QL-3)
TV Camera Manipulator:	William Markwood, Babcock & Wilcox
TV Control Unit Operator:	Lyle Bohn, Babcock & Wilcox (QL-1 and 2) James Tarpinian, Bechtel Northern (QL-3)
TV Cable Handler:	William Austin, GPU Nuclear (QL-1 and 3)
Equipment Handler:	Daryl Miller, Bechtel National Inc. (QL-3)
Debris Probe Manipulator:	William Austin (QL-3)

1.4 SEQUENCE OF EVENTS

On July 19, 1982, the leadscrew for the CRDM at location H-8 (see Figure 5) was uncoupled from the control rod spider. On July 21, 1982, it was removed from the CRDM and packaged for further examination and analysis. The first Quick Look inspection (QL-1) was then initiated at the H-8 location, which is

above the center of the core. The camera was lowered down through the leadscrew hole in the CRDM, and an inspection was made of the control rod guide assembly and upper grid plate area of the plenum assembly. The spider and fuel assembly end fitting were not seen, indicating that part of the core was gone from its normal position. Next, the camera was lowered down into the void in the core, which at that location extended to 5 feet 3 inches below the nominal top of core. The debris bed was examined, and then the camera was rotated to point upwards and raised to examine the underside of the plenum assembly. See Figure 6 for a sectional view of the reactor.

On August 5, 1982, after trying several locations, the leadscrews were removed at locations E-9 and B-8 (see Figure 5). On August 6, the second Quick Look inspection (QL-2) was performed at both locations. At the B-8 location, which is near the core periphery, the spider assembly was still in place, and the camera could not be lowered beyond that point. The camera was moved to the E-9 location, which is midway between the other two, and an auxiliary light was lowered into the core at H-8. At E-9, the camera was again unobstructed by the upper end of a fuel element, and the CRDM guide tube, debris bed, and underside of the plenum assembly were examined. Variations of lighting using the on-camera and auxiliary lights were tried.

On August 9, 10, and 11, 1982, a panel of experts - the Quick Look Videotape Review Group - was convened to review and interpret the videotape recordings made during QL-1 and QL-2. This panel is described in the next section of this report. The panel made recommendations about specific areas and techniques for the third Quick Look inspection.

On August 12, 1982, the third and final Quick Look inspection (QL-3) was performed. The location chosen was again E-9, and the auxiliary light was again placed into the core at H-8. Besides additional inspection of the debris bed, two other activities were added to the inspection. The debris was probed for depth and degree of compaction with a stainless steel rod, and a right-angle viewing lens was mounted on the camera to enhance the horizontal viewing possibilities.

On August 17, 1982, the Quick Look Videotape Review Group was again convened to examine the tapes from QL-3. This report summarizes the observations and conclusions of that Review Group.

1.5 QUICK LOOK VIDEOTAPE REVIEW GROUP

This expert panel of reviewers was convened to provide an organized review of the approximately 6 hours of videotape recorded during the three inspections. This panel consisted of cognizant individuals from most of the organizations participating in the TMI-2 recovery effort. The base group of participants were individuals who were familiar with the details of construction of the fuel and core internals, and with the video technology. This base group included:

- V. R. Fricke - GPU Nuclear, Technical Planning - Chairman
- N. M. Cole - MPR Associates, Inc., Technical Director of QL Inspections
- R. V. DeMars - Babcock & Wilcox, Fuel Engineering
- J. T. Mayer - Babcock & Wilcox, Lynchburg Research Center
- C. Cox - Westinghouse Hanford Company
- W. T. Franz - EG & G

In addition, the following part-time participants provided significant input to the review efforts:

- J. McCarthy - GPU Nuclear Fuels Division
- P. Kasik - MPR Associates
- T. Patterson - Bechtel Northern Corporation
- D. Owen - EG & G Idaho
- P. MacDonald - EG & G Idaho
- G. E. Kulynych - Babcock & Wilcox
- R. E. Kosiba - Babcock & Wilcox
- E. J. Bateman - Babcock & Wilcox
- H. Davis - Babcock & Wilcox
- C. S. Caldwell - Babcock & Wilcox

The approach was to index the raw tapes by footage from the beginning so that sections of interest could be found quickly, and then to examine in detail the footage that was particularly interesting. The indices for each set of tapes are included as appendices to this report.

SECTION 2.0
BRIEF CHRONOLOGY OF QUICK LOOK INSPECTIONS

2.1 QUICK LOOK 1, JULY 21, 1982

The camera was lowered at the H-8 position (see Figure 5). The inside of the control rod guide assembly was examined down to the level of the top of the core. The camera was then raised slightly and angled in a way that would allow it to pass through the flow holes in the side of the guide tube into an adjacent location (see Figure 7). Because of symmetry and lack of adequate reference marks, it was not possible to determine which adjacent location the camera entered when it was tilted out through the flow hole. At any rate, the control spiders were not visible, either at H-8 or at the adjacent location.

The camera was then drawn back into the H-8 guide tube and lowered vertically into the region where the fuel assemblies should have been. Nothing but small particles of debris suspended in the water was encountered until the camera contacted a rubble bed, 5 feet 3 inches below the top of the core.

After scanning the debris bed for a time, the camera was tilted from vertical downward position to horizontal. The camera was then rotated 360 degrees without encountering any obstructions. This indicates that the void space at the center of the core involves at least the 9 center fuel assemblies and possibly as many as 21 because the camera focus was believed to be set at 3 inches, which increases the sweep diameter to 27 inches (see Figure 8).

The camera was also tilted so that it looked vertically upward at the bottom side of the upper plenum assembly (see Figure 9). While looking upward in the H-8 position, C tubes and two grid pads on the bottom side of the grid plate were inspected (see Figures 10 and 11).

A detailed chronology index of the QL-1 Command Center videotapes can be found in Appendix A of this report.

2.2 QUICK LOOK 2, AUGUST 6, 1982

In preparation for this inspection, the leadscrews at the E-9 and B-8 positions were removed. An auxiliary light was inserted at H-8 and lowered into the core void. The camera was first inserted at B-8, on the core periphery. After examining the top of the control rod assembly hub (spider), which was in its normal location, the light on the camera failed. The camera was replaced with a spare, and the B-8 spider and fuel element upper end fitting were again examined in detail.

The camera was then raised and "kicked out" through a flow hole into an adjacent location, where a burnable poison rod assembly (BPRA) is located. Figure 7 shows how a BPRA is held down by a retainer. The retainer with the spider hub inside it was visible at this point. Because the spiders were still in place at B-8 and the adjacent location, the camera could not be lowered any further.

The camera was then withdrawn from B-8 and inserted through the E-9 location. Although portions of the upper end fitting were still in place at E-9, the major part of the end fitting was gone, as well as the fuel pins below it. The partial end fitting offered no impediment to the motion of the camera. When the camera was lowered into the core, it also encountered nothing until it reached a rubble bed approximately 5 feet below the top of the core. The debris in the rubble bed was scanned for a considerable time, as it contained many identifiable components.

While attempting to orient the camera vertically upward to inspect the underside of the plenum, the camera was repeatedly stopped from further motion by objects that interfered with raising the camera. After five attempts, the camera was finally pointed upward and raised into contact with the underside of the plenum (see Figure 12).

When the camera was lowered a bit, the juncture of four partial upper end fittings came into view (see Figures 13 and 14). These upper end fittings are part of fuel bundles, but their remains were suspended from the underside of the plenum. Their condition is described in detail in Section 3.1.2 of this report.

A detailed chronology index of the QL-2 in-containment videotapes can be found in Appendix B of this report.

2.3 QUICK LOOK 3, AUGUST 12, 1982

In this inspection the camera was again inserted at the E-9 location, with the auxiliary light at H-8. After additional examination of the inside of the control rod guide assembly, the camera was lowered to the debris bed.

After some examination of the debris bed and the underside of the plenum, the camera was again lowered to the bottom of the void space. A 1/2-inch diameter stainless steel rod was used to probe the depth of the debris bed at the E-9 location and later at H-8. In both places the rod penetrated to a depth of 14 inches into the rubble bed, using only rotation plus its own weight.

Next, the camera was removed, and a camera fitted with a right-angle viewing lens was inserted at E-9. A detailed scan was made of most of the support plates in the control rod guide assembly (see Figure 15). This scan inspected the upper and lower surfaces of the support plates by locating the right-angle lens opposite the plate (see Figures 16 and 17). The end fitting in E-9 with its grillage plate gone was also inspected with the right-angle lens (see Figures 18 and 19).

Finally, the camera was inserted 2 feet 6 inches into the core void, and a panoramic scan was made. During this scan, some vertical arrays of tubes could be seen in the distance, very indistinctly.

A detailed chronology index of the QL-3 in-containment videotapes can be found in Appendix C of this report.

SECTION 3.0 OBSERVATIONS

3.1 CONDITION OF PLENUM

The upper plenum assembly is a structure whose purpose is to guide the control elements in their vertical motion and to compress the springs at the top fitting of the fuel elements, and by so doing, align them and hold them firmly in place. The upper plenum assembly is shown in cross-section in Figure 20.

Several portions of the upper plenum assembly were accessible during the quick look video inspections. These included the control rod guide assemblies at H-8, E-9, and B-8, the upper grid plate (which is at the bottom of the plenum assembly), and the grid pads attached to the underside of the grid plate. The control rod guide assembly is shown in cross-section in Figures 15 and 16, and in plan view near a typical support plate in Figure 17. The upper grid plate as seen from below is shown in Figures 10 and 11. These figures also show the grid pads, which are bolted and dowelled to the grid plate.

3.1.1 Control Rod Guide Assembly

The insides of all three control rod guide assemblies (H-8, E-9, B-8) were examined. In each location, the inside surface of the column weldment appeared to be in good condition. These vertical surfaces were clean near the top, and only small accumulations of scale were visible at lower elevations.

At nearly every brazement support plate observed, the 3/8-inch diameter setscrews that fasten the support plate to the column weldment were found (see Figures 16 and 17). All screws appeared to be in good condition, with intact threads clearly visible. The screws had varying amounts of fine surface deposits, and several had small, flaky debris resting on their top surfaces.

The brazement support plates support the C tubes and split tubes, which are brazed into openings in the support plate. These braze joints, in the locations examined, appeared normal and showed no sign of melting. In particular, at the 10th support plate in the E-9 location, a braze joint with a split tube was inspected and showed no sign of melting or metal loss.

The detailed inspection with the right-angle camera lens in the E-9 position showed that the top surfaces of the first and second support plates had a light corrosion film typical of that normally found on reactor internals and no indication of any material with any thickness. The third support plate had a small amount of material with some thickness (probably less than 1/64 inch) on its top surface. From this support plate downward, the amount and size of material on the top surface increased. The lowermost or 10th support plate top surface had metal chips and part of what appears to be a poison pellet (see Figure 15 for locations of each support plate relative to the core). The bottom surfaces of all support plates inspected (1st, 2nd, 3rd, 4th, 5th, 6th, and 10th), as well as the grid pads, were free and clean of debris. There were gas bubbles noted on almost all bottom surfaces that were inspected.

The C tubes and split tubes serve as guides for the rods of the control element when it is withdrawn into the guide tube. For the most part, these tubes were intact and in good condition. However, at the E-9 location, one of the split tubes showed evidence of minor wastage of metal. Also, two or three adjacent C tubes (adjacent to each other, not necessarily to the split tube) showed signs of melting at the bottom end, below the 10th support plate. Other C tubes at E-9, some only centimeters away, were undamaged. The reason for the localization of the damage was not understood.

At H-8, the bottom ends of several C tubes were visible on several occasions and appeared to be intact.

3.1.2 Grid Plate

The depth of the camera lens below the top of the CRDM at the work platform on the service structure is known to within an uncertainty of less than 1 inch. This is possible because the cable on the camera is marked by a series of colored tapes at various distances from the front end of the camera. Refer to Figure 3.

Using these tape markings, and references of known position inside the plenum assembly (see Figure 15), no evidence of sagging of the grid plate was observed at any of the three locations. The brazement support plates, ends of C tubes and split tubes, grid plate surfaces, and grid pads which were observed were all at the expected locations.

At the H-8 location, the underside of the plenum assembly appeared to be in the normal configuration, which resembles the view shown in Figures 10 and 11. However, the field of view was not as large as that in the photograph. Two of the grid pads were seen and appeared to be in normal condition, except for linear surface patterns. These patterns could have been either cracks in a surface coating of fine debris, or fracture marks associated with spalling of the pad surface. It was not possible to determine which by looking at the video image. Gas bubbles appeared to collect on the underside of the grid pads.

At E-9, four adjacent fuel element upper end fittings could be seen suspended from the underside of the grid plate with the TV camera positioned as shown in Figure 12. The view was similar to that depicted in Figure 14. Figure 14 shows several upper end fittings as seen from below. Figure 21 shows top and side views of the upper end fitting.

The upper end fitting is manufactured from two separate castings, which are welded together at four places along each edge. The upper piece is referred to as the "plenum" piece, while the lower piece is called the "grillage" piece. The diamond-shaped bosses visible on the bottom of the grillage piece are where the control element guide tubes are mounted. The central hole in the grillage piece is for the incore instrument guide tube. All fuel elements contain these guide tubes.

The four end fittings suspended from the grid plate were identified as belonging to the fuel elements located at grid points D-9, D-8, E-9, and E-8, using some additional information not on the videotapes. Figure 21 shows that the fuel element nameplate is mounted along an edge of the upper end fitting which is perpendicular to the bars on the grillage. GPU Nuclear records confirmed that the fuel elements are all loaded into the reactor with the nameplates on the south side.

Figure 22 depicts the view from below diagrammatically on the left half of the figure. The grillage lines were oriented as shown, along the north-south axis. While scanning the end fitting diagonally located from E-9, it was apparent that it was part of a C element, i.e., one with a control spider. Stubs of control rod were visible extending downward, with solid cores as in Figure 12. This eliminates D-10 as a possible identity, since D-10 has an

axial power shaping rod spider, which at its current elevation would have hollow tubes protruding through the end fitting grillage.

This diagonal element also had partial length fuel rods and guide tubes along its far edge, and a portion of a spacer grid was visible near the fuel rods. Location F-8 was also eliminated as a possibility, since, as shown on the right half of Figure 22, the grillage lines go the wrong way (i.e., grillage lines of F-8 would run vertically if viewed from E-9). This left only F-10 and D-8 as possible locations for the partial fuel rods.

If the diagonal element were the F-10 element, the partial fuel rods would be aligned radially with respect to the center of the core. If the diagonal element were the D-8 element, the partial fuel rod orientation is consistent with being the perimeter of a void in the core. That is, the partial fuel rods would be tangential to a core void volume, which is consistent with the observed void and rubble bed. Thus it was concluded that the diagonal element was D-8, and the other two visible end fittings were at D-9 and E-8.

On the E-9 upper end fitting, the grillage is completely gone. The spider is also gone, as is the spring retainer and the spring (see Figure 13). On the other three visible upper end fittings, the grillage is still present, but partially damaged. The end fittings are retained in the plenum grid plate without any apparent support from below.

At first glance, the parts of the grillage that are missing from D-8, D-9, and E-8 appear to have eroded away. But only a fraction of an inch away, there are other portions of the grillage that are in pristine condition, with sharply defined edges evident and no apparent damage or discoloration.

The Review Group concludes that some unexplained damage mechanism must have removed the missing portions of the grillage. It was suggested that the mechanism might have been steam cutting or perhaps abrasion by a mixture of coolant flow and core debris, or some other chemical/metallurgical mechanism related to the high temperatures and hydrogen concentrations present in this area when the core was uncovered and quenched.

In addition to the partially damaged grillage, one of the upper end fittings (D-8) had additional identifiable components suspended from it. A portion of a spacer grid was visible, stubs of control elements protruded from the grillage, and partial fuel rods were suspended along one edge of the fittings. The fuel cladding was broken or eroded or melted away a few inches or less below the grillage. Several rods had portions of the internal springs protruding out the end of the cladding.

When the end fitting at E-9 was carefully scanned from the inside with the right-angle viewing lens, it appeared to be at the normal elevation with respect to the grid structure. Many chips and pieces of debris were found in the tight space between the centering tabs on the end fitting and the grid plate. This debris may be what is holding the end fittings in place, while the remainder of the fuel element is broken away.

Portions of the upper end fitting at E-9 look similar to metal which has been cut by a torch. Adjacent to the cut areas, the metal appears to be in the as-manufactured condition. The cutting mechanism and why it is highly localized is not understood.

3.2 DISTRIBUTION OF CORE DEBRIS

3.2.1 Top Side of Horizontal Surfaces

Top and bottom sides of horizontal surfaces on the 1st, 2nd, 3rd, 4th, 5th, 6th, and 10th support plates (see Figure 15) of the E-9 guide tube were inspected with the right-angle lens (see Figures 16 and 17). The top surface of the first and second support plates appeared to have a light corrosion film typical of that found in normal plants. Starting with the third support plate, the top surface had some debris with thickness (e.g., probably less than 1/64 inch). The thickness and amount of the debris on the horizontal surfaces increased the closer the support plate was to the top of the core. Down through the six support plate, the thickest layer of debris flakes appeared to be no more than about 1/16 inch in depth. On the top side of the 10th support plate, the amount and size of debris were more extensive. For example, a piece of what appeared to be a pellet was observed lying on top of the 10th support plate.

