R0250

MPR ASSOCIATES, INC.

- DRAFT -

PHASE 3 STATUS REPORT

REMOVAL OF TEST SPECIMENS FROM THE TMI-2 REACTOR VESSEL BOTTOM HEAD

SUMMARY OF WORK DURING 30 DAY IN-VESSEL PERIOD

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Section 1

INTRODUCTION

This report presents the results of Phase 3 efforts completed by MPR Associates for the Three Mile Island, Unit 2 (TMI-2) Bottom Head Sampling Project. The Phase 3 portion of this project involved in-vessel operations at TMI-2 to physically remove metallurgical specimens from the reactor vessel lower head.

The in-vessel work was completed over a 30 day calendar period starting on January 30, 1990, and ending on March 1, 1990. Over this period, fifteen (15) reactor vessel samples were cut out of the vessel bottom head. In addition, fourteen (14) incore nozzle stubs were cut out of the reactor along with two (2) incore instrument guide tube sections. All the metal specimens were placed in individual lead-filled canisters for shipment to a national lab for subsequent examination. Shipment of the samples from TMI is scheduled for mid April, 1990.

The purposes of this report are to provide a chronology of events over the 30 day in-vessel period, provide a summary of the sample locations, types and appropriate descriptions, and discuss some of the interesting findings and problems that occurred while working in the reactor vessel. This report will not discuss the sampling tools or techniques as this has been presented in previous reports and will be presented in the final cumulative report (Phase 4 report).

The remainder of this report includes the following main sections:

- Chronology of Events -- This section summarizes the events that took place over the 30 day in-vessel portion of the project and includes discussions of boat sample cutting, incore nozzle cutting and guide tube cutting. Some of the findings and problems that occurred over the 30 days will be discussed.

- Summary of Vessel Samples -- This section documents the locations of the boat samples that were removed from the reactor vessel. Information will also be presented on sample cutting times, the identification of the lead-filled canisters in which the samples were loaded, and specific descriptions of sample types.

- Summary of Incore Nozzle Samples -- This section documents the locations of the incore nozzles that were cut out of the reactor vessel. Canisters holding the nozzles are identified along with estimated nozzle damage and length.

- Summary of Incore Guide Tube Samples -- This section documents the locations of the incore guide tube sections that were cut off and prepared for shipment and identifies the canisters holding each guide tube section.

Section 2

CHRONOLOGY OF EVENTS

Table 2-1 and the tables in Appendix A (Table A-1 and A-2) summarize the chronology of events that occurred over the 30 day in-vessel period at Three Mile Island. Table 2-1 provides a summary of the operations that were completed including the cutting of vessel samples, the cutting of incore nozzle samples and the cutting of guide tube sections. The solid lines on Table 2-1 indicate the activities that were originally planned prior to going to site, while the broken lines indicate actual work over the 30 day in-vessel period. Table A-1 provides a detailed shift-by-shift, day-by-day summary of the activities associated with the cutting of the vessel samples and the incore nozzle samples. Table A-2 provides a detailed summary of the activities associated with the cutting of the guide tube sections.

As noted in Table 2-1, there were several findings and problems which resulted in deviations from the planned activities. These are discussed below.

2.1 Vessel Cleaning

Two vessel cleaning operations had originally been planned during the 30 days (Operations No. 1 and 5 on Table 2-1). The purpose of these operations was to remove non-conductive material from the vessel surface to permit use of the Metal Disintegration Machining (MDM) process to obtain samples. A special wire brush cleaning tool had been developed for this purpose. The cleaning operations were estimated to require almost four full days to complete.

After visual inspections of the bottom head, it was decided to skip these cleaning steps, as the only debris on the head appeared to be

loose, dust-like particles. During MDM cutting on the vessel, the MDM cutter head was able to flush this loose debris away from the cutting area so that no wire brush cleaning was required.

2.2 Initial Vessel Sample MDM Cutting

As shown on Table 2-1, the initial MDM boat sample cutting operations were performed over a period of approximately 15 days, which was seven days longer then originally planned. Over this period, eight vessel samples were successfully cut and stored in lead-filled canisters. The vessel sample at position H-7 was not successfully cut. Some of the problems with this and other cuts are discussed below.

There were several major problems which caused the seven day delay, including a faulty vessel return ground, poor containment pneumatic systems, and electrode vibrator problems. Each of these is discussed below:

- Faulty Vessel Return Ground -- The MDM cutting process used to remove the vessel samples requires a return circuit for the cutting current (ranging from about 80 amps up to peaks of about 1000 amps). During development and testing, this return circuit was provided by a cable attached directly to the material being cut and routed back to the main power supply. Problems developed during initial attempts at MDM cutting in the vessel due to the quality of the vessel ground. GPU Nuclear had supplied a ground that had been used during previous plasma cutting of the lower core support assembly (LCSA). It was found, after the fact, that this ground was not connected directly to the vessel material but was bolted to the upper core support assembly (UCSA). The UCSA is directly bolted to the LCSA but only rests, by its own weight, on the vessel. This ground circuit had a higher than desired resistance and resulted in stray current paths through various containment structures back to the cutting power supply. The stray currents caused two primary power transformer failures along with the failure of several control and protection relays. To correct the problems, redundant power cables were mounted on a specially designed fixture which was then routed and clamped directly to one of the reactor vessel incore nozzles on the lower head of the vessel. The power cables were then attached to the main power supply. This corrected the stray current problems.

- Poor Containment Pneumatic Systems -- TMI-2 pneumatic supply systems in containment were used to power several critical pieces of the MDM equipment. After several failures of the equipment, inspections were made which revealed an exorbitant amount of water in the system. Upon further investigation, it was found that, contrary to normal air supply systems, no water separation equipment was in use for the containment air system. The air was drawn from the atmosphere and supplied directly into containment without passing through any type of dryer or water separator. Existing equipment for these functions had been disabled. This problem is believed to have caused several stoppages of the cutting process. In particular this is believed to be one of the major reasons why the sample cut at H-7 could not be completed. To correct this problem a desiccant dryer was installed in the air system. In addition, an after cooler (dehumidifier) was ordered and installed near the end of the in-vessel period.

- Electrode Vibration Problems -- Small air driven turbine vibrators are used inside the electrode slide assemblies (mounted on the MDM head) to oscillate the electrodes near the work piece. This oscillation provides the mechanism by which electric arcs are made between the electrode and work piece. The arcs create small puddles of molten material in the work piece from which small spheres of material are ejected. During cutting operations in the vessel, the turbine vibrators ran intermittently and sometimes stopped completely. If they could not be restarted, the cut would have to be aborted and the MDM head would have to be removed from the vessel and rebuilt. Water in the air system was not considered to be the only cause of the problem since the problem continued, albeit to a lesser degree, after air dryers had been installed. Although no one cause for the problem could be found, it was discovered later that PCI replacement bearings for the vibrators were not the original manufacturer's supplied equipment that had been used throughout testing. To correct this problem, the hydraulics system, normally used only to position the electrodes, was converted through a MOOG valve to permit cycling of the electrodes in a manner similar to that provided by the turbine vibrators. This modification eliminated the vibration problems.