The layer of flake debris that was on the horizontal surfaces appeared to be loosely deposited and not tightly adherent. Several times the motion of the camera through the water caused the flakes to move around.

3.2.2 Underside of Horizontal Surfaces

The underside of horizontal surfaces of the 1st through the 6th support plates and the 10th support plate of E-9 guide were inspected by the 90-degree lens and were clean and free of material buildup. The undersides of the two grid pads inspected in the H-8 position were clean and free of material buildup (Figure 11). On the underside of almost all horizontal surfaces there were gas bubbles, which is normal for reactor internals.

3.2.3 Vertical Surfaces

In the E-9 position, the vertical surfaces of the CRDM guide assembly tube and the C tubes were relatively clean and scale-free for the top several feet of the plenum, with an increasing corrosion film and/or scale as the camera was lowered. However, near the very bottom of the guide tube, the corrosion film/scale buildup on these surfaces was slight.

3.2.4 Surfaces in the Area of End Fittings

The E-9 end fitting had debris of a larger characteristic size that was packed into the tight space between the upper end fitting centering tabs and the plenum grid plate (see Figure 19). This debris looked like metal chips or fragments, rather than tiny flakes. One piece of debris appeared to be a fragment of a pellet.

3.2.5 Debris and Effect on Water Clarity

Frequently when the core debris bed was jarred by camera impact, a cloud of very finely divided particles was raised. These small clouds settled or dispersed very quickly. In general, the cloudiness of the water showed no consistent pattern from one inspection to the next. In Quick Look 1, the water was quite cloudy, and visibility was only 1/2 to 3 inches beyond the camera lens. In Quick Look 2, the water was clearer, and visibility extended to about 9 inches beyond the camera; it seemed to be limited by available

light, rather than water clarity. In Quick Look 3, some objects were discerned to be at a distance of 1 to 2 feet from the camera, but the image was very indistinct and probably limited by available light.

The improvement in water clarity as the Quick Look inspections progressed may have been due to the time interval between the leadscrew disconnect and removal and when the TV inspections were made. The longer this time interval, the greater the clarity of water due to settlement of greater amounts of debris, as can be seen by the water clarity experienced during Quick Look 3.

3.3 EXTENT OF CORE DAMAGE

3.3.1 Core Void

There is a void in the upper central portion of the core. At the very center, at H-8, the void extends downward from the bottom of the plenum to a debris bed whose top surface is 5 feet 3 inches below the plenum lower surface. This void includes at least the central 9 fuel element locations, and possibly as many as 21, as shown in Figure 8. This was concluded based on the ability to rotate the camera 360 degrees while it was pointed horizontally, without encountering any obstruction.

The void also extends down to 5 feet below the top of the core at the E-9 location. At E-9 it was not possible to make such a 360-degree sweep; the camera was obstructed from turning each time this was attempted. In addition, at E-9, several stubs of rods extended vertically upward from the debris bed. There were also rod stubs extending vertically downward a few inches along the west edge of the D-8 location, suspended from the remains of the upper end fitting of the fuel element, which was still in place (see Figure 23).

The entire fuel element upper end was gone from the H-8 location. No upper end fittings were suspended at H-8 or at the adjacent locations visible (see Figure 11). Because of uncertainty as to the way the camera was pointed, it was not possible to determine which locations adjacent to H-8 were observed.

At E-9, portions of the upper end fittings for the E-9, D-9, E-8, and D-8 fuel elements were suspended from the plenum grid plate. The remainder of the top 5 feet of E-9 was gone.

At B-8, as well as one adjacent location, the spider assembly was encountered at its expected location. This indicates either that the fuel bundles in these locations are intact or suffered minor damage, or that the upper end fittings are stuck in the plenum grid.

3.3.2 Debris Bed

The debris bed was probed by lowering a 1/2-inch diameter stainless steel rod to a point where it touched the debris, and then rotating it and allowing it to penetrate the debris by the force of its own weight (about 30 pounds). It was not considered prudent to push it downwards because that could have caused the probe to buckle to the extent it could not have been withdrawn.

When this was done, the probe penetrated easily to a depth of 14 inches, until it was stopped by an unyielding surface. The probe penetrated to the same depth at both locations, H-8 and E-9.

At H-8 a control spider was visible at a location slightly off center, resting on top of the debris bed. The portions of the spider that were visible appeared to be undamaged. The spider must have fallen when the leadscrew was uncoupled, since there was no upper end fitting to support it, and it was on top of the debris bed. No spider was found below the E-9 location.

At the center location (H-8), the debris bed was relatively flat and level and consisted of granular material of small average size, perhaps 1/8 inch or less. At E-9, the debris bed was more irregular, and the pieces were of larger average size with many identifiable components visible. Appendix D contains a tabulation of these identifiable component pieces.

3.3.3 Radial Scan

When the camera with the right-angle viewing lens was inserted at the E-9 location, a panoramic scan was made at an elevation about 2-1/2 feet below the top of the core. For one-third of the circuit, when the camera was looking in the direction of the auxiliary light, which was at the H-8 location, the picture was washed out by flare from the light. For the third of a revolution when the camera was pointing away from the light, an array of vertically oriented rods or tubes could be discerned, although indistinctly.

Based on apparent size and the known magnification characteristics of the lens, the tubes appeared to be 1 to 2 feet away from the camera. During the remainder of the scan, when the camera was roughly perpendicular to the line of sight to the light, the picture was dark with no detail.

Based on this scan, it is believed that the limit of the core void in this sector extends approximately to where indicated on Figure 23. Although fuel damage may exist beyond this line, tubes extending from end fittings to the debris bed do exist in this area.

SECTION 4.0

CONCLUSIONS

The following conclusions can be drawn within the limits of the examinations conducted:

- The upper plenum appears relatively undamaged; however, there are some upper end fittings with some fuel attached to the upper grid unsupported by fuel rods, and the lower ends of several C tubes appear to have melted.
- The TMI-2 fuel was severely damaged over a significant portion of the core with the result that a portion of the fuel is in the form of rubble with fuel clad in particles of all sizes from very small to full size.
- A significant size void exists in the upper center of the core resulting from settling of the damaged core and/or removal and redistribution of material from the core.
- At two points -- one at the center and the other midway to the edge -- the rubble at the bottom of the void is composed of loose material to a depth of at least 14 inches and in those areas is not a fused mass.
- There appeared to be evidence of partial melting of non-fuel material, such as metal components that have melting points lower than uranium oxide fuel.

In arriving at the above conclusions, limitations of the TV camera system and procedures employed with respect to focusing, lighting, range of visibility, resolution, ability to orient the camera, and other factors were carefully considered.

SECTION 5.0
RECOMMENDATIONS

Based on the results of the review of the three Quick Look inspections, the following recommendations have been made by the Videotape Review Group:

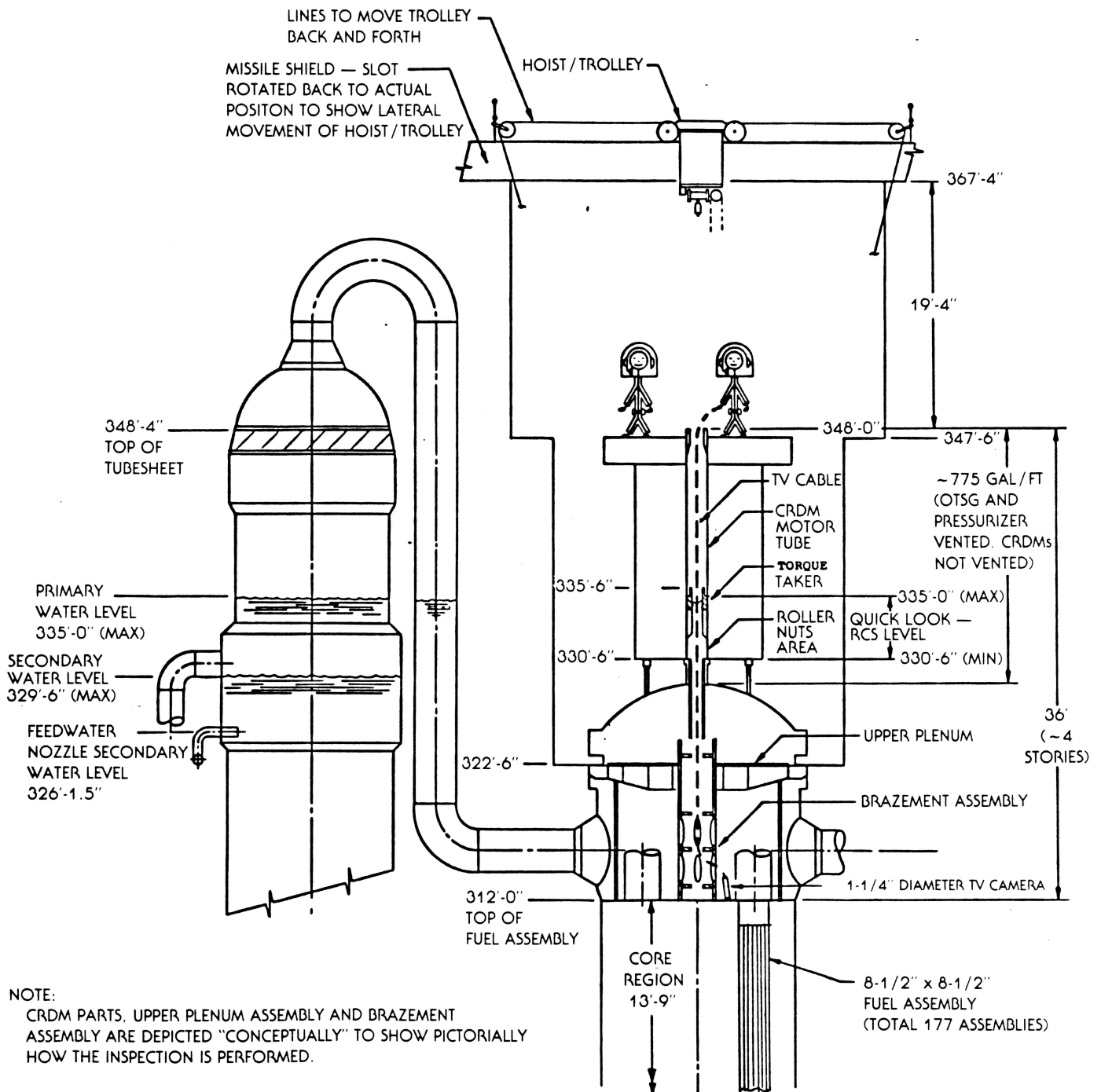
- ° Samples of reactor core debris which were taken in conjunction with leadscrew removals should be analyzed as soon as possible to determine their composition.
- ° The program to disconnect the remaining leadscrews should proceed as scheduled. Although much has been learned about the damaged core using this video inspection technique, it is the consensus of the Review Group that any further inspections at other locations are not likely to add much to that knowledge. Accordingly, it is not recommended to delay the uncoupling to perform more video inspections. Subsequent to uncoupling, additional inspections may be perceived to be desirable, depending on lessons learned during other evolutions.
- ° Specific techniques for conducting Quick Look 3 and the uncoupling of leadscrews were recommended by the Review Group. These have been incorporated into the appropriate procedures and will not be repeated in this report.

REFERENCES

1. TAAG Report, dated March 1, 1982.
2. Report on the Insertion of a Camera into the TMI-2 Reactor Vessel through a leadscrew opening. (BNoC Report)

FIGURES

FIGURE 1
CONCEPTUAL ARRANGEMENT
FOR
TV "QUICK LOOK" VIA LEADSCREW HOLE



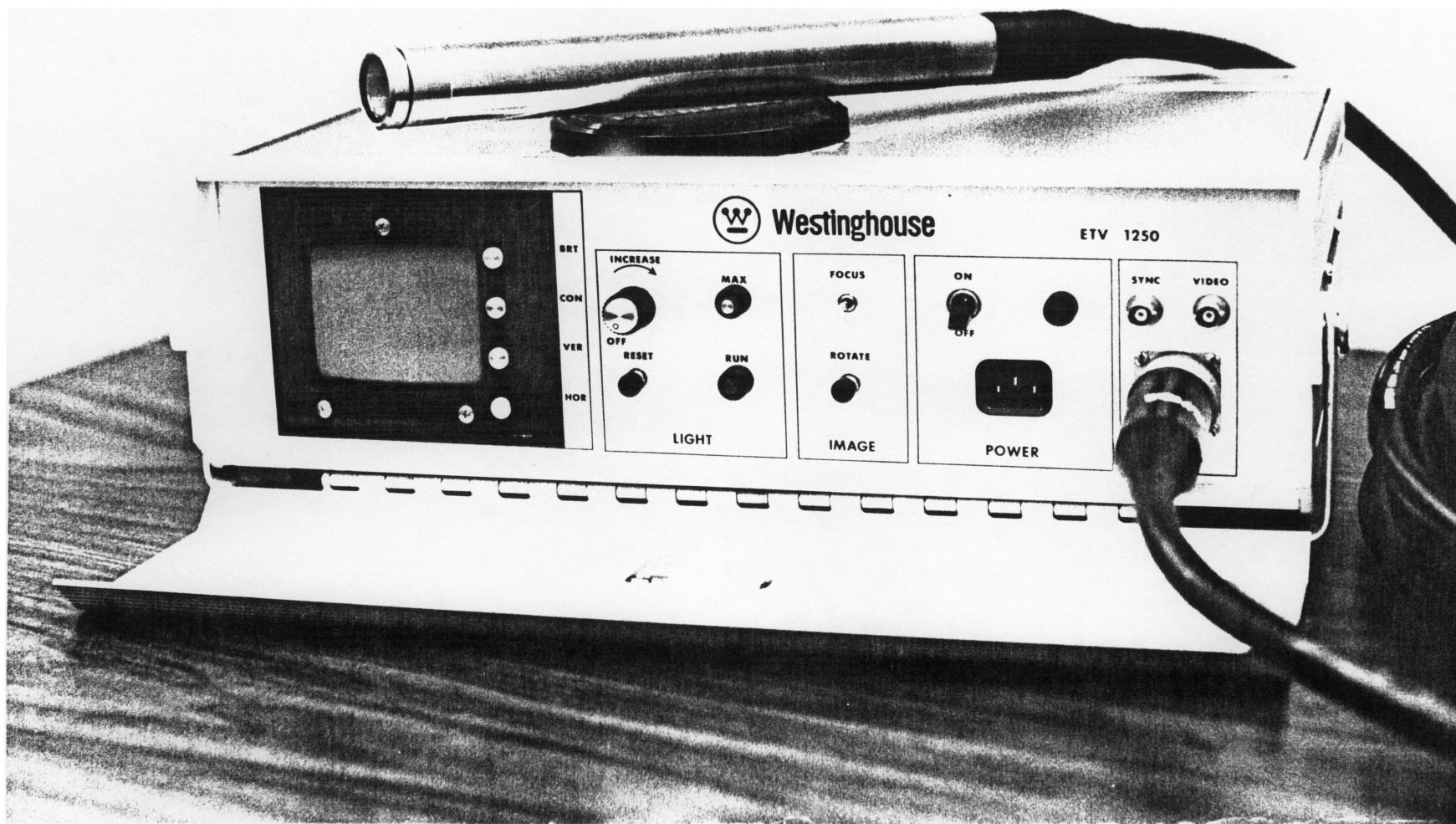


FIGURE 2
MINIATURE TV CAMERA

FIGURE 3
MARKING OF TV CAMERA CABLE FOR TMI-2

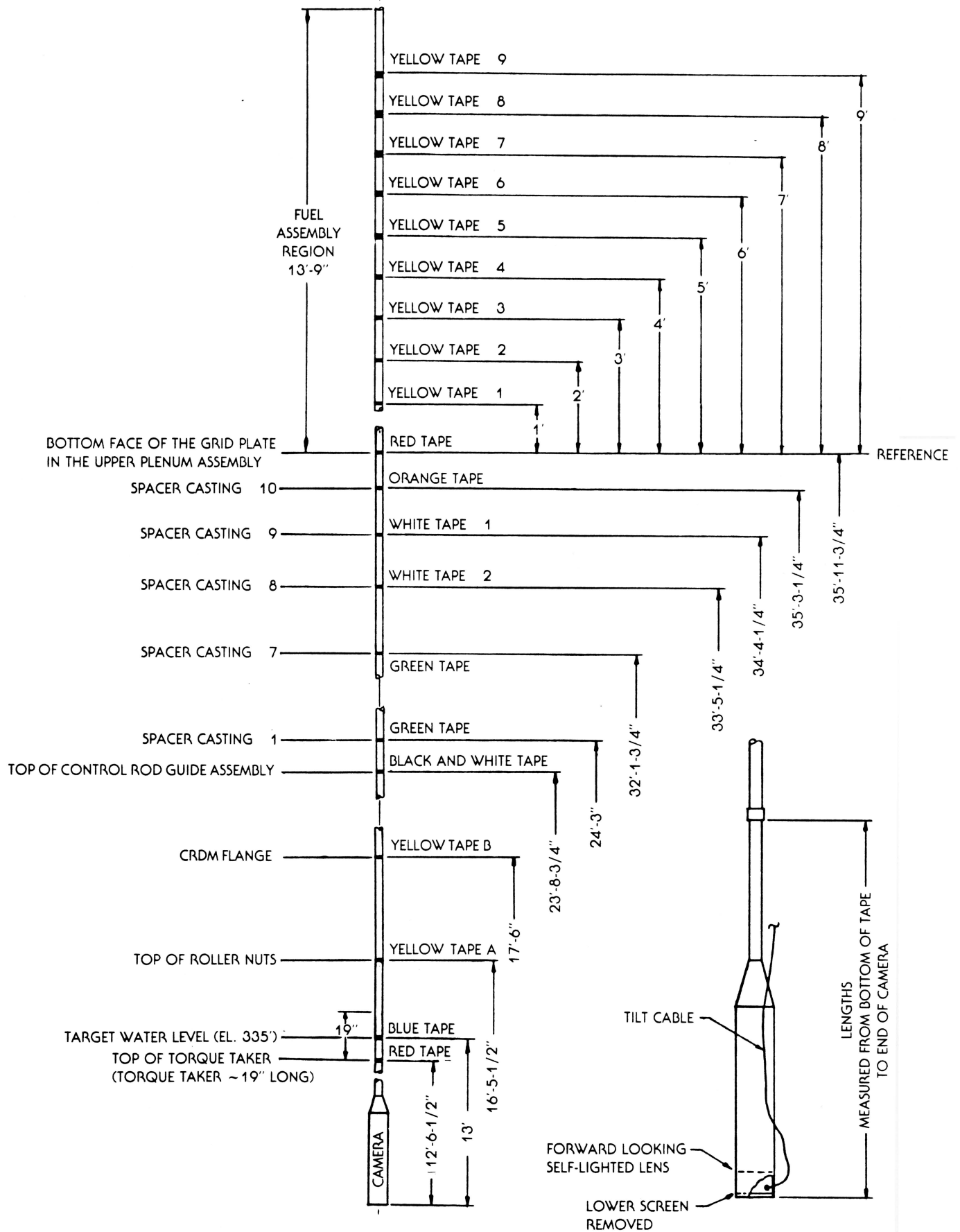
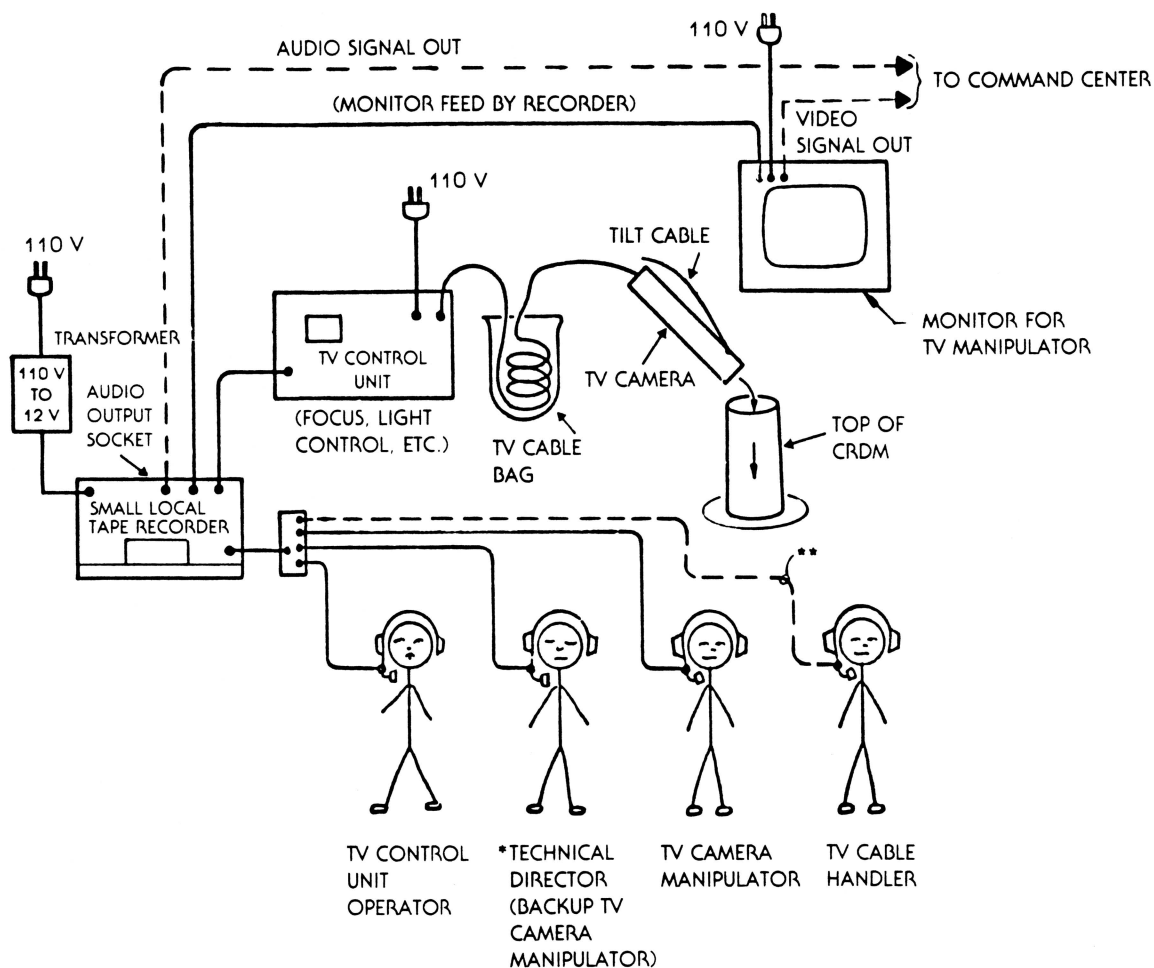


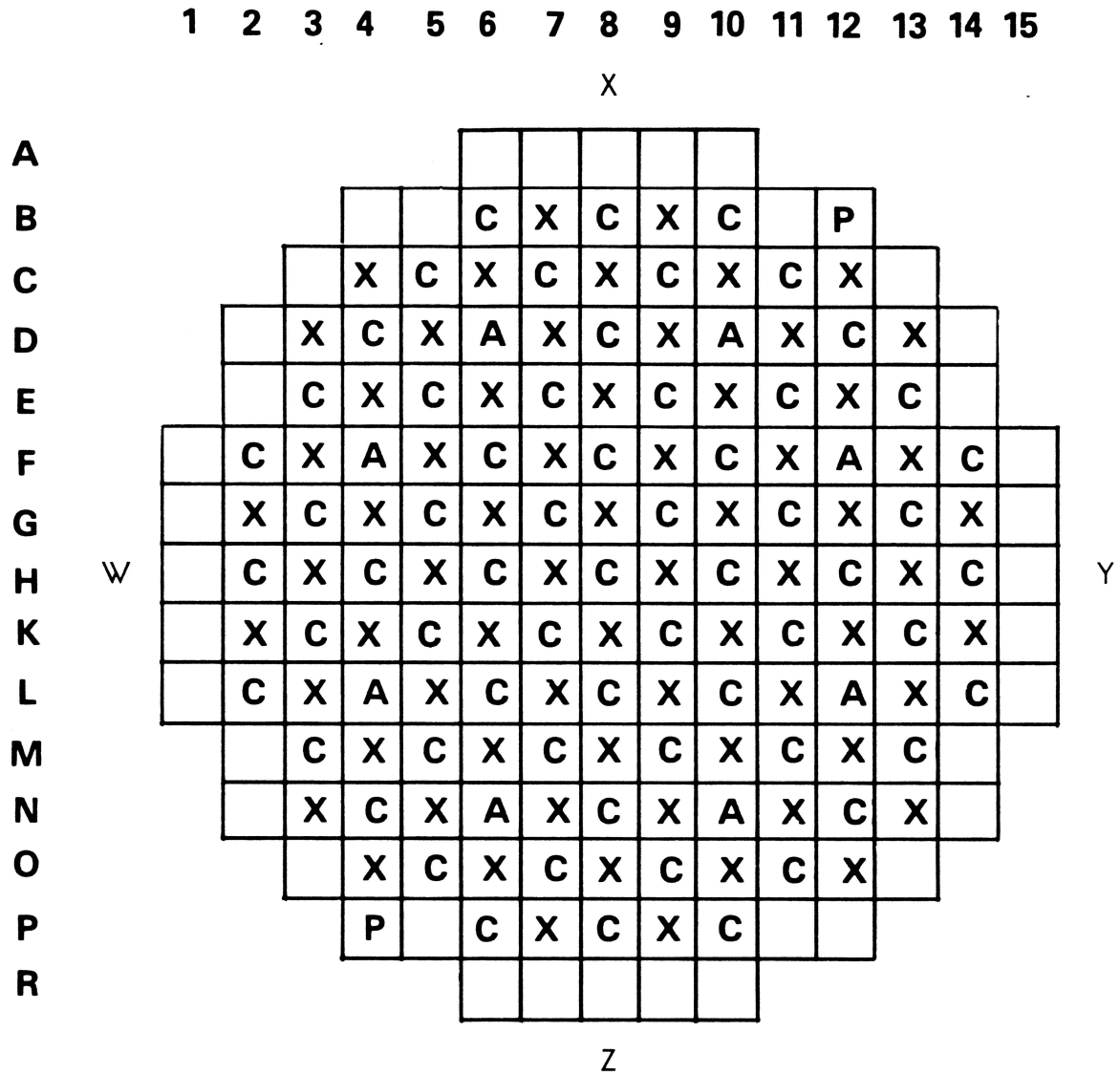
FIGURE 4
BASIC SETUP FOR TV INSPECTION OF TMI-2
CORE REGION VIA LEADSCREW HOLE



NOTES:

- * COMMUNICATION BETWEEN TECHNICAL DIRECTOR AND COMMAND CENTER. THE HEADSET USED BY THE PERSON ON THE INSPECTION TEAM THAT COMMUNICATES WITH THE COMMAND CENTER IS TO BE MODIFIED SO THAT ONE EAR OF THE HEADSET IS TIED INTO THE ABOVE INSPECTION COMMUNICATION SYSTEM. THE OTHER EAR OF THE HEADSET IS TO BE TIED INTO A RADIO RECEIVER TO RECEIVE COMMUNICATIONS FROM COMMAND CENTER.
- ** CABLE HANDLER FREE TO MOVE ABOUT AND TO CONNECT IN AND OUT OF COMMUNICATION SYSTEM.

FIGURE 5
LOCATION OF CONTROL ASSEMBLIES, TMI-2



- ☐ CONTAINS NO CONTROL COMPONENT
- ☐ C CONTROL ROD ASSEMBLIES
- ☐ A AXIAL POWER SHAPING ROD ASSEMBLIES
- ☐ X BURNABLE POISON ROD ASSEMBLIES
- ☐ P PRIMARY NEUTRON SOURCES

FIGURE 6
CUTAWAY VIEW OF REACTOR

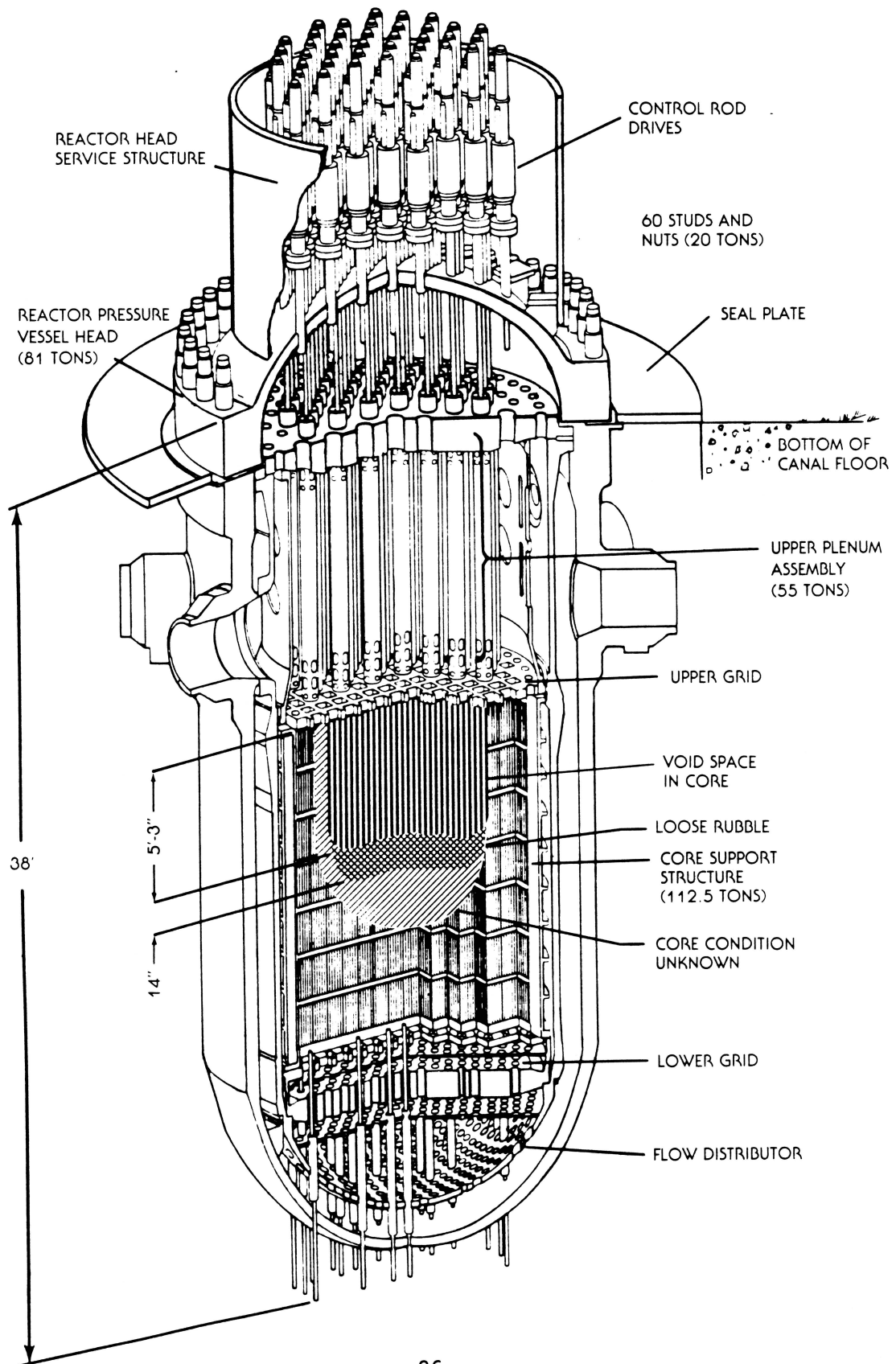


FIGURE 7
 LOOKING OUT OF BRAZEMENT ASSEMBLY
 FLOW HOLES WITH A 1.25-INCH TV CAMERA TO
 INSPECT AN ADJACENT FUEL ASSEMBLY WITH
 A BPRA RETAINER