In addition to the MDM system problems, two interesting findings were uncovered. During positioning of the MDM head prior to cutting vessel sample G-8, it was found that the center of the vessel (over about a 12 inch radius) is slightly convex as opposed to the concave (spherical) shape intended by design. The convex shape is believed to be a result of fabrication techniques and not the March 1979 accident.

It appears as though the vessel head was not formed exactly spherically or that extra weld clad was deposited in the center. The orientation of the MDM cutting head and delivery system had to be adjusted to permit positioning over the convex G-8 location.

The second point of interest was found during the final positioning of the MDM head on location G-8. Throughout the 30 day in-vessel operation there was a thin layer of debris over the lower head which could cover and hide small areas of damage. Just before positioning on G-8, a set of flush jets in the MDM electrodes were turned on to blow nonconductive material away from the cut area. After flushing, a tear was uncovered in the vessel clad, similar in appearance to the tear at the E-7 nozzle. The tear area was included as part of the G-8 sample. This may indicate that there are other similar clad tears in other parts of the lower head. Time did not allow for a detailed cleaning and inspection of the entire lower head.

2.3 Incore Nozzle Cutting Operations

The incore nozzle cutting operations were completed in five days versus the originally planned seven. Fourteen nozzles were cut off and collected in canisters. No major problems occurred.

There were, however, several interesting findings. During inspection of the incore nozzles, the nozzle designation K-11 was found to be undercut apparently due to material flow during the 1979 accident. Approximately one half of the total nozzle wall thickness was missing over a length of about 4 to 5 inches. The damage was limited to the central portion of the nozzle; the bottom and top areas of the nozzle (about 3 inches in length each) were visibly undamaged. There were several nozzles other than K-11 that were completely melted off, some almost flush with the vessel, but K-11 was the only nozzle found with undercutting. In addition, the top 6 inch portion of the K-11 nozzle was visibly leaning over maybe 10 to 20 degrees as a result of the damage. The K-11 nozzle was cut off with the entire damaged region

included in the cut nozzle section. The remaining nozzle stub was about 2 inches high. After the K-11 nozzle was cut, what looked like resolidified fuel was found in the 5/8 inch diameter hole of the remaining nozzle stub. The resolidified material was formed around the incore instrument string completely filling the 5/8 inch hole. This was surprising since prior to cutting, the top of the nozzle appeared clean of any type of debris. This might indicate that molten type material flowed into the nozzle either through the top of the nozzle or by way of the undercut region midway down the nozzle.

As a second item of interest, two nozzles (designations G-5 and G-6) bubbled after the nozzle wall of the penetration was cut through with the saw blade. Both penetrations bubbled several minutes after cutting. This would indicate that there were gases trapped in the incore string, possibly the result of fuel material which may have flowed into the nozzles during the accident. Both the G-5 and G-6 locations were previously vented on the seal table prior to the start of the 30 day in-vessel work. The venting was done as part of work to prepare the incore strings for retraction operations. No water or noticeable gases were vented from G-5 and G-6 at the seal table.

It should also be pointed out that during the seal table operations, nozzle penetration F-7 leaked water. During venting of F-7, about a five second stream of water was forced out of a 1/4 inch diameter vent hole. The incore pipe must have been pressurized since the seal table is at elevation 347′ and the vessel water level during this operation was about at elevation 329′. Bubbling of this nozzle, similar to G-5 and G-6, could not be checked since the nozzle at F-7 was too short to attempt a nozzle cut.

While cutting incore nozzles, it was originally planned to obtain two to three peripheral incore nozzle samples. Unfortunately only the peripheral Nozzle R-7 was obtained. In other attempts to cut Nozzles P-6 and L-2, the cutting tool and abrasive saw blades were broken or constrained. After nozzle R-7 was successfully cut, one attempt was

made for P-6. On this attempt the cutting blade broke during positioning of the tool. After this, two additional attempts were made for Nozzle L-2. During the first attempt, the tool could not be installed near the nozzle due to geometry constraints of the lower flow distributor plate. Some relatively simple hardware modifications were made to fix this problem. After the modifications, a second attempt was made for L-2. The tool was successfully positioned on L-2 but the cut could not be completed due to constraints from surrounding incore guide tubes. Due to the tight time schedule, it was decided to end cutting attempts on the periphery incore nozzles and proceed with the second round of MDM operations.

2.4 Retracting Incore Instrument Strings

The incore string retraction operations were expected to take about three days while nozzle cutting operations were performed in parallel. Table 2-1 indicates that the actual retraction operations (over the 30 day period) were completed on one shift of one day. About three days of preparation work, however, had been completed prior to the start of the 30 days. Preparation work included the removal of the incore seal assemblies on the seal table and the installation of lift bails on the incore strings.

The pull loads on the incore strings that were retracted during this operation and the retraction lengths are provided on Table A-1 (day 21; February 19, 1990). Six incore strings were successfully retracted.

2.5 Cleaning, Measuring, and Installing Seal Plugs

As shown on Table 2-2, four incore penetrations were cleaned, measured and plugged in a period of about 3 days. This is consistent with the schedule. No problems occurred while working on these penetrations. The seal plugs installed in the penetrations consist of a tapered wedge, a mating conical section and a push rod. During installation, the push rod is driven hydraulically down on the tapered wedge which

expands the outer conical section. Expansion of the conical section into the incore pipe and vessel penetration bore provides the necessary seal. To provide quantitative feedback that the seals were installed correctly, several plugging parameters were measured during installation. From previous mock-up testing, it was found that the displacement of the tapered wedge in relation to the driving force on the push rod provides a very good indication of the quality of the seal plug installation. As a result, during each plug installation, these parameters were measured and recorded. The data were then plotted in comparison with successful plugging tests completed in the lab. The plugging data for each of the four incore penetrations are compared to test data on Figures 2-1 through 2-4. As shown, the vessel plugging operations for all four penetrations compared well with test data. Table 2-2 lists some of the final plugging data including final wedge displacement and wedge force.

On incore E-7, a two inch piece of a drill string was broken off in the nozzle during attempts to clean and prepare the penetration. Although no conclusive evidence could be acquired, it appeared from visual inspections that the nozzle was slightly bent over the vessel penetration bore and that the nozzle and vessel penetration were not concentric. This bending of the E-7 nozzle was similar to the bending that was seen on nozzle K-11, and could have occurred during the March 1979 accident. Due to the drill string problem, Nozzle E-7 was temporarily abandoned. Additional preparation work was performed on this nozzle later in the 30 day period. This work is discussed in Section 2.7 of this report.

2.6 Final Vessel Sample MDM Cutting

MDM sample cutting was reinitiated after completion of the preparation and plugging work on the incore nozzle penetrations. The MDM cutting was restarted on Day 23 of the schedule (see Table 2-1) and continued until the end of the 30 days. Due to time savings at other points in the schedule, the final MDM

cutting was performed almost on schedule. Over the final cutting period, a total of seven additional vessel samples were cut and stored in lead-filled canisters. Four of the seven samples were from incore penetration locations. The other three samples were taken from open areas.