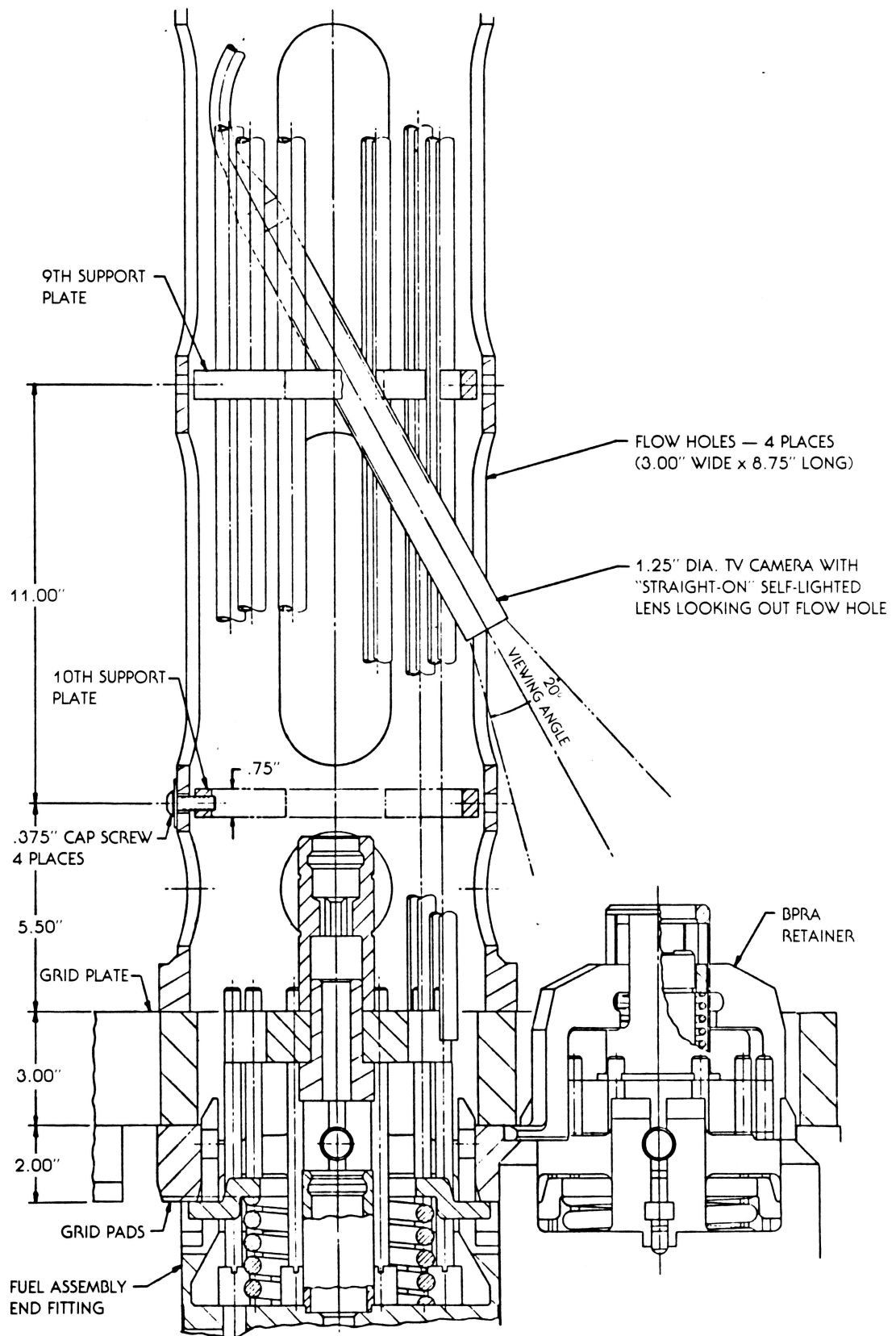


FIGURE 8
360 DEGREE ROTATION OF THE
1.25-INCH DIAMETER TV CAMERA
POSITIONED 90 DEGREES TO THE CORE DEBRIS PILE

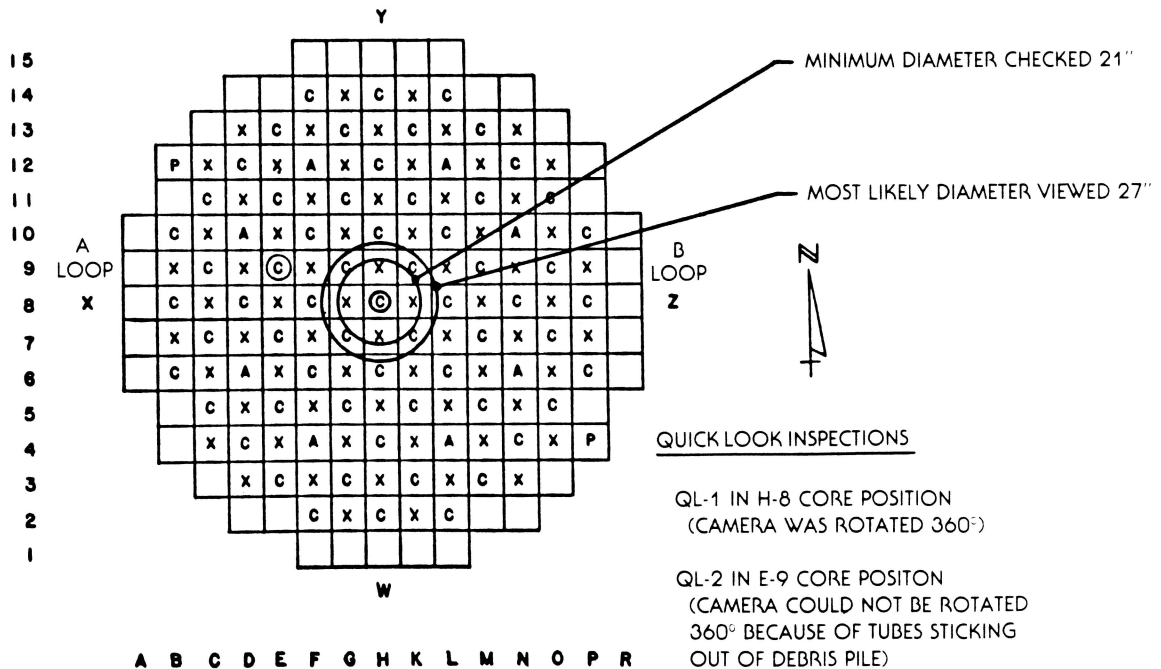
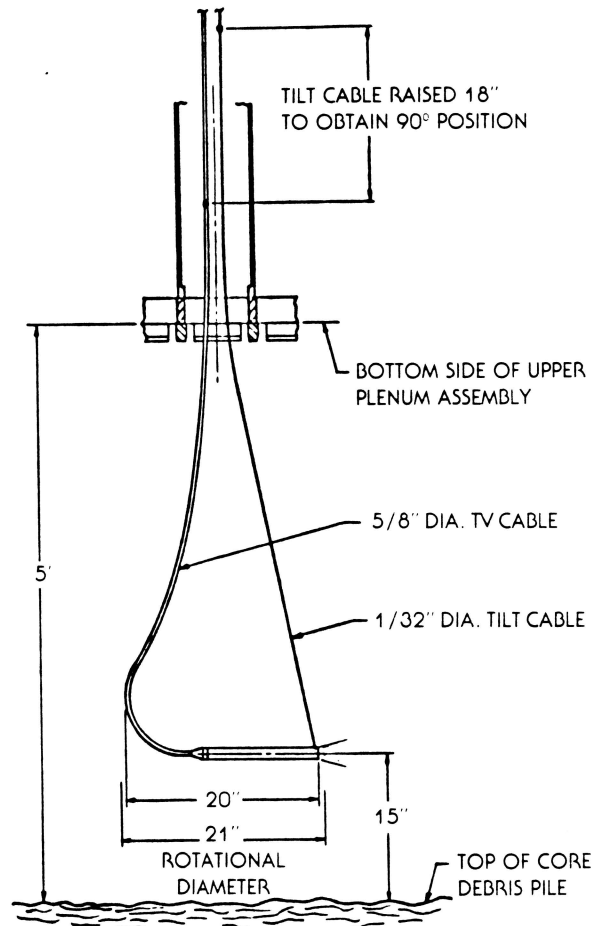
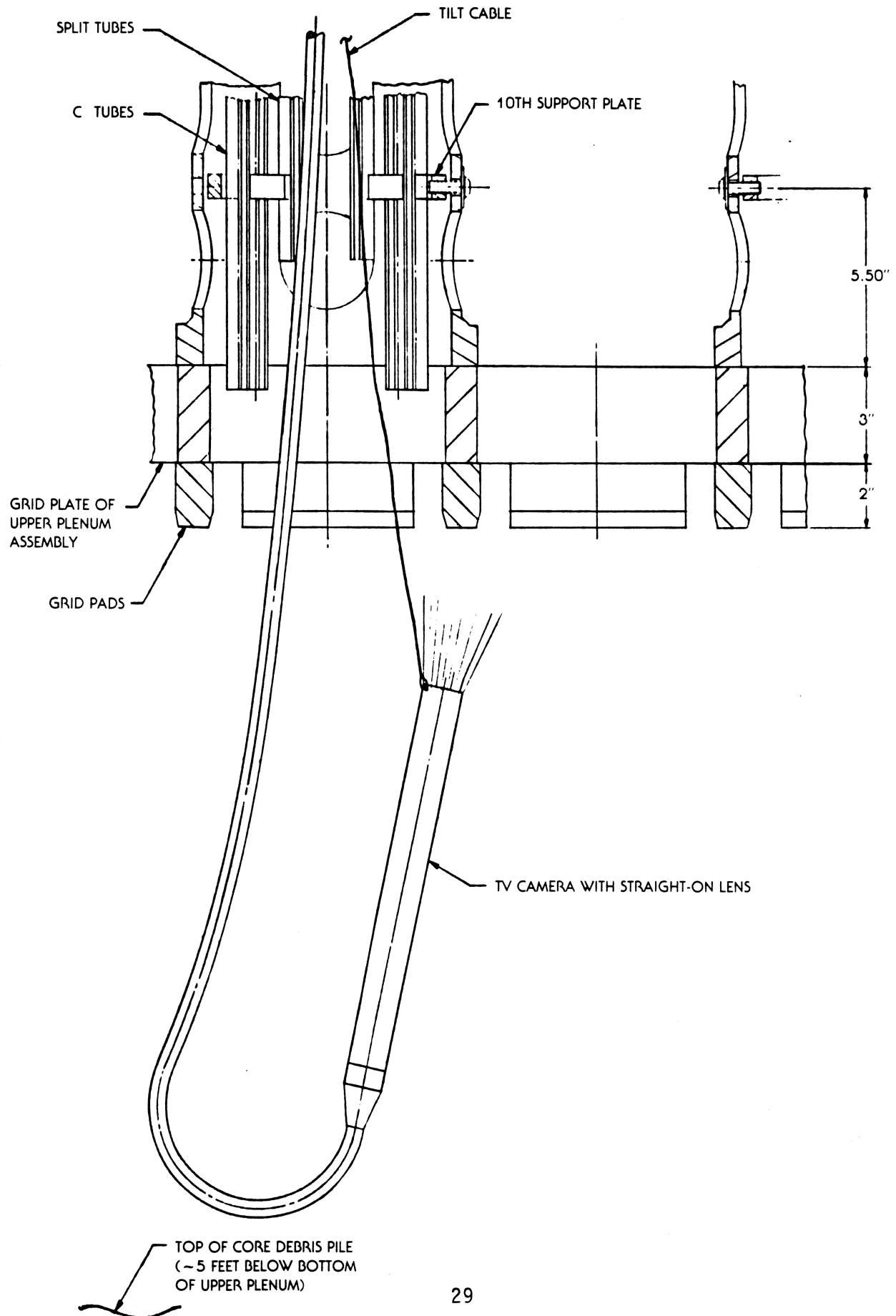


FIGURE 9
LOOKING UP AT UNDERSIDE OF UPPER PLENUM ASSEMBLY
AT H-8 CORE POSITION DURING QUICK LOOK 1



UPWARD LOOKING VIEWS SHOWING PLENUM ASSEMBLY GRID PADS, "C"
TUBES AND SPLIT TUBES ----- BABCOCK & WILCOX

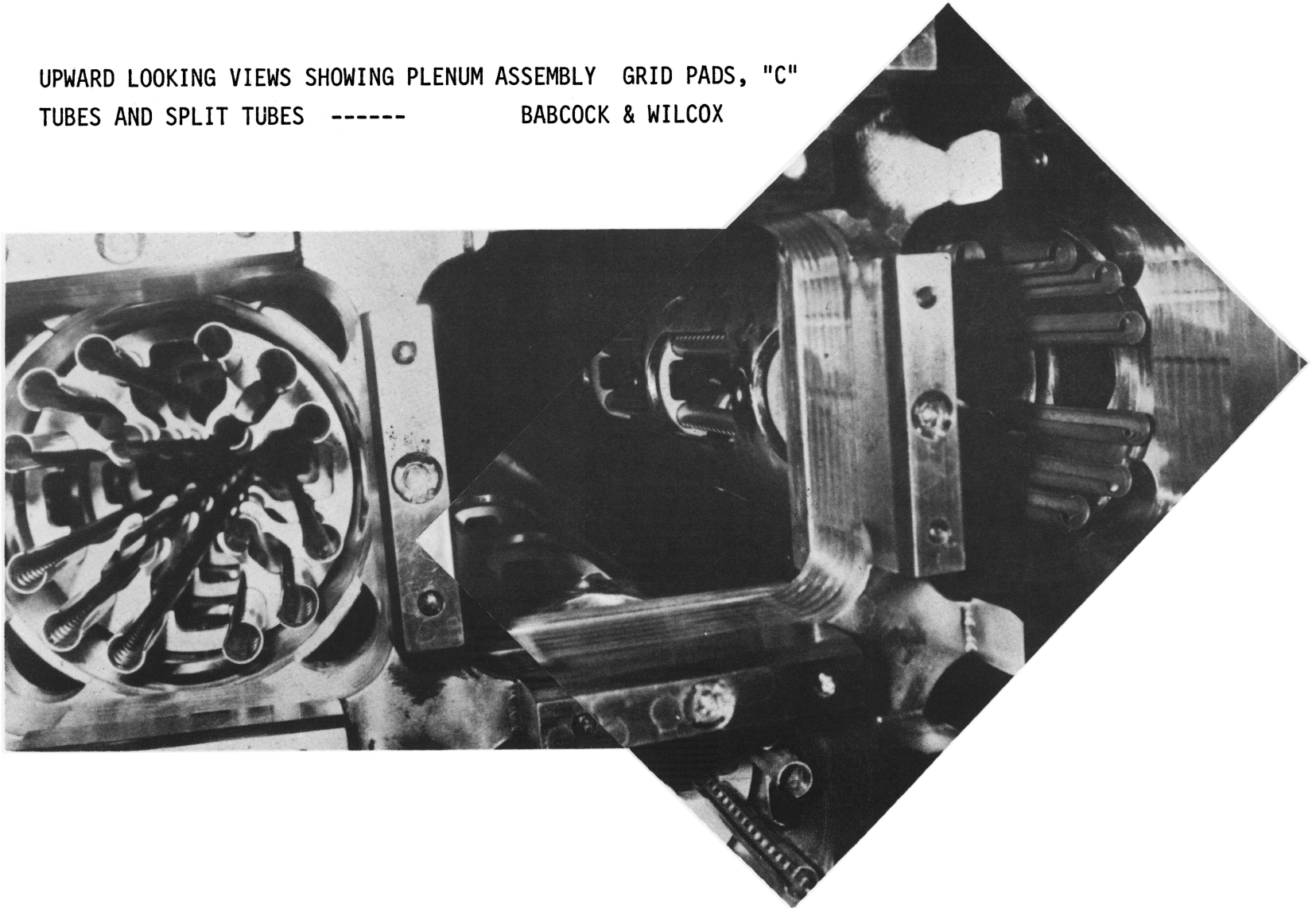


FIGURE 10

FIGURE 11
 LOOKING VERTICALLY UPWARD AT UNDERSIDE
 OF THE UPPER PLENUM ASSEMBLY GRID PLATE
 (LIKE LOOKING INTO THE H-8 POSITION
 OF QUICK LOOK 1 OF JULY 21, 1982)

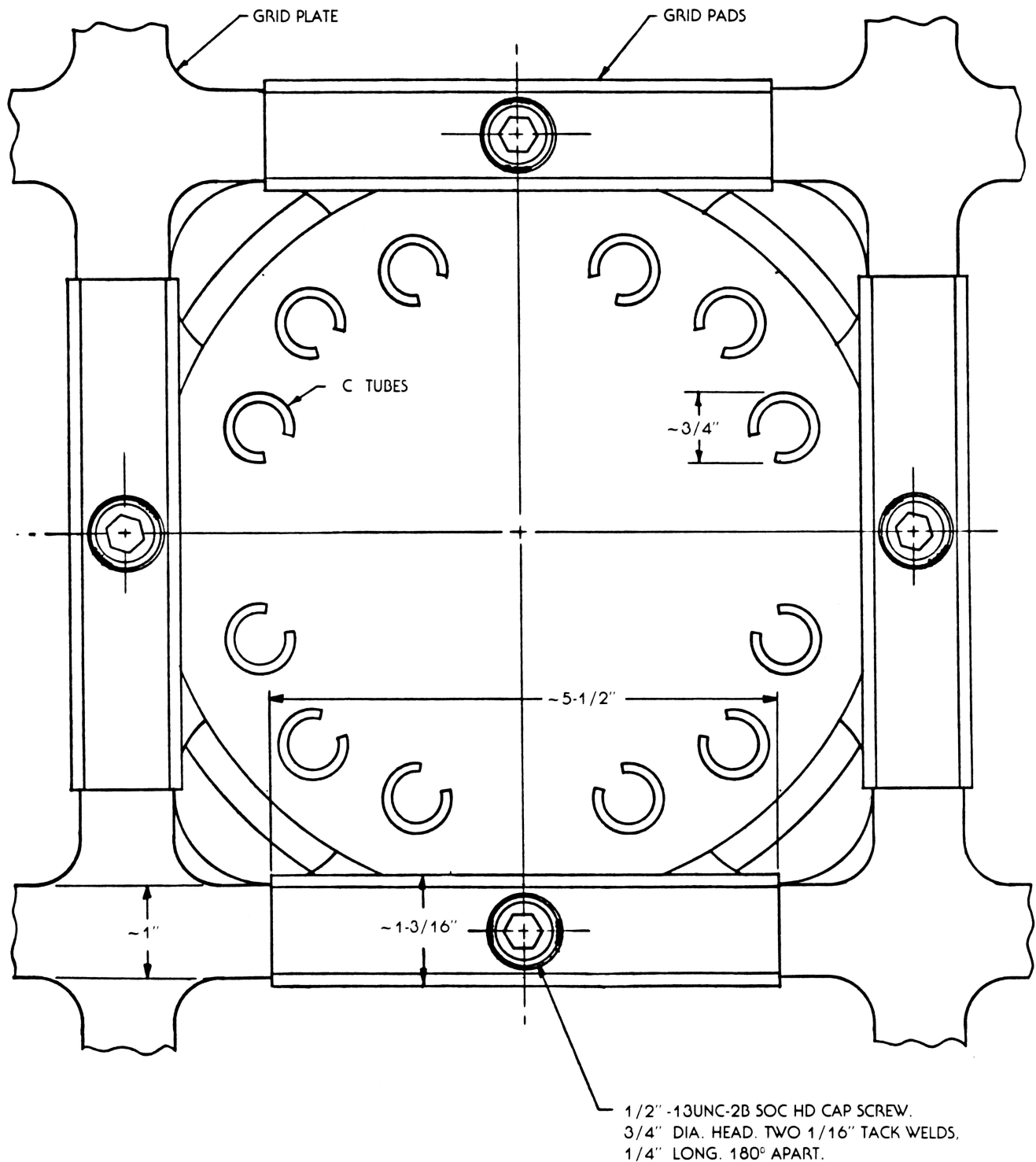


FIGURE 12
 LOOKING UP AT UNDERSIDE
 OF THE UPPER PLENUM ASSEMBLY WITH FUEL ASSEMBLY
 END FITTINGS STUCK IN THE GRID PLATE
 (THIS WAS VIEWED AT THE E-9 CORE
 POSITION DURING QUICK LOOK 2 AND 3)

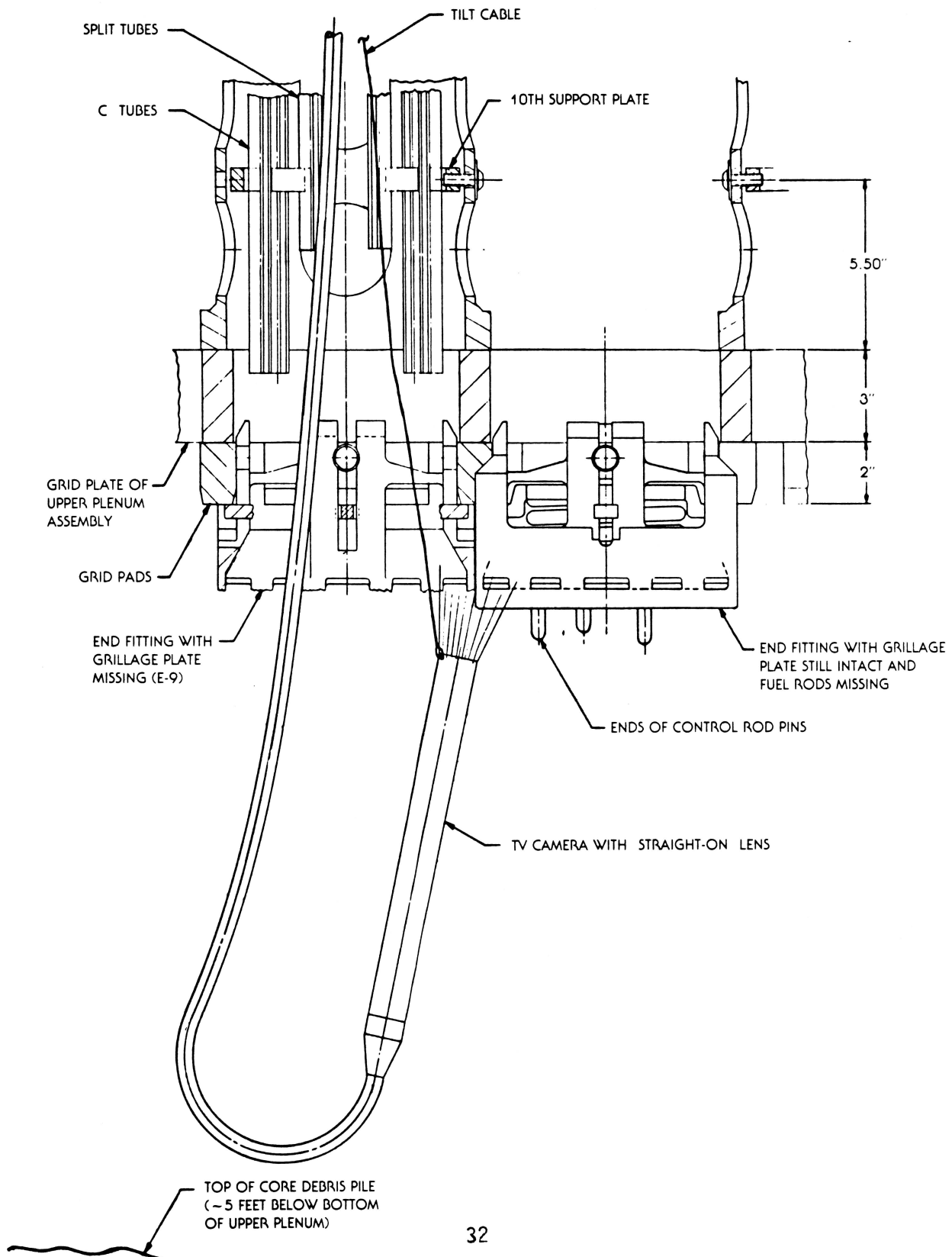


FIGURE 13
LOOKING UP INTO THE BOTTOM
OF THE FITTING POSITION E-9
(E-9 END FITTING HAS LOST ITS BOTTOM GRILLAGE PLATE)

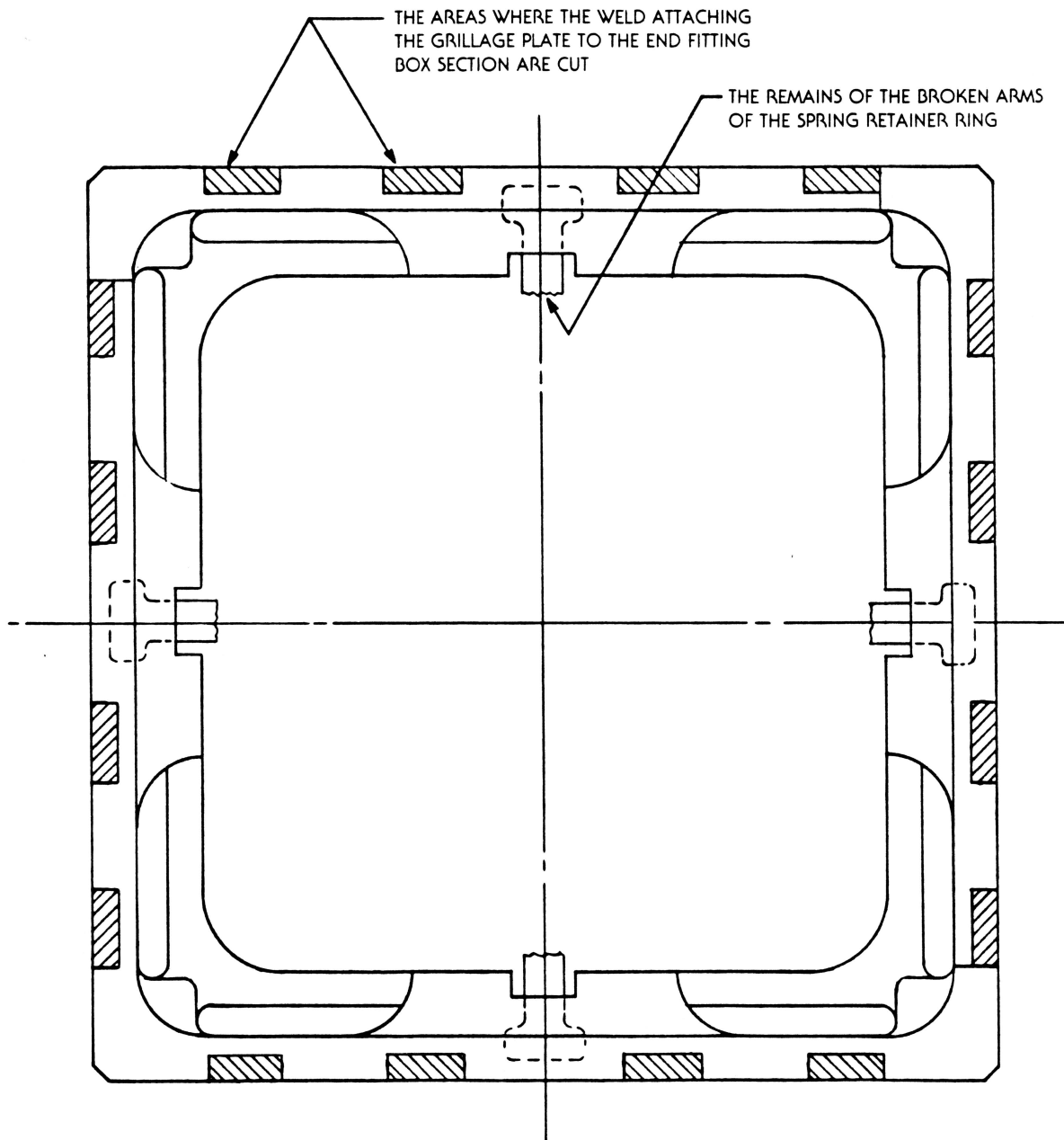


FIGURE 14
 LOOKING UP FROM THE UNDERSIDE OF POSITION E-9
 WITH THE GRILLAGE PLATE MISSING FROM THE
 E-9 END FITTING
 (AUGUST 6 AND 12, 1982)