No major problems occurred over the final cutting period. The vessel sample at H-8, however, was not completely cut by the MDM process and some difficulties did occur in trying to remove the sample. An impact weight and pry tool was used, over a period of about 8 hours, to work the sample free. Upon inspection of the H-8 sample, (after it was removed from the vessel) it was discovered that a piece of one of the graphite cutting electrodes must have broken off prior to the cut. This most likely happened during positioning and was not noticed due to poor water clarity and difficulty with camera operations. As a result of the broken electrode, the sample was not completely severed from the vessel during MDM cutting. In the process of removing the H-8, the bottom edge of the sample, which was not cut by the MDM electrodes, was fatigued and the sample was torn free of the vessel. This should be considered during examination of the sample.

2.7 Preparation Attempts at Incore Penetration E-7

As discussed earlier, problems developed during initial attempts to clean out, measure and install a seal plug in E-7. A drill string was broken off inside of E-7 apparently due to a lack of concentricity between the nozzle and the vessel penetration bore. At this point, E-7 was temporarily abandoned while the MDM equipment was reinstalled. After MDM operations were resumed, parallel operations were initiated to complete the preparation and plugging of E-7., A drill string retraction tool was developed that consisted of two spiral wound spring steel leads which could be inserted in the flutes of the broken drill string. This tool was successfully inserted in the drill string flutes but was not able to remove the drill string.

At this point, it was decided to drive the broken drill string into the penetration such that a plug could be installed. An impact punch was used to drive the drill into the penetration about six inches. This would have been sufficient to allow the installation of a seal plug at a distance slightly shorter than design. A vessel sample removed from a penetration plugged in this manner would have been about 1 1/2 inches deep and 1 3/4 inches wide compared to the normal 2 1/2 inches deep and 3 inches wide. Unfortunately at this point, the 30 day period had ended. The decision was made by the NRC not to further pursue the E-7 sample. The final condition of the E-7 incore penetration at the end of the TMI work is as follows:

- A 5/8 inch diameter drill string, about 2 inches long, is lodged in the penetration piping about 6 inches below the top of the vessel nozzle stub.
- A seal plug was not installed in this penetration.

2.8 Guide Tube Cutting Operations

Table 2-1 indicates that the guide tube cutting operations were originally planned to run in series with the 30 day sampling activities in the vessel. The guide tube operations were to be started after the 30 day in-vessel work was complete. A large tank filled with water was going to be placed on the work platform, above the reactor vessel. Guide tube sections, hanging on the D-Ring wall, were to be placed in the tank for cutting.

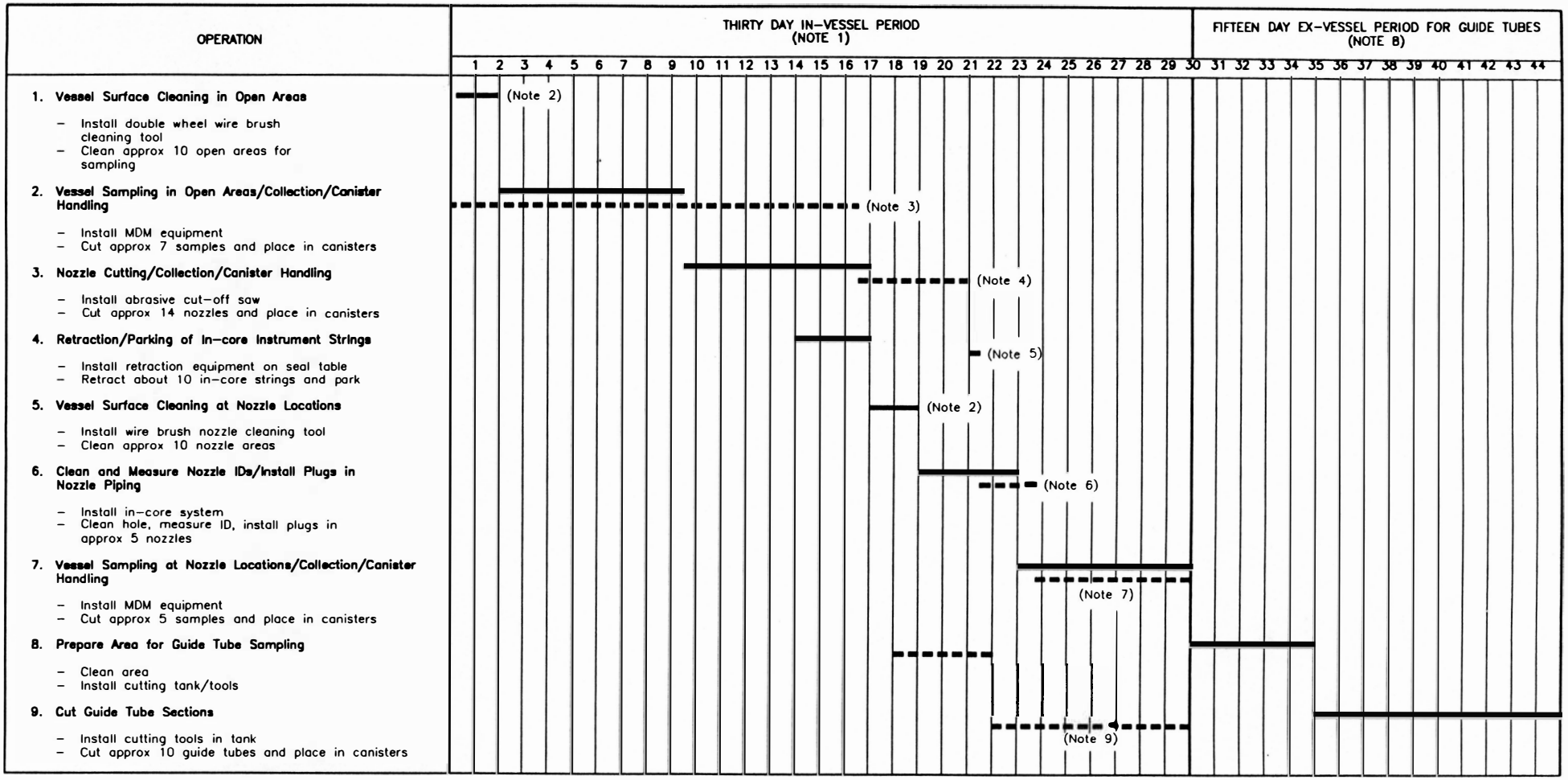
In an attempt to save time and money, a plan was developed to perform the guide tube work in parallel with vessel sampling. (After the original 30 days in-vessel, the GPUN/MPR contract allowed GPUN to increase their daily costs by about 30% to account for overhead and profit.) As part of the parallel plan, the top of the 'A' D-Ring was used to hold the cutting tank. As shown on Table 2-1, about four days were used to clean the top of the D-Ring and construct the tank and scaffolding. Cutting operations were performed over the remaining eight days. Note that similar to the original plan, the guide tube

cutting work was only performed on day shift as opposed to the three shift (around the clock) in-vessel work.

Problems did occur in the guide tube cutting work. These problems were not related to or affected by the parallel operations. It was found that the material of the damaged guide tube sections was much harder than the as-fabricated stainless steel. In testing, the mock up stainless steel guide tube pieces could be cut with a modified pipe cutting tool in about an hour. In addition, a back-up abrasive saw tool could cut a guide tube in about four hours.