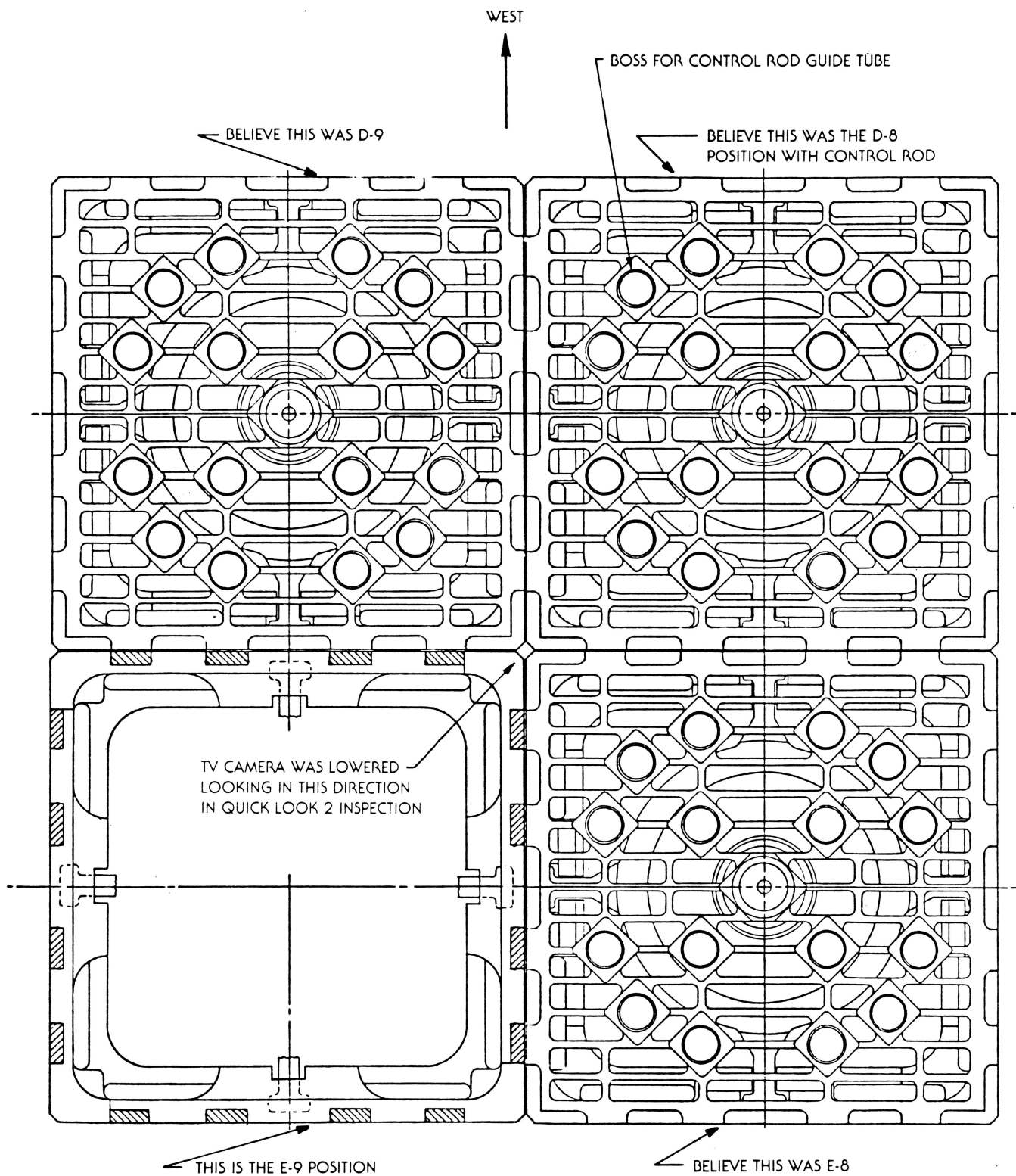


FIGURE 15
DEPTH OF VARIOUS PARTS TO BE INSPECTED VIA A
TV CAMERA INSERTED DOWN A LEADSCREW HOLE IN TMI-2

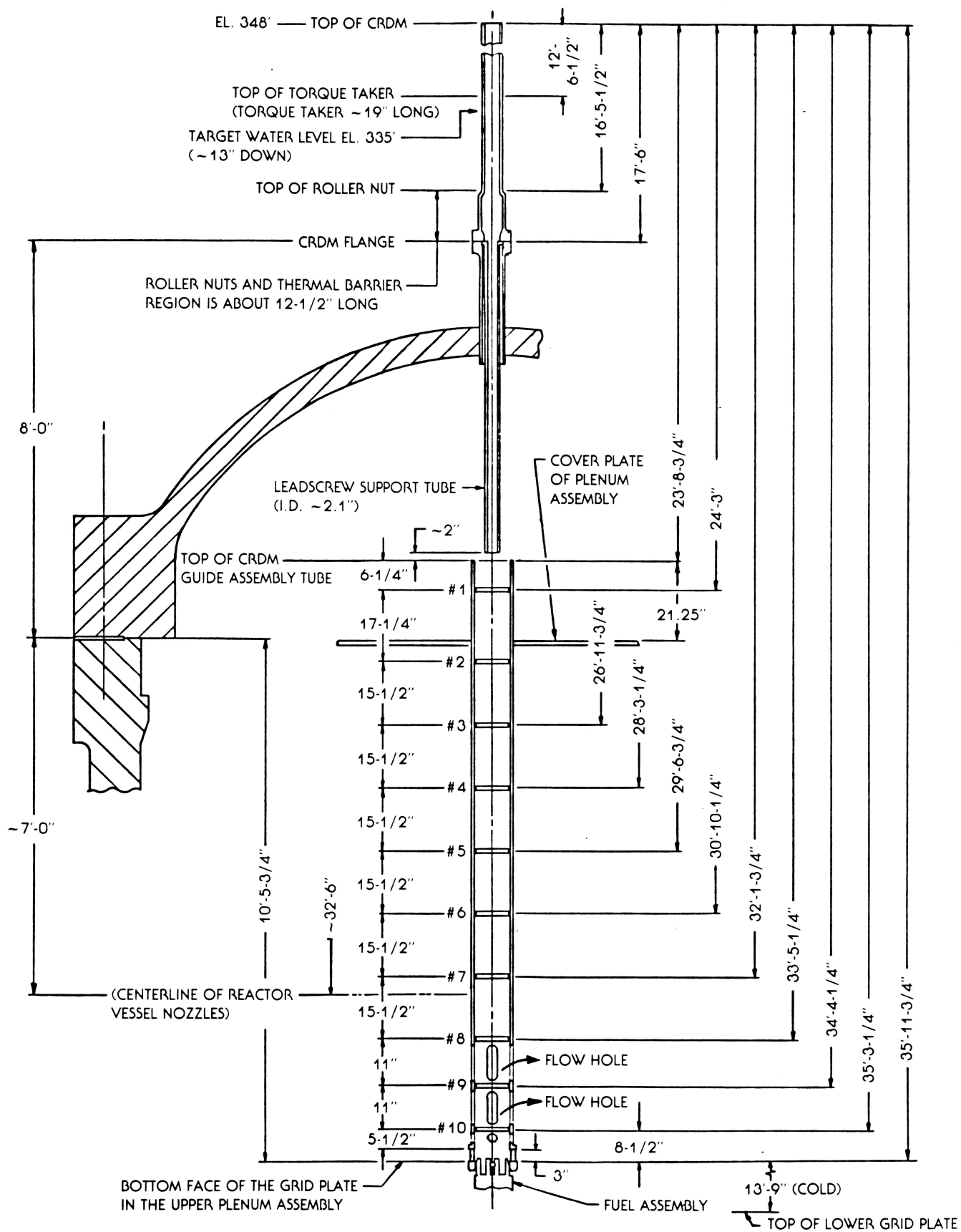


FIGURE 16
RIGHT ANGLE VIEWING CAMERA
INSIDE CONTROL ROD GUIDE ASSEMBLY

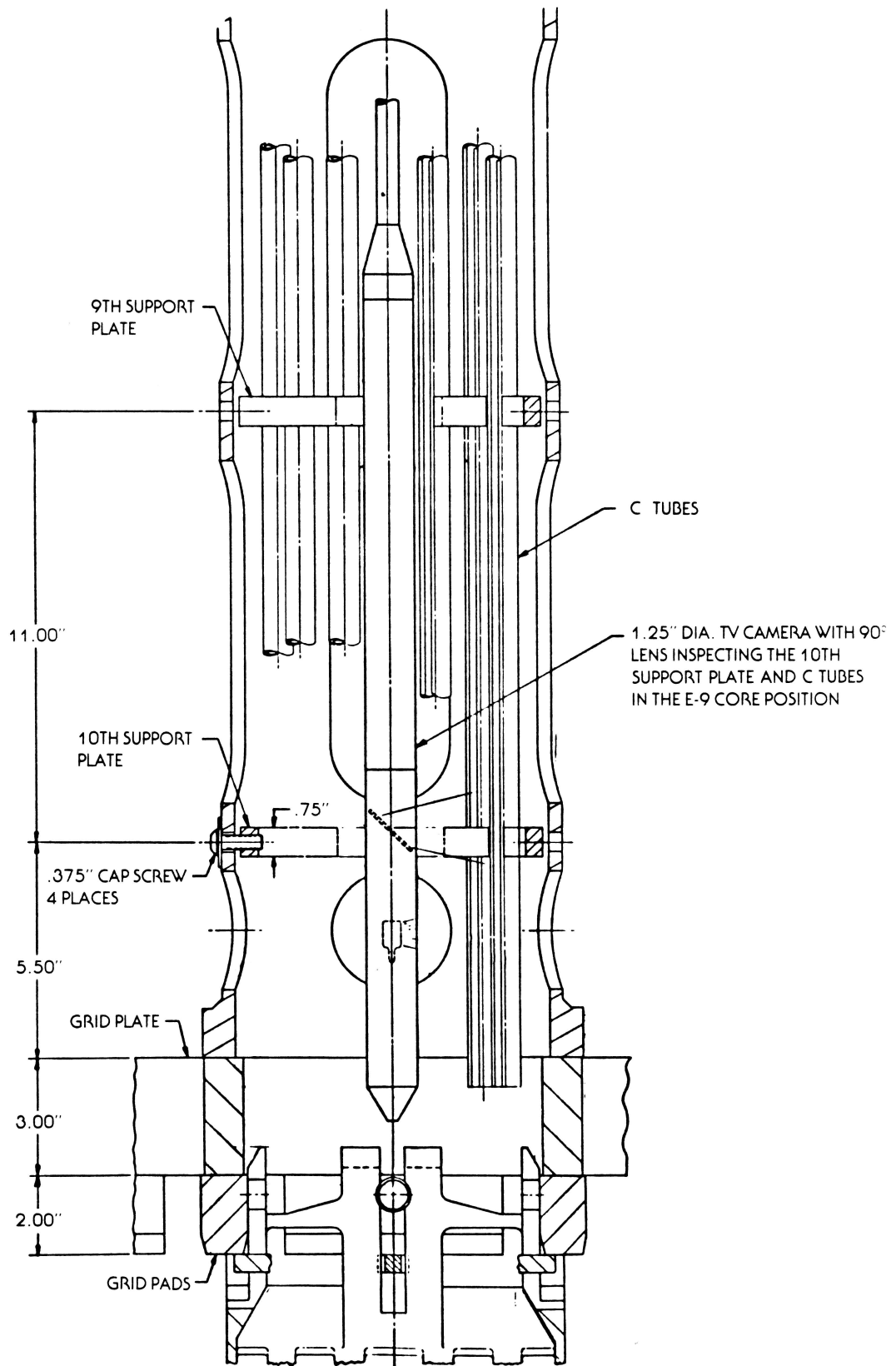
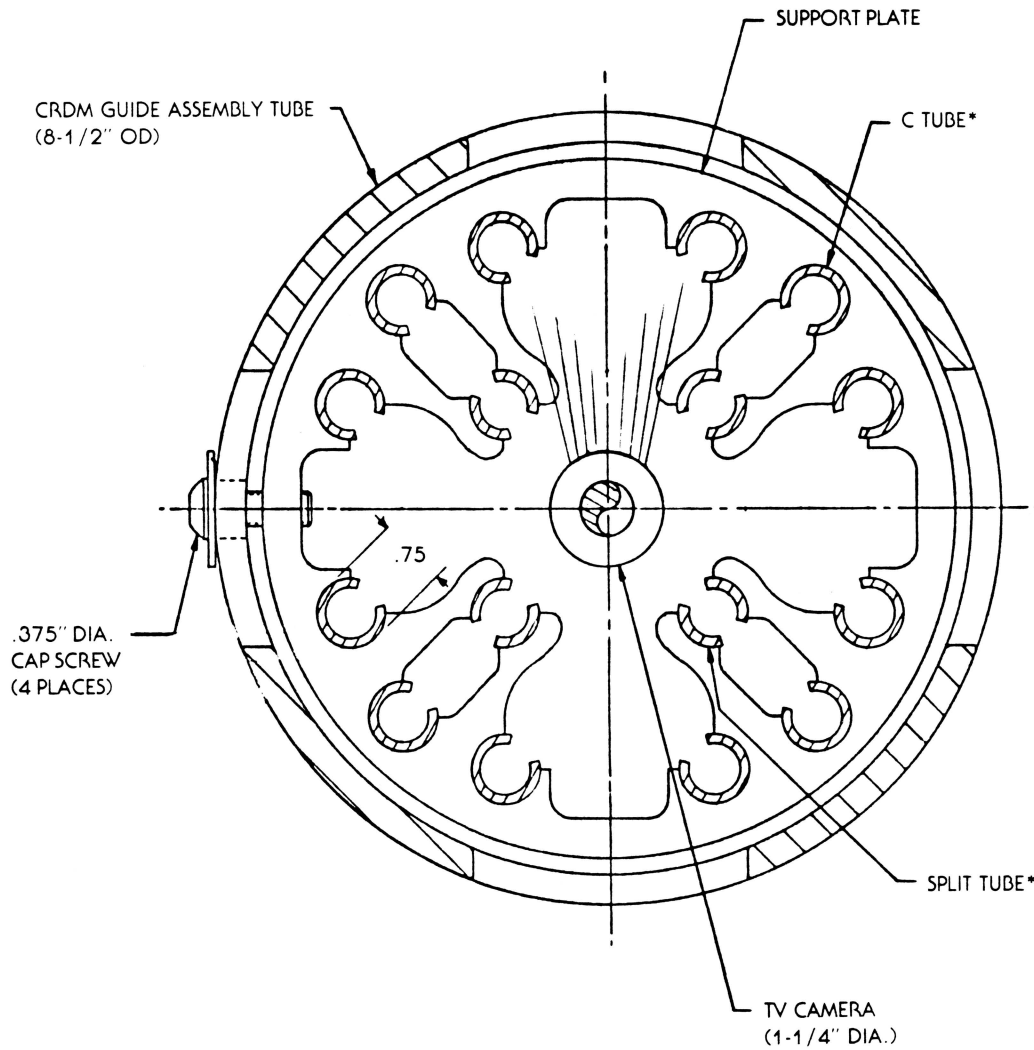


FIGURE 17
INSPECTION OF C TUBES AND SUPPORT PLATES
USING 1.25-INCH DIAMETER CAMERA WITH 90-DEGREE LENS



*BOTH THE C AND SPLIT TUBES ARE
BRAZED INTO EACH SUPPORT PLATE

FIGURE 18
1.25-INCH DIAMETER TV CAMERA WITH 90-DEGREE LENS INSPECTING
THE END FITTING IN THE E-9 CORE POSITION

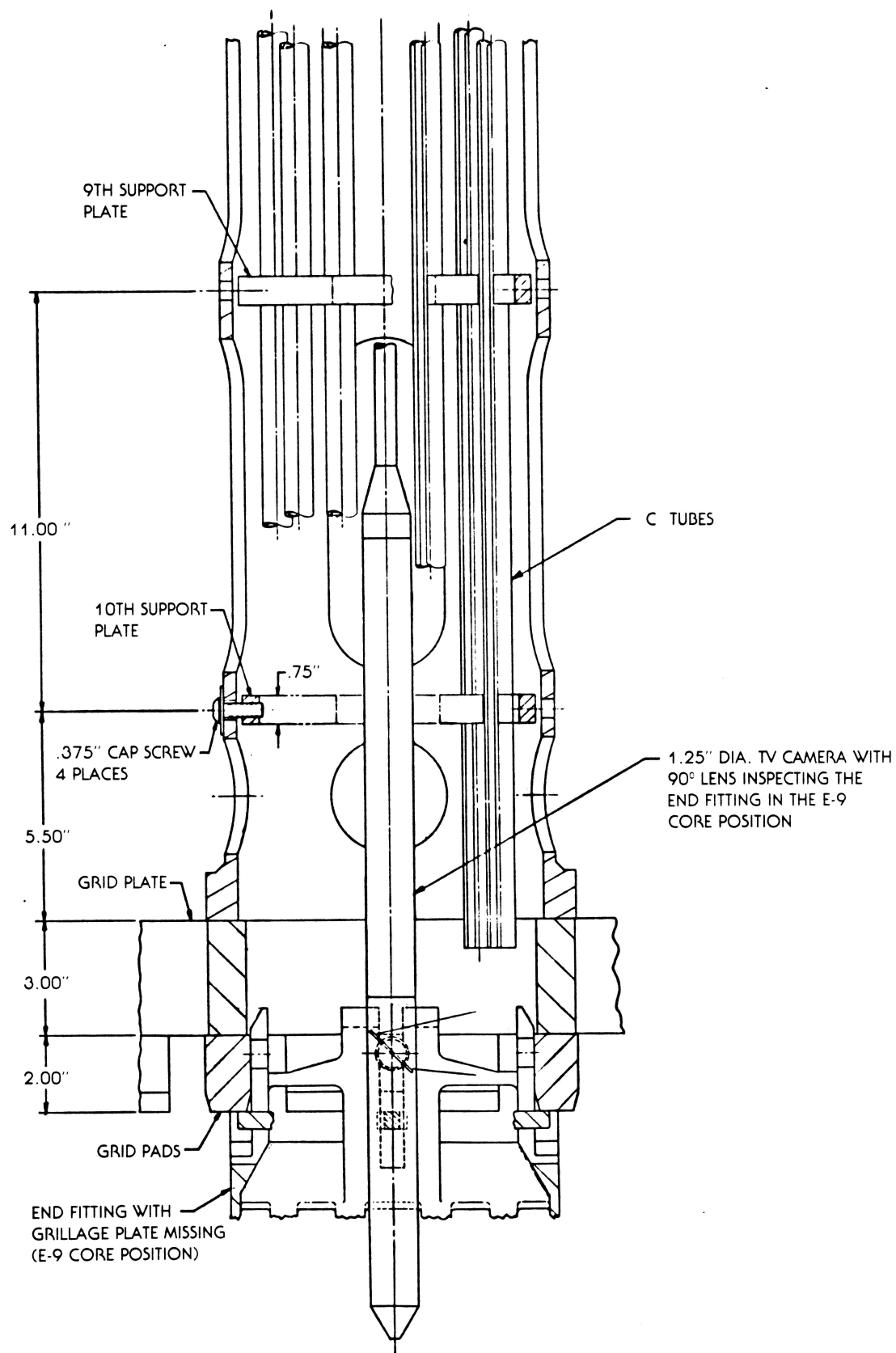
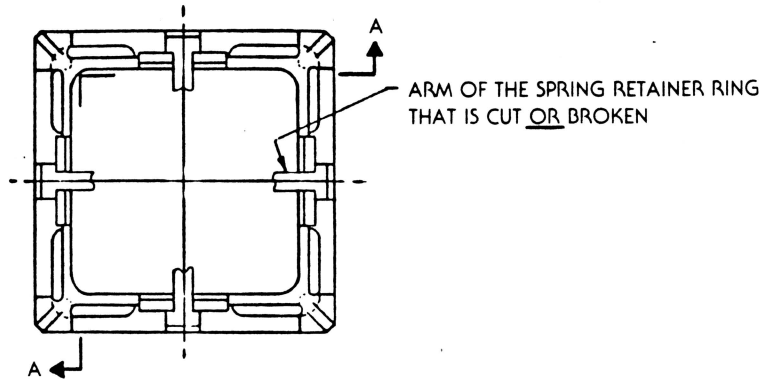
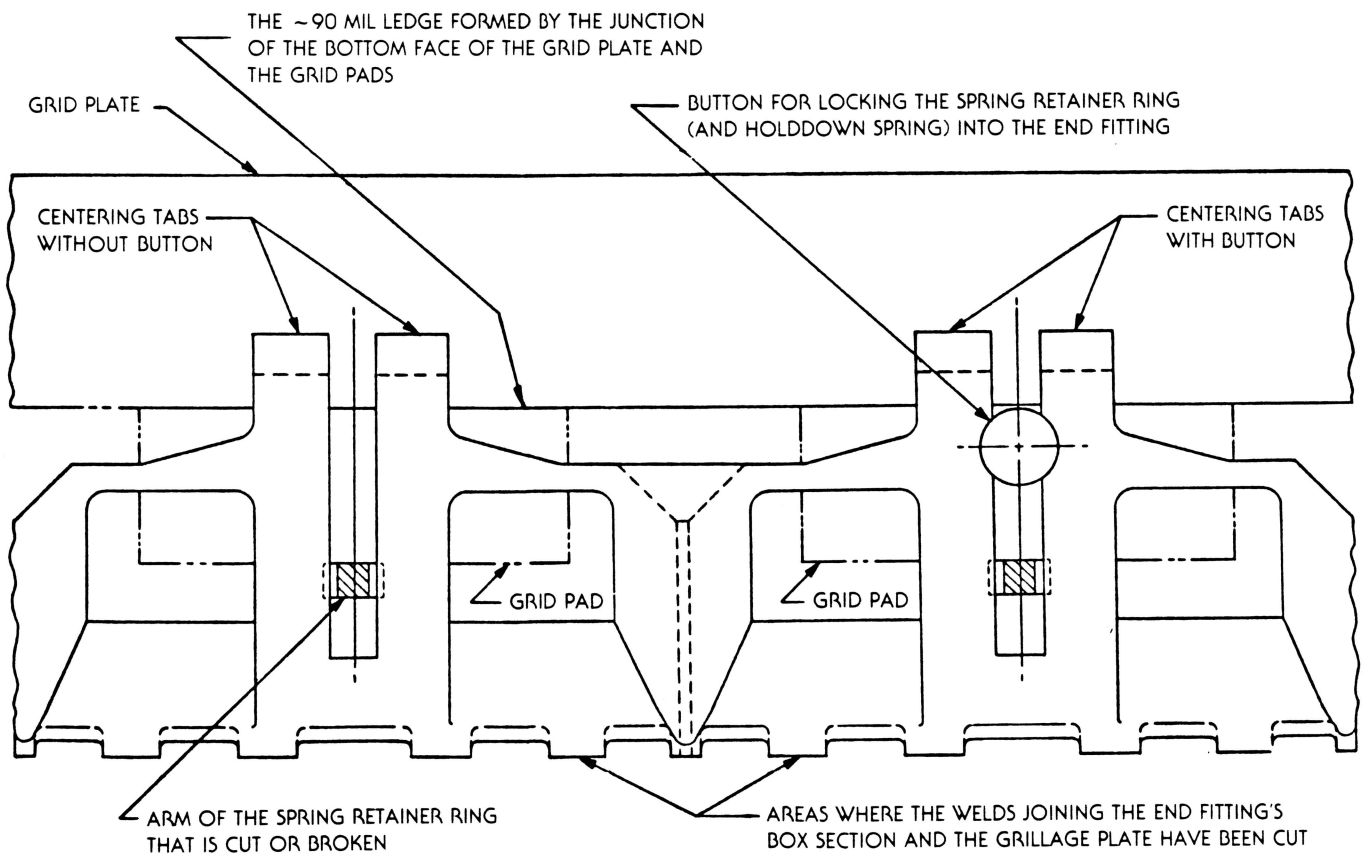