During cutting of the actual damaged guide tubes, the modified pipe cutter tool broke several times and not once was the tool able to complete a cut. It took about eight hours for the abrasive saw tool to cut half way through a guide tube section.

As a result of these problems, only two guide tube pieces were successfully cut. Two additional canisters were loaded with the stainless steel shavings of the cutting work.



Notes:

1. Thirty day period started 0700 hours, January 30, 1990 and ended 1100 hours, March 1, 1990.
2. Vessel cleaning was not required.
3. Eight open samples were removed and placed in canisters.
4. Fourteen in-core nozzles were cut and placed in canisters.
5. Six in-core instrument strings were retracted on day 21 (February 19, 1990).
6. Four in-core nozzle penetrations were prepared (counter sunk, brushed and measured) and sealed.
7. Seven boat samples were removed, four at in-core nozzle penetrations and three in open areas.
8. Original plans called for guide tube cutting operations to be performed in series with in-vessel operations.
9. Due to cutting problems, only two guide tube samples were removed.

Legend:

Planned Operations

Actual Operations

SUMMARY OF OPERATIONS DURING TMI-2 VESSEL SAMPLING PROJECT

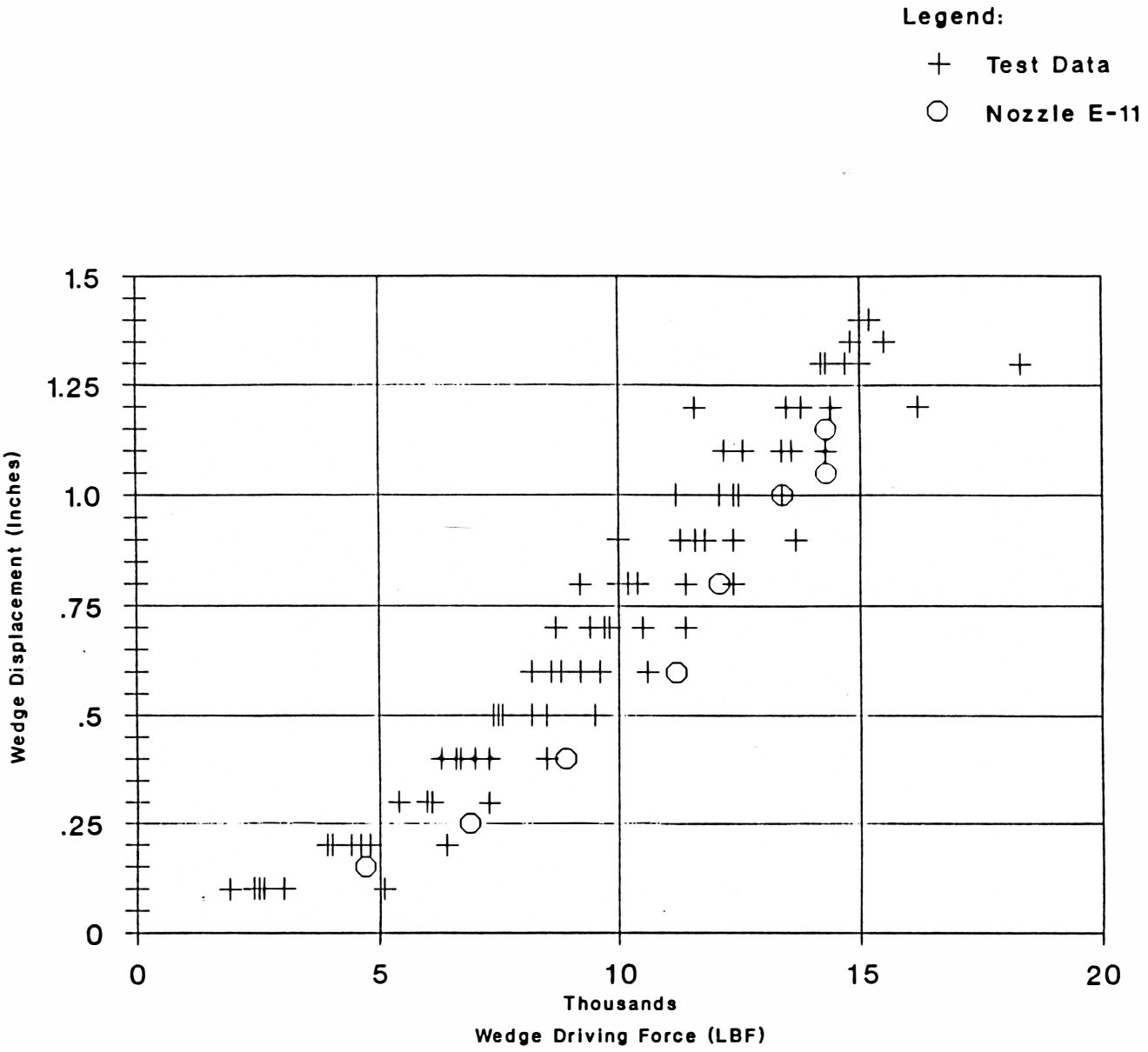
TABLE 2-1

MPR ASSOCIATES
F-73-30-310 (A)
04/16/90 (16)