FIGURE 19
EXPANDED VIEW OF THE E-9 END FITTING
(GRILLAGE PLATE MISSING)
(AS SEEN BY THE 90-DEGREE TV LENS ON AUGUST 12, 1982)



VIEW LOOKING DOWN ON TOP END FITTING



VIEW A-A

FIGURE 20
UPPER PLENUM ASSEMBLY CROSS-SECTION

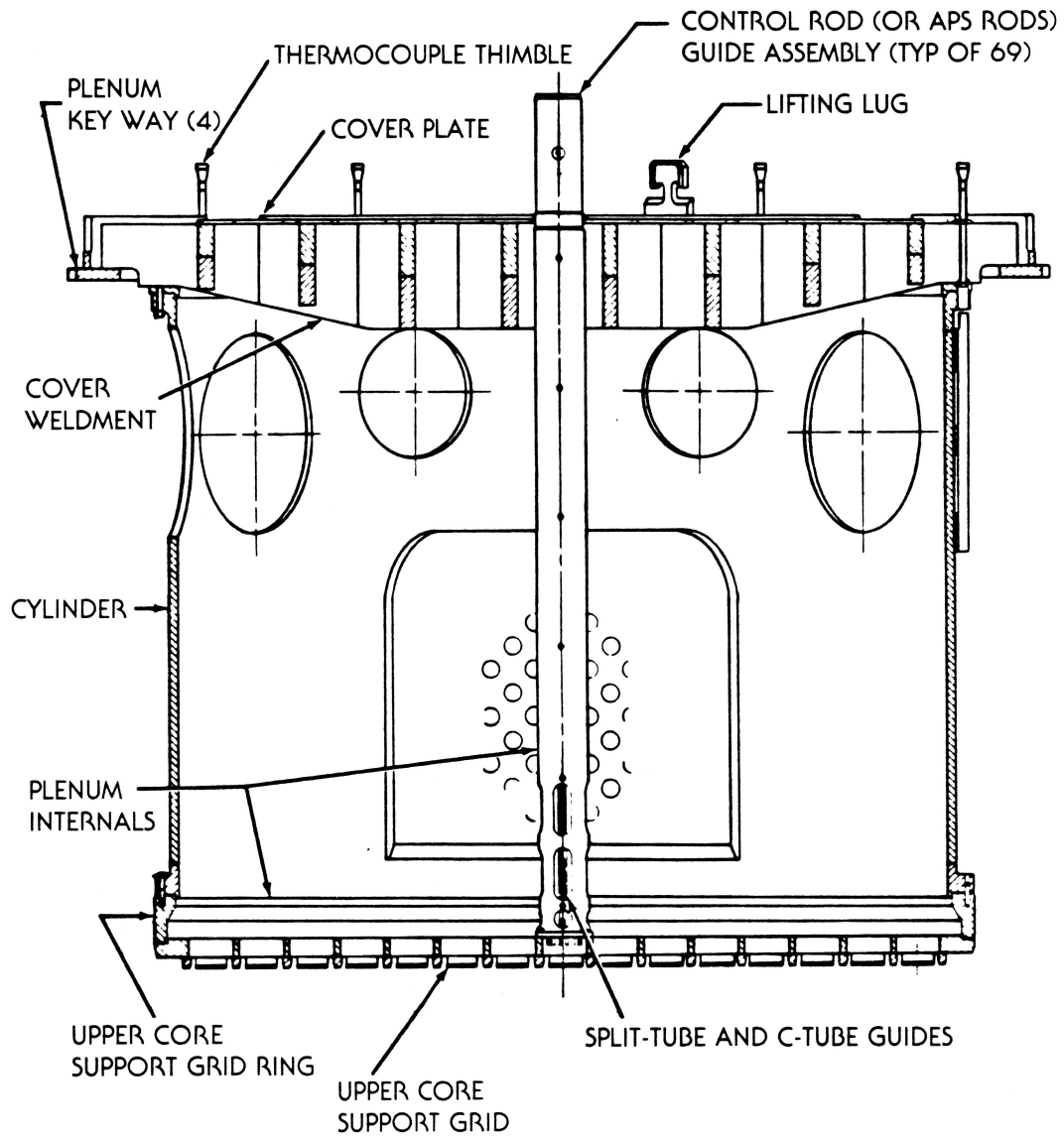
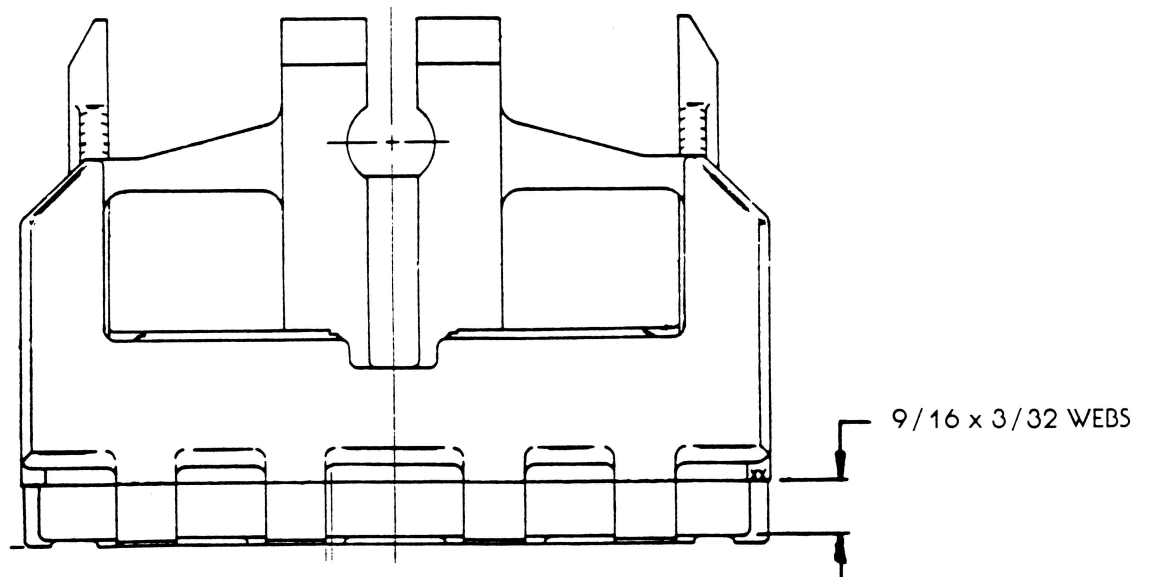
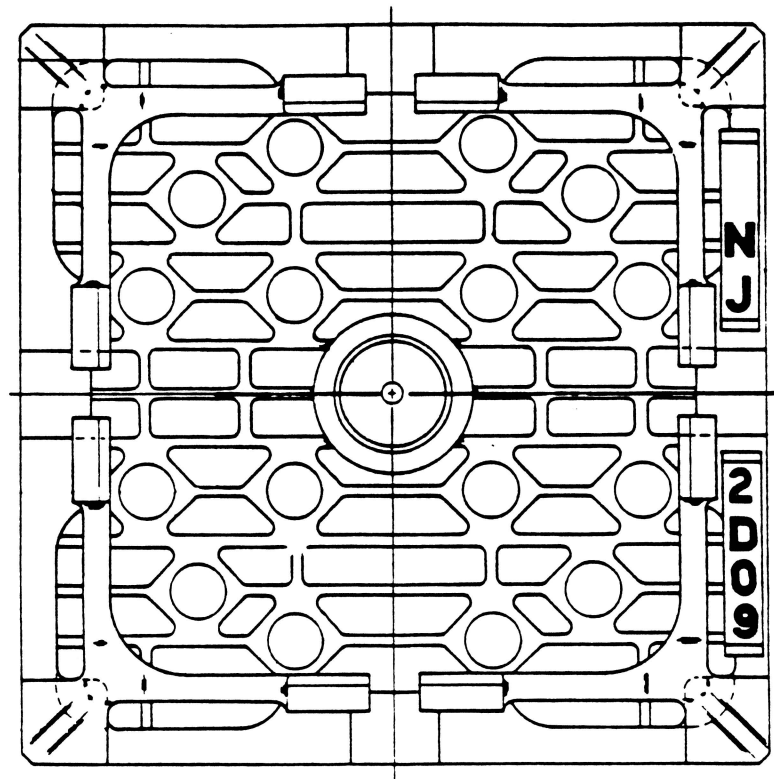
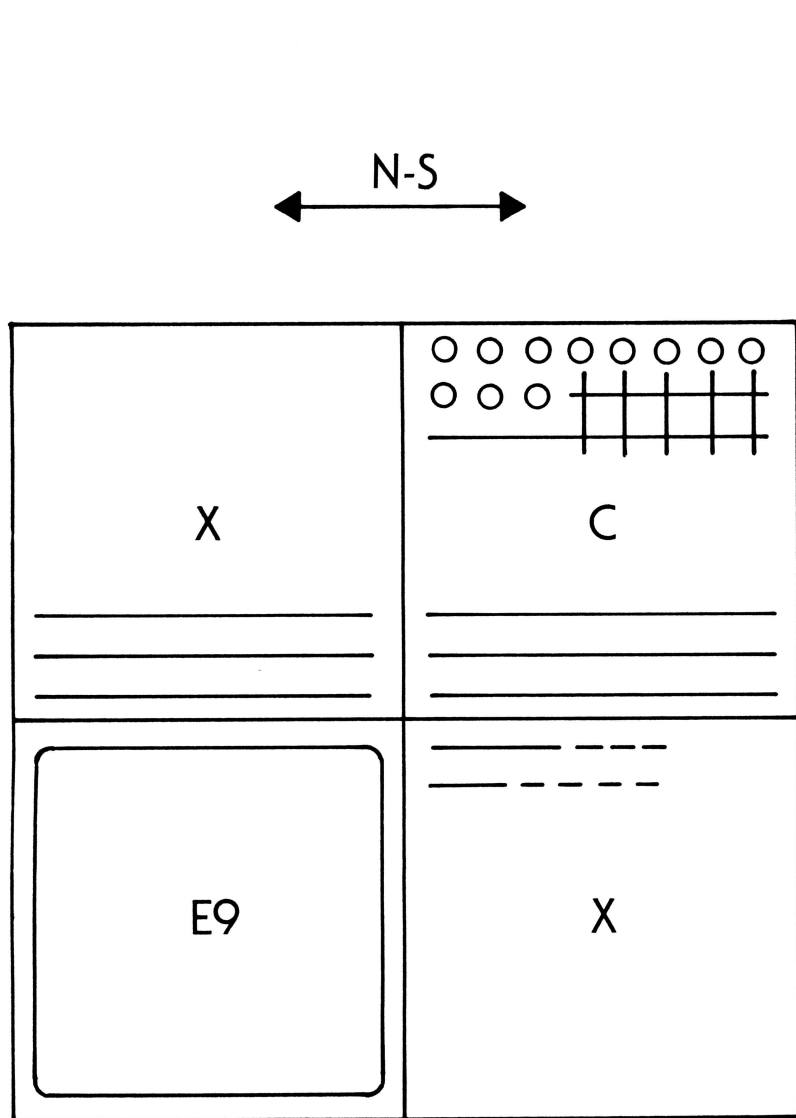
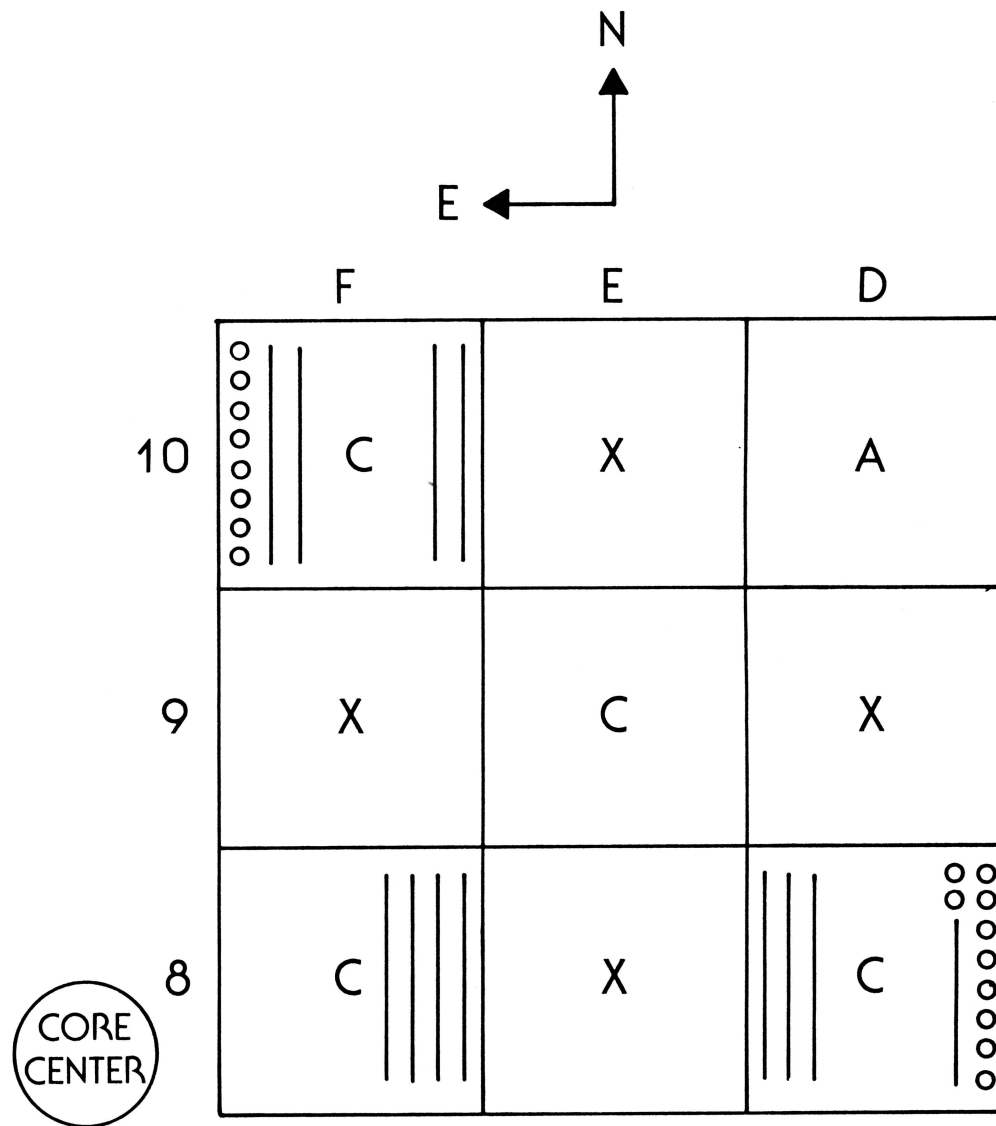


FIGURE 21
FUEL ASSEMBLY UPPER END FITTING





VIEW ON TAPE
835-END



LOOKING FROM
BELOW

FIGURE 22
VIEW FROM BENEATH E-9 LOCATION

15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

Y

N

A LOOP

X

B LOOP

Z

A

W

QUICK LOOK INSPECTIONS

QL-1 IN H-8 CORE POSITION
QL-2 IN B-8 AND E-9 CORE POSITION
QL-3 IN E-9 CORE POSITION



APPENDIX A

QUICK LOOK 1 COMBINED IN-CONTAINMENT VIDEOTAPE INDEX QUICK LOOK EXAMINATION - JULY 21, 1982

This tape was recorded in the command center and is a composite of pictures from both the in-core and in-containment cameras. The cassette is labeled Tapes 1 and 2, which presumably refers to the numbers of the cassettes being simultaneously recorded on the machine at the service structure of the reactor.

- 0 - 60 Introductory remarks by Technical Director of inspection team.
 View is from camera inside containment.
- 60 - 75 The in-core camera is looking down the inside of the leadscrew
 support tube as it is being lowered.
- 77 The camera reaches the level of the torque-taker. The lights are
 cut as the camera enters the water.
- 77 - 95 No picture.
- 96 The light is turned on. Nothing visible on the screen.
- 96 - 245 The picture has no detail. Attempting to focus.
- 245 - 275 The picture is in focus and the camera is going down the guide tube
 at the H-8 location.
- 289 The set screw which holds a support plate to the guide tube is
 visible.
- 303 - 329 Examining an irregular piece of metal that looks torn, with the
 camera at the level of the top of the core.
- 365 - 380 The camera passed the obstruction and was lowered. The team
 decided to lift the camera 2 feet and try to kick out through the
 side of the guide tube. There is no picture visible at this time.
- 404 The lobes of a support plate on the brazement assembly were visible
 for only a few seconds. This is followed by a lot of blank picture.
- 428 - 438 The camera was again lowered and the set screw in the ninth support
 plate is visible.
- 455 Back at the screw again, attempting to kick out the camera through
 the hole in the side of the guide tube at the ninth support plate.
- 482 - 487 No picture. Changing tapes on the in-containment recorder.