Table 2-2

SUMMARY OF
INCORE NOZZLES THAT WERE
CLEANED, MEASURED AND PLUGGED

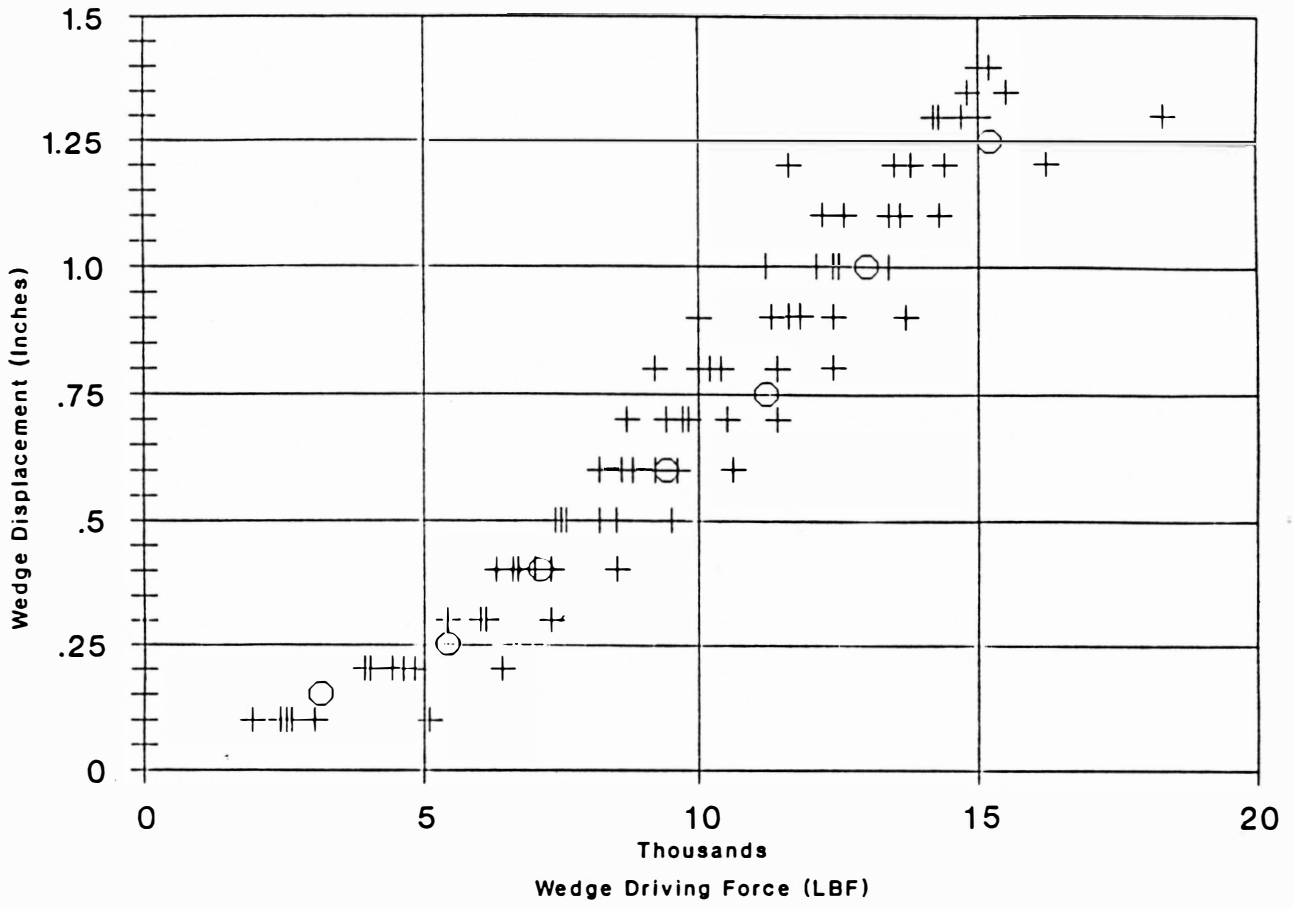
Nozzle	Inner Diameter Measurement (Inches)	Size of Expander Outer Diameter (Inches)	Final Wedge Driving Force (LBF)	Final Wedge Displacement (Inches)
E-11	0.603	0.590	14,300	1.15
H-8	0.610	0.590	15,200	1.25
H-5	0.602	0.590	13,900	1.10
D-10	0.614	0.600	14,300	1.15



INSTALLATION OF SEAL PLUG IN PENETRATION
NOZZLE E-11

FIGURE 2-1

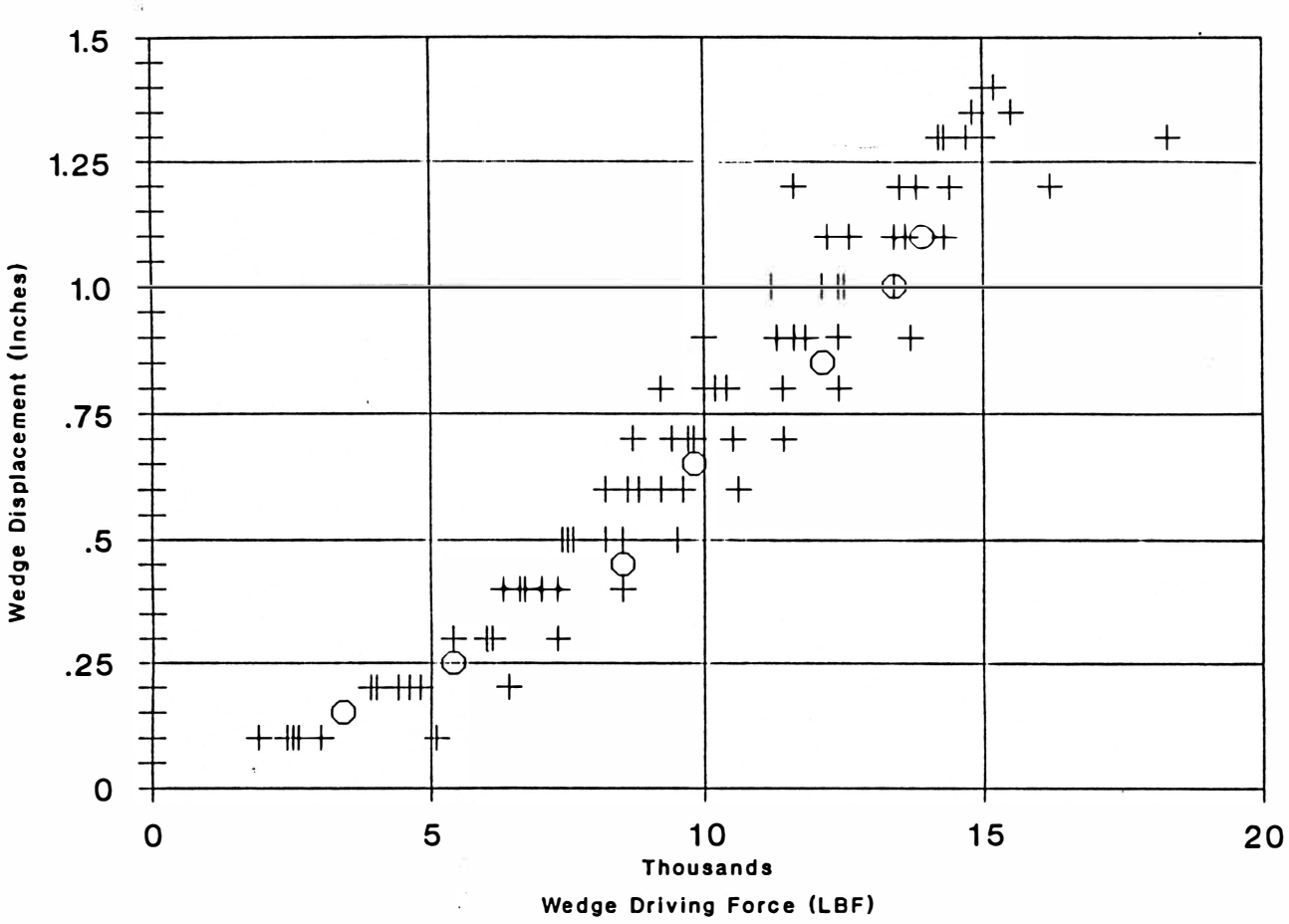
MPR ASSOCIATES
F-73-30-306
4/9/90



INSTALLATION OF SEAL PLUG IN PENETRATION NOZZLE H-8

FIGURE 2-2

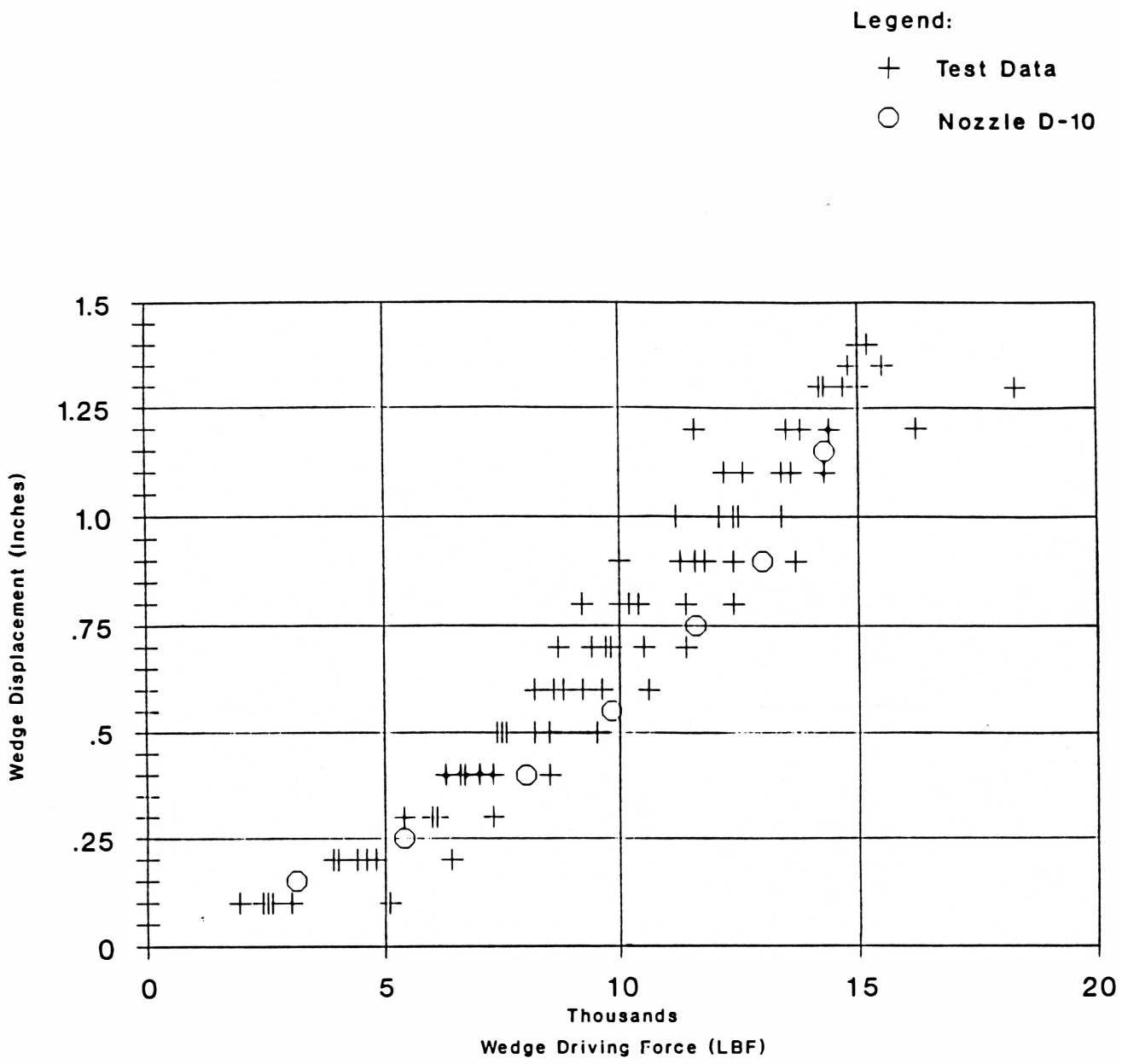
MPR ASSOCIATES
F-73-30-309
4/9/90



INSTALLATION OF SEAL PLUG IN PENETRATION NOZZLE H-5

FIGURE 2-3

MPR ASSOCIATES
F-73-30-306
4/9/90



INSTALLATION OF SEAL PLUG IN PENETRATION NOZZLE D-10

FIGURE 2-4

MPR ASSOCIATES
F-73-30-307
4/9/90

Section 3

SUMMARY OF METALLURGICAL SAMPLES

A summary of all the metallurgical specimens removed during the 30 day in-vessel period at Three Mile Island, Unit 2 is provided on Table 3-0. This table lists the sample type (vessel sample, incore nozzle sample, or guide tube sample) and the designation of the canister holding the sample.

3.1 Summary of Vessel Samples

A summary of the reactor vessel samples removed during the 30 day period is provided on Table 3-1. This table lists the vessel samples that were removed (in the order they were removed), the cutting times, and any particular problems or comments related to the cutting. The canisters in which the samples were placed are also designated on Table 3-1.

Figure 3-1 shows the location and orientation of each of the samples that were removed from the lower head.

3.2 Summary of Incore Nozzle Samples

A summary of the incore nozzle samples removed during the 30 day period is provided on Table 3-2. This table lists the nozzles that were cut off (in the order they were cut), the cutting times, the nozzle stub heights and any other relevant information. The canisters in which the nozzles were placed are also designated. As shown, two incore nozzle stubs were placed in each canister. This was done to reduce shipping costs. The 1-13-C shipping cask can hold six canisters per shipment and one shipment was estimated to cost around $30,000. In some cases the two nozzles in each canister were not distinguishable based on their heights. For these cases, a notch was

placed on one of the two nozzles as an identifying mark. The notch was made by nicking the side of the nozzle with the abrasive saw blade.

Figure 3-2 shows the locations of each of the nozzles that were cut and removed from the vessel. Also shown are the nozzles that were too short to cut and the nozzles in which seal plugs were installed.

3.3 Summary of Incore Guide Tube Samples

A summary of the incore guide tube samples removed during the 30 day period is provided on Table 3-3. This table lists the guide tube sections that were cut off, the cutting techniques and any other relevant information and/or problems. The canister designations in which the guide tubes were placed is also provided. Note that two additional canisters are listed on Table 3-3. The metal shavings from the guide tube cutting work were collected and placed in these canisters for evaluation if desired.

Figure 3-3 shows the location of each of the guide tube samples in relation to the lower head.

Table 3-0

SUMMARY OF ALL METALLURGICAL
SPECIMENS REMOVED DURING 30 DAY PERIOD

Canister I. D.	Sample Location	Sample Type
MPR-5-1	L-6 & E-11	Incore Nozzles
MPR-5-2	K-12 & M-10	Incore Nozzles
MPR-5-3	M-9 & E-7	Incore Nozzles
MPR-5-4	G-5 & R-7	Incore Nozzles
MPR-5-5	K-13	Open Area Vessel Sample
MPR-5-6	H-8	Vessel Sample at Nozzle Location
MPR-5-7	K-7	Open Area Vessel Sample
MPR-5-8	F-10	Open Area Vessel Sample
MPR-5-9	E-6	Open Area Vessel Sample
MPR-5-10	L-9	Open Area Vessel Sample
MPR-5-11	H-4	Open Area Vessel Sample
MPR-5-12	E-8	Open Area Vessel Sample
MPR-5-13	F-5	Open Area Vessel Sample
MPR-5-14	G-8	Open Area Vessel Sample
MPR-5-15	L-11 & H-9	Incore Nozzles
MPR-5-16	H-5 & D-10	Incore Nozzles
MPR-5-17	H-8 & K-11	Incore Nozzles
MPR-5-19	M-8	Open Area Vessel Sample
MPR-5-21	D-10	Vessel Sample at Nozzle Location
MPR-5-23	M-10	Incore Instrument Guide Tube Sample
MPR-5-24	K-5	Incore Instrument Guide Tube Sample
MPR-5-25	NA	Incore Instrument Guide Tube Shavings
MPR-5-26	NA	Incore Instrument Guide Tube Shavings
MPR-5-42	M-11	Open Area Vessel Sample
MPR-5-43	H-5	Vessel Sample at Nozzle Location
MPR-5-44	E-11	Vessel Sample at Nozzle Location