QUICKLOOK 1 INDEX

- 487 - 560 Nothing on the tape of interest. Attempting to jockey the camera out of a lobe and into the central section.
- 562 - 575 Attempting to focus and kick the camera out at the eighth support plate.
- 575 - 615 Continuing to attempt to kick out between the eighth and ninth support plates.
- 615 - 630 Camera lowered back down to the 10th support plate. It is hung up on the edge of something. A piece with what appears to be the number "10" is visible.
- 638 The set screw is visible again.
- 650 The camera is kicked out through the side of the tube. Lowering the camera.
- 650 - 670 There is nothing visible with the camera kicked out. Backing the camera into the guide tube.
- 670 - 680 Back in the center guide tube, lowering the camera. Nothing is visible but flakes drifting by the lens in the water.
- 680 - 690 Camera is below the top of the core. Nothing is visible, as the camera is rapidly lowered down to 5 feet below the top of the core. The rubble bed comes into view.
- 690 - 737 The crew scans the rubble bed.
- 737 The crew decides to point the camera upwards and try to look at the underside of the plenum.
- 740 The tape runs out in the containment. No further picture on this tape either.

QUICKLOOK 1 INDEX

The second cassette for the Quick Look inspection of July 21, 1982 is labeled "Quick Look Tapes 3 & 4". It is the continuation tape, and the action commences at the point where the first cassette ended.

- 0 - 32 Out of focus.
- 32 - 40 Views of the debris bed coming into focus.
- 40 - 60 The camera is being rotated to point upward at the underside of the plenum.
- 60 - 120 The underside of the plenum is visible. Some bubbles are visible underneath.
- 125 - 140 The surface of the plenum is covered with what appears to be spalling, scaling, or mud-cracking.
- 207 A C tube came into view.
- 220 - 300 The camera is looking at a split tube with a lot of porous surface deposits on it. The object referred to on the soundtrack as a split tube is really a C tube.
- 320 - ? A grid pad came into view, with a gas bubble on its surface. A capscrew which holds the grid pad to the grid may be visible inside the bubble.
- 380 - 470 The camera was lowered back down to the debris bed. The spider is visible resting on the bed. The camera scans the spider for a considerable amount of time.
- 473 The in-containment tape ended, and a new tape was mounted. The camera continues to scan the spider.
- 495 - 514 Some kind of a circular feature that appears to be a spring retainer ring is visible.
- 520 - 595 The camera is pointing straight down at the debris pile. The lens is very close at times. The object people have been calling a "potato" is in view.
- 600 - 620 The camera was again rotated to point at the underside of the grid plate.

QUICKLOOK 1 INDEX

- 625 - 655 The camera is again rotated downward to look at the debris pile.
In the last 5 feet of this sequence there are several objects which
may be worth looking at. These may include a piece of a spring,
and perhaps a piece of grillage.
- 655 Tape ends.

APPENDIX B

QUICK LOOK 2 COMMAND CENTER VIDEOTAPE INDEX QUICK LOOK EXAMINATION - AUGUST 6, 1982

This tape was recorded in the command center and is a composite of pictures from both the in-core and in-containment cameras. The cassette is labeled "Tape 1 of 2".

- 0 - 70 The beginning of the tape shows the inspection crew coming into the containment building.
- 70 - 360 Inspection crew is shown climbing down to the service structure work platform and finishing all the preparations, including lowering the light into the H-8 location.
- 360 - 375 The view is from the in-core camera as it is lowered down the CRDM guide tube at the B-8 location.
- 375 Down to the level of the torque taker.
- 400 - 470 Nothing visible on the screen. The light was turned off just before the camera entered the water.
- 470 - 525 The light was turned on but the camera was having trouble getting any picture because apparently there is something on the end of the lens. Indistinct flakes can be seen floating by, but no detail.
- 525 A set screw is visible, but not in focus.
- 548 The set screw came into focus and then went out again.
- 560 - 590 The camera is now close to the flow window in the side of the guide tube. The top of the control spider is in view. At 563 there is some squarish object that looks like it should not be there. It appears to be resting on the top edge of the spider hub.
- 590 - 629 The light went out again. The light continued to be out. At 623 the sound track indicates the inspection crew decided to pull the camera and try to replace the light. There is no picture during this sequence.
- 630 - 680 The picture switches to the D-ring camera, which shows the crew pulling out the in-core camera.
- 680 - 695 They switched back to the small camera, and the view is again of the inside of the leadscrew support tube.

QUICKLOOK 2 INDEX

- 685 Reached the level of the torque taker.
- 695 The light is cut as the camera enters the water.
- 695 - 725 The picture continued to be indistinct.
- 725 - 745 The camera reached the level of the C tubes. It stopped there, and wisps of cloudy material and flakes can be seen drifting by, in addition to the C tubes.
- 745 - 755 The camera lost its picture again.
- 755 - 780 The camera is lowered until it comes into contact with the control spider hub. At 762 the splines on the inside of the hub for the leadscrew bayonet are visible. The spider appears to be more or less where it is supposed to be.

Note: The man who uncoupled the screw observed by the feel of the operation that the spider did not drop. (It normally drops about 2 inches when it is uncoupled.) This could indicate it is being held up by the remains of a distorted element. This information was provided by N. Cole and was not recorded on the videotape.

- 780 - 790 They lowered the camera some more and it came to rest on top of something. At this point the lights went out again on the camera.
- 790 The camera lights came back on again, gradually bringing the picture into focus. The camera is resting on one of the arms of the spring retainer ring.
- 815 The picture is in focus. The camera is resting on the ear of the spring retainer. There appears to be a layer of flakes of core debris which fell onto the horizontal surface. Average flake size is about 25 to 100 mils.
- 840 They lifted the camera a little bit, and the web between the two arms of the spider is visible. (It is not the corner of an end fitting).
- 849 - 863 They pulled the camera up so it is looking at the top of the hub on the spider. They continued bouncing the camera up and down on top of the spider hub.
- 863 - 866 The camera is raised in order to kick it out through one of the flow openings in the side of the guide tube.

QUICKLOOK 2 INDEX

870 - end The camera is looking at the top of an adjacent assembly. The narration says that the camera is at the bottom edge of the grid looking out towards an adjacent fuel element and is trying to focus to see if anything is visible. The camera sees a BPRA retainer with a hub inside and a layer of debris over it. As the camera swings away, a ligament of the spider can be seen at a distance.

QUICKLOOK 2 INDEX

Tape 2 of 2 begins with the camera down in the core looking at one of the arms on the spider of an element adjacent to B-8 (B-7, B-9, or C-8).

- 0 - 40 Looking at the spider arm.
- 40 - 125 They switched off the in-core camera, and the tape now shows the view from the D-ring camera. The sequence shows them removing the camera, wiping the cord, and getting ready to insert the camera into the E-9 position.
- 125 - 138 Lowering the camera. View is now from the in-core camera.
- 133 The camera reached the level of the torque taker.
- 138 - 165 The camera light is turned off to enter the water. The picture continues to be indistinct.
- 165 - 214 Lowering the camera into the core.
- 165 At the level of the plenum.
- 205 Below the plenum.
- 207 Three feet below the top of the core.
- 214 Five feet below the top of the core. The camera is now at the rubble bed.
- 214 - 287 Scanning the rubble bed.
- 242 They started seeing several tubes sticking up vertically out of the debris, or at least one; it might be the same one.
- 262 Auxiliary light was turned on.
- 266 Some kind of agglomerated mass is visible at 5-1/2 feet below the top of the core.
- 280 The camera is resting on the debris at 5 feet 4 inches below the top of the core.
- 297 - 330 The view switches back to the D-ring camera while they change tape cassettes.
- 330 - 350 The view switches back to the in-core camera. They attempt to point the camera horizontally. There is no picture.

QUICKLOOK 2 INDEX

- 350 - 370 The auxiliary light is turned on, and they try to rotate the camera 360 degrees pointing horizontally. They are unsuccessful.
- 376 As they are focussing, some of what appear to be fuel pins sticking up vertically are coming into view. This is with the camera light off and auxiliary light on and the camera looking horizontally 18 inches off the bottom.
- 390 - 440 This sequence has some excellent views of the rubble bed with sidelighting. A lot of details are showing.
- 430 The chamfered end of one of the rods is visible.
- 433 What appears to be a sectional view of a fuel rod that appears to have been sliced.
- 440 - 507 They attempt again to point the camera upwards to see the underside of the plenum (unsuccessfully).
- 507 - 675 The camera is looking downwards again.
- 514 A tubular spacer and what appears to be a flat bar of some kind are visible.
- 520 A rod sticking up.
- 550 A fuel pin internal coil spring is visible, up to 555. There is another one at 556.
- 570 - 578 A beautiful shot of a rod with a slag deposit on the side that looks like a hole, but is not (light illusion).
- 664 An excellent view of an aluminum boron carbide pellet (burnable poison).
- 672 A broken piece of what looks like the arm on a spring retainer.
- 676 - 716 The picture shifts back to the D-ring camera again.
- 716 - 726 The in-core picture returns. The camera is moved upward, and sees its own cable.
- 726 - 770 The camera is moved to horizontal, and repeated attempts to focus are being made, with and without the auxiliary light.
- 770 - 815 The camera is pointing downwards, scanning the debris.

QUICKLOOK 2 INDEX

- 773 Some more fragments came into view. Pellet shapes are distinguishable.
- 778 Some kind of interesting structure; may be axial power shaping rod tubes.
- 811 Camera pointing down. This may be a rod that is split open, or just has surface deposits that look that way.
- 815 - end They finally succeed in pointing the camera upwards and raising it to the underside of the plenum.
- 819 The end of one of the C tubes is visible.
- 837 Inside a grid cell looking at the bottom of the grid.
- 855 - end As the camera backs away, the junction of four upper end fittings comes into view. They are suspended from the underside of the plenum. Portions of several end fittings seem to be wasted away. Adjacent areas look undamaged. Partial length fuel pins, control elements, and guide tubes protrude from one of the end fittings being scanned.

APPENDIX C

QUICK LOOK 3 IN-CONTAINMENT VIDEOTAPE INDEX QUICK LOOK EXAMINATION - AUGUST 12, 1982 (Index by Feet from Beginning)

This tape was recorded on the machine on the reactor head service structure, and is marked Tape 1 of 3.

- 0 - 44 No content.
- 44 - 56 Focusing on second support plate, location E-9.
- 56 - 62 No picture.
- 62 - 101 Going down tube.
- 101 - 115 Looking at debris on 10th support plate.
- 115 - 124 Focusing.
- 125 - 131 Set screw on support plate.
- 132 - 163 Trying to focus on end fitting.
- 163 - 176 Looking at centering pads and ear of spring retainer rings -- ear is broken off and lodged in its slot.
- 177 - 240 Looking at debris trapped between end fitting and support grid.
- 183 - 202 Possible piece of split tube or C tube in debris.
- 210 Broken spring retainer ring foot.
- 242 - 280 At debris bed 5 feet 1 inch below top of core. Pulling up on draw cable to tilt camera. Spring visible, with draw cable up 6 to 8 inches.
- 265 Moving against a mound or wall.
- 285 - 300 Lowering both the cable and the draw cable simultaneously to lower camera into debris bed.
- 300 - 330 No picture while maneuvering camera.
- 356 End of C tubes.
- 330 - 370 Camera pointing upward looking at underside of plenum -- picture very indistinct.
- 375 - 415 Looking at C tubes and portions of upper end fittings. Poor contrast.

QUICKLOOK 3 INDEX

415 - 430 Looking at blob of something that looks like it ran and dripped.

435 - 450 No picture.

450 - end Electrical problem. Nothing recorded on tape.

QUICKLOOK 3 INDEX

Tape 2 of 3 (In-Containment Tapes)

- 0 - 8 No picture.
- 9 - 80 Looking at piece of grillage and end fitting. Centering tabs and C tubes also visible. Picture low in contrast.
- 84 - 170 Camera pointing at bottom--lowering probe.
- 215 - 220 Probe visible briefly.
- 170 - 315 Probe touching bottom. Camera swinging around wildly.
- 225 Several tubes with spots or holes inside.
- 315 Removed probe and moved it to H-8. Not recorded on tape. Discussion with team members indicated probe penetrated 14 inches in both places below 5-foot level.
- 315 View changes to right angle lens. At first and second support plate.
- 325 - 330 C tube visible, with a notch right at braze joint.
- 330 - 355 Scanning downward along C tube. Discolored upper end of C tube, deposits on inside surface of C tube, top end of brazement guide tube visible, inside surface of guide tube very clean.
- 360 - 382 Support plate visible -- 1/16-inch layer of flakes on top surface. Screw visible -- good shape. Underside of support plates clean.
- 445 Notch in C tube at braze joint visible.
- 480 Entered upper end fitting.
- 492 - 493 Arm of retaining ring (broken off) visible in slot between ears on upper fitting piece.
- 516 Button visible, with shards trapped in slot above.
- 539 Joint between grid pad and grid plate visible between ears of the end fitting.
- 560 C tube visible just below 10th support plate; badly degraded. Base metal appears to have melted and run like hot wax.
- 574 Fragment of a pellet visible resting on 10th support plate.

QUICKLOOK 3 INDEX

Tape 3 of 3 (In-Containment Tapes)

- 0 - 60 Looking at C tubes--drilled holes visible--scanning at 10th support plate. Scanning upper end fitting.
- 83 - 95 Rectangular notches in skirt visible, with edge of backup plate.
- 95 - 110 Spacer grids and tube stubs with end springs protruding (adjacent location).
- 154 Camera down 2 feet 6 inches and rotating. Clusters of rods visible, but very indistinct.
- 270 Broken end of pin visible, with parallel marks on side.

APPENDIX D
IDENTIFIABLE COMPONENTS OBSERVED

<u>Item</u>	<u>Description</u>	<u>Location Observed</u>
1.	Setscrew which fastens brazement support plates to CRDM guide tubes.	H-8, E-9, and B-8, at nearly every support plate.
2.	Brazement support plates within CRDM guide tubes.	H-8, E-9, and B-8
3.	CRDM guide tube, inside surface.	H-8, B-8 briefly; E-9 in much detail
4.	Small debris flakes	Top of support plates Top of spider hubs Top of structural debris Superseded in water.
5.	Plenum upper grid plate	H-8, E-9
6.	Fuel element upper end fitting (plenum piece)	E-9, suspended from grid plate; also E-8, D-8, D-9. B-8, in normal location.
7.	Fuel element upper end fitting (grillage piece)	E-8, D-8, D-9 intact; E-9 grillage gone. Entire end fitting at H-8 gone.
8.	C tubes	E-9, some intact, some melted at bottom end; B-8, H-8 all intact
9.	Split tubes	E-9, some wastage on bottom end of one split tube; B-8, H-8 OK
10.	Plenum grid plate pressure pads	H-8, E-9 in normal position
11.	Fuel element upper end skirt	Fragment with torn edge still fastened to E-9 end fitting; piece in debris bed below E-9
12.	Fuel element spacer grid	Portion visible at D-8

<u>Item</u>	<u>Description</u>	<u>Location Observed</u>
13.	Fuel element guide tubes	Portions of several visible at D-8
14.	Fuel pins	Several broken pieces laying horizontally on debris bed at E-9; several stubs extending vertically upward from debris bed at E-9; several stubs hanging from end fitting at D-8; broken end at E-9 debris bed
15.	Fuel Pellet	Fragment lying on top of centering tabs of upper end fitting at E-9
16.	Alumina/boron carbide pellet (burnable poison)	Several visible on debris bed at E-9
17.	Tubular spacers from inside of fuel pins	Many visible on debris bed at E-9
18.	Fuel pin end cap	On partial-length pin lying on debris bed at E-9
19.	Fuel pin internal springs	Two visible on debris bed at E-9; several extending from ends of fuel pin stubs below D-8
20.	Upper end fitting spring retainer ring	In place at B-8 and adjacent location; broken ears still in slots in upper end fitting at E-9. Piece on debris bed at H-8
21.	Control element spider	In place at B-8 and adjacent location; intact spider on debris bed at H-8
22.	BPRA retainer	In place at location adjacent to B-8

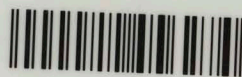


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Deacidified using the Bookkeeper process.
Neutralizing agent: Magnesium Oxide
Treatment Date: Feb. 2007

Preservation Technologies
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111 Thomson Park Drive
Cranberry Township, PA 16066
(724) 779-2111



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