Table 3-1

SUMMARY OF
REACTOR VESSEL SAMPLES

Location	Sample Type	MDM Head Rebuild #	Date Cut Completed	"A" Electrode Cut Time (hr:min)	"B" Electrode Cut Time (hr:min)	Total Cut Time (hr:min)	Sample Severed	Canister I.D.	Electrode Vibration Type Used	Comments
K-7	Open-Area	4	2/6/90	9:55	13:00	22:55	Yes	MPR-5-7	Turbine	Cut made with primary transformer only providing 25 volts.
F-10	Open-Area	5	2/7/90	7:50	4:35	12:25	Yes	MPR-5-8	Turbine	Auxiliary transformer reconnected back into system at half way point in "A" cut. Cutting voltage was set at 30 volts and system was adjusted. Resulting cut rate was 0.6 inch per hour.
E-6	Open-Area	6 (Note 3)	2/8/90	5:40	4:15	9:55	Yes	MPR-5-9	Turbine	MDM head was modified and E-6 sample cut with head rotated 90° from standard orientation. E-6 sample included lower crack portion extending from E-7 nozzle.
L-9	Open-Area	8	2/10/90	4:35	4:05	9:40	Yes	MPR-5-10	Turbine	No cutting problems.
H-4	Open-Area	10 (Note 3)	2/12/90	8:50	6:40	15:30	Yes	MPR-5-11	"A" side: Turbine "B" side: 20% Turbine 80% Hydraulic	Turbine vibrator operation intermittent on "A" electrode cut. Turbine vibrator failed on "B" side. Hydraulic vibrator used in prototype MDM design was used to finish "B" side cut.
E-8	Open-Area	11	2/13/90	8:00	5:10	13:10	Yes (Note 1)	MPR-5-12	"A" side: Simultaneous Turbine and Hydraulic "B" side: Turbine	No cutting problems.
F-5	Open-Area	12	2/13/90	4:45	4:10	8:55	Yes (Note 1)	MPR-5-13	"A" side: Hydraulic "B" side: Simultaneous Turbine and Hydraulic	No cutting problems.
G-8	Open-Area	13	2/14/90	4:35	3:55	8:30	Yes (Note 1)	MPR-5-14	Simultaneous Turbine and Hydraulic	G-8 sample cut with MDM head rotated 90° from standard orientation. MDM head would not sit properly during previous attempts with standard orientation.
K-13	Open-Area	14	2/22/90	4:40	4:15	8:55	Yes	MPR-5-5	Simultaneous Turbine and Hydraulic	Cut was started at 04:40, 2/22/90 following a seven day period cut completed used to cut, prep and seal incore nozzles.
E-11	Nozzle	15	2/22/90	5:30	4:55	10:45	Yes (Note 1)	MPR-5-44	Simultaneous Turbine and Hydraulic	First MDM cut at nozzle location. Camera in MDM head showed slight interference between nozzle stub and flush fittings on electrodes. This interference prevented sample from being completely severed and retained by the electrodes.
H-5	Nozzle	16	2/23/90	4:10	4:25	8:35	Yes (Note 1)	MPR-5-43	Simultaneous Turbine and Hydraulic	The tabs of the H-5 sample could not be completely severed. There was also concern at the time that the sample was not severed on the bottom. Until this concern could be resolved it was decided to temporarily suspend sample cutting at nozzle locations.

Table 3-1

SUMMARY OF
REACTOR VESSEL SAMPLES

Location	Sample Type	MDM Head Rebuild #	Date Cut Completed	"A" Electrode Cut Time (hr:min)	"B" Electrode Cut Time (hr:min)	Total Cut Time (hr:min)	Sample Severed	Canister I.D.	Electrode Vibration Type Used	Comments
M-8	Open-Area	17	2/24/90	4:15	3:40	7:55	Yes (Note 1)	MPR-5-19	Simultaneous Turbine and Hydraulic	While cutting M-8 sample, tabs on H-5 sample were broken with minimal effort using a chisel tool. MDM cutting of nozzle samples was resumed next cut.
H-8	Nozzle	18	2/25/90	4:50	4:55	9:45	No (Note 2)	MPR-5-6	Simultaneous Turbine and Hydraulic	Malfunctioning camera in MDM head made deploying head at H-8 location extremely difficult. Unsevered H-8 sample required 8 hours to break free using crust impact tool due to uncut area aprox. 1/2 inch x 2 inches at bottom of sample. Failure to complete cut was attributed to electrode damage sustained while deploying.
M-11	Open-Area	19	2/26/90	4:30	4:15	8:45	Yes	MPR-5-42	Simultaneous Turbine and Hydraulic	No cutting problems.
D-10	Nozzle	20	2/27/90	5:15	5:40	10:55	Yes	MPR-5-21	Simultaneous Turbine and Hydraulic	D-10 nozzle stub was approx. 2 ½ inches long. New electrode design was used with flush fittings which could not interfere with nozzle.

Notes:

1. The sample was severed. Two small side tabs were left on the sample. The tabs were broken free with minimal effort when the sample was removed from the vessel and placed in a canister.

2. The sample was not completely severed apparently due to a broken cutting electrode. The sample was broken free from the vessel using a pry bar and impact punch.

3. The vessel cuts attempted following MDM head rebuilds #7 and #9 were aborted due to electrode turbine vibrator problems.

Table 3-2

SUMMARY OF
TMI-2 INCORE NOZZLE
SAMPLES

	Nozzle Location (Note 1)	Date Cut	Approximate Sample Length (Inches)	Canister I.D. (Note 2)	Reason for Selection	Nozzle Condition/Comments
INEL	L-11	2/15/90	10	MPR-5-15	Undamaged Nozzle Sample for Comparison with Damaged Nozzles	Nozzle was full 12 inches long.
INEL	H-9	2/15/90	10	MPR-5-15 (Notched)	Potentially Damaged Nozzle	Nozzle was full 12 inches long.
ANL	H-5 (BOAT SAMPLE)	2/15/90	6	MPR-5-16	Damaged Nozzle	Nozzle was approximately 6 inches tall prior to cut. The nozzle was cut off flush with the vessel.
ANL	D-10 (BOAT SAMPLE)	2/15/90	4	MPR-5-16 (Notched)	Damaged Nozzle/Alternate MDM Sample Location	Nozzle was approximately 5.5 inches tall.
INEL	K-11	2/16/90	9	MPR-5-17	Damaged Nozzle	Nozzle was full 12 inches long, however, from 3 inches to 8 inches above the vessel surface the nozzle was badly damaged with one-half of the wall thickness melted away.
ANI	H-8 (BOAT SAMPLE)	2/16/90	2-1/2	MPR-5-17	Damaged Nozzle/Primary MDM Sample Location	Nozzle was approximately 6 inches long post-accident. About two inches of this nozzle was broken off during lower head defueling.
ANL	E-11 (BOAT SAMPLE)	2/16/90	10	MPR-5-1	Damaged Nozzle/Primary MDM Sample Location	Nozzle was full 12 inches long with minor damage to upper 3/16 inch wall section.
ANL	L-6	2/16/90	9	MPR-5-1 (Notched)	Undamaged Nozzle Cut to Allow Access for MDM Head at M-6 Location	Nozzle was full 12 inches long.

Table 3-2

SUMMARY OF
TMI-2 INCORE NOZZLE
SAMPLES

	Nozzle Location (Note 1)	Date Cut	Approximate Sample Length (Inches)	Canister I.D. (Note 2)	Reason for Selection	Nozzle Condition/Comments
INEL	K-12	2/16/90	9-1/2	MPR-5-2	Undamaged Nozzle Cut to Allow Access for MDM Head at K-13 Location	Nozzle was full 12 inches long.
INEL	M-10	2/16/90	4 to 5	MPR-5-2 (Notched)	Damaged Nozzle Sample	Nozzle was approximately 4 to 5 inches long.
ANL	M-9	2/16/90	7	MPR-5-3	Damaged Nozzle Sample	Nozzle was 7 inches to 10 inches long with minor damage to the top of the nozzle.
INEL	E-7	2/17/90	1/2	MPR-5-3	Damaged Nozzle/Primary MDM Sample Location	Nozzle was severely damaged and was approximately 2 inches tall. Three attempts were required to completely cut the nozzle.
INEL	R-7	2/17/90	10	MPR-5-4	Damaged Nozzle Sample	Nozzle was full 12 inches long. The top of the nozzle had fuel adhered to it which protruded approximately 1 inch above of the nozzle.
INEL	G-5	2/18/90	1-1/2	MPR-5-4	Damaged Nozzle Sample/Alternate MDM Sample Location	Nozzle was approximately 4 inches tall.

Notes:

1. This table includes only nozzles that were cut. The following nozzles were too short to cut: F-8, E-9, G-6, G-9, F-7. Also peripheral nozzles L-2 and P-6 could not be cut due to interference of saw tool with flow distributor plate and other nozzles.

2. Two nozzle stubs were placed in each canister. When required, a nozzle was notched for identification purposes. Notched nozzles are indicated in this column.

Table 3-3

SUMMARY OF
GUIDE TUBE SAMPLES

Sample Location	Canister I.D.	Date Cut Completed	Aprpoximate Length	Tool Used to Make Cut
M-10	MPR-5-23	2/25/90	(Note 1)	Tri-tool: first 1 3/8 inch of wall thickness Abrasive Saw: last 1/2 inch of wall thickness
K-5	MPR-5-24	2/27/90	8"	Tri-tool: first 1 3/8 inch of wall thickness Abrasive Saw: last 1/2 inch of wall thickness
Guide Tube Shavings	MPR-5-25	NA	NA	NA
Guide Tube Shavings	MPR-5-26	NA	NA	NA

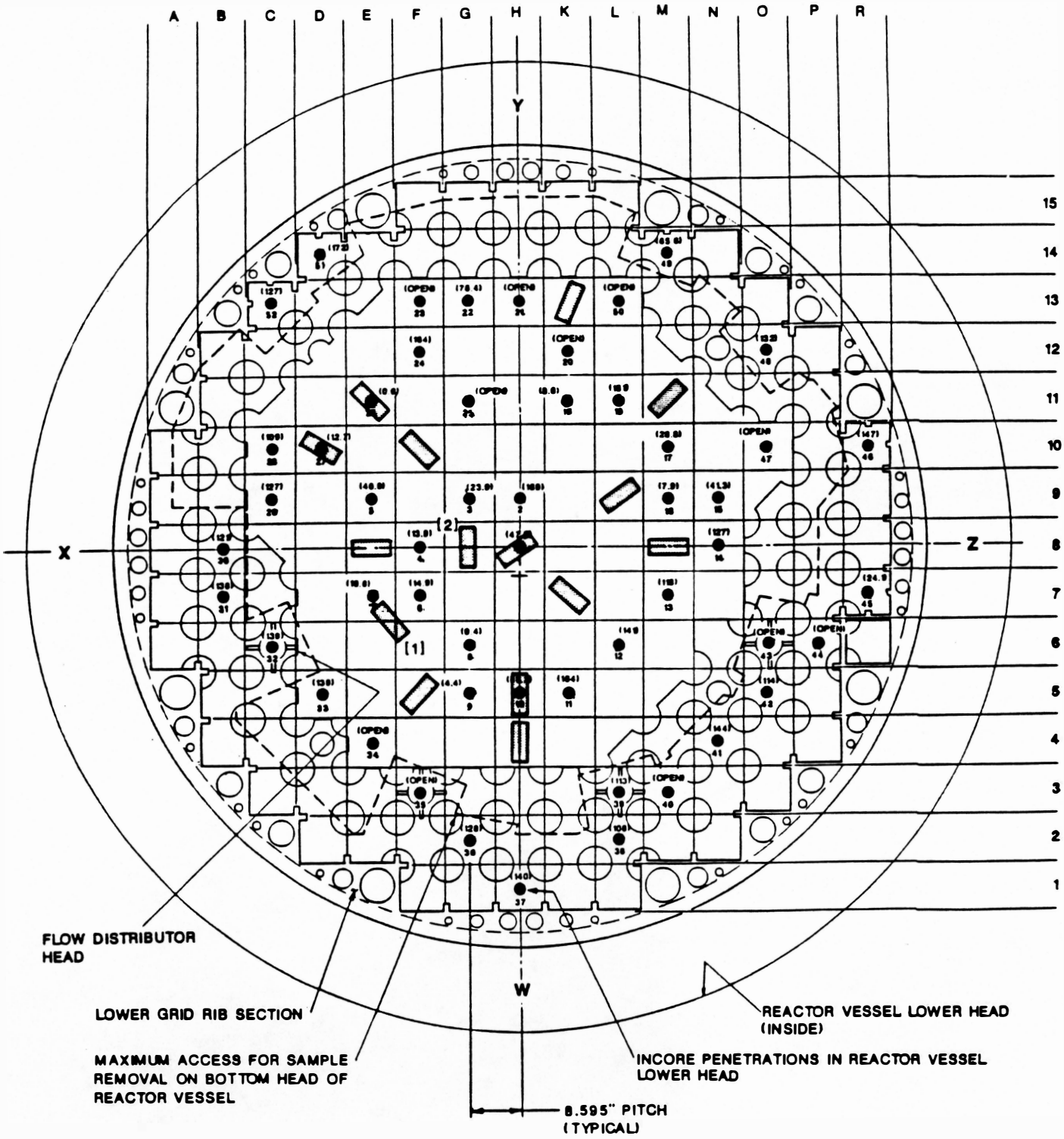
Note:

1. Length of sample was not recorded.

NOTES: [1] SAMPLE CUT AT E-6 LOCATION WITH MDM HEAD ROTATED 90° FROM STANDARD ORIENTATION TO INCLUDE CRACK.

[2] SAMPLE CUT AT G-6 LOCATION WITH MDM HEAD ROTATED 90° BECAUSE THE HEAD WOULD NOT SIT PROPERLY AT STANDARD ORIENTATION.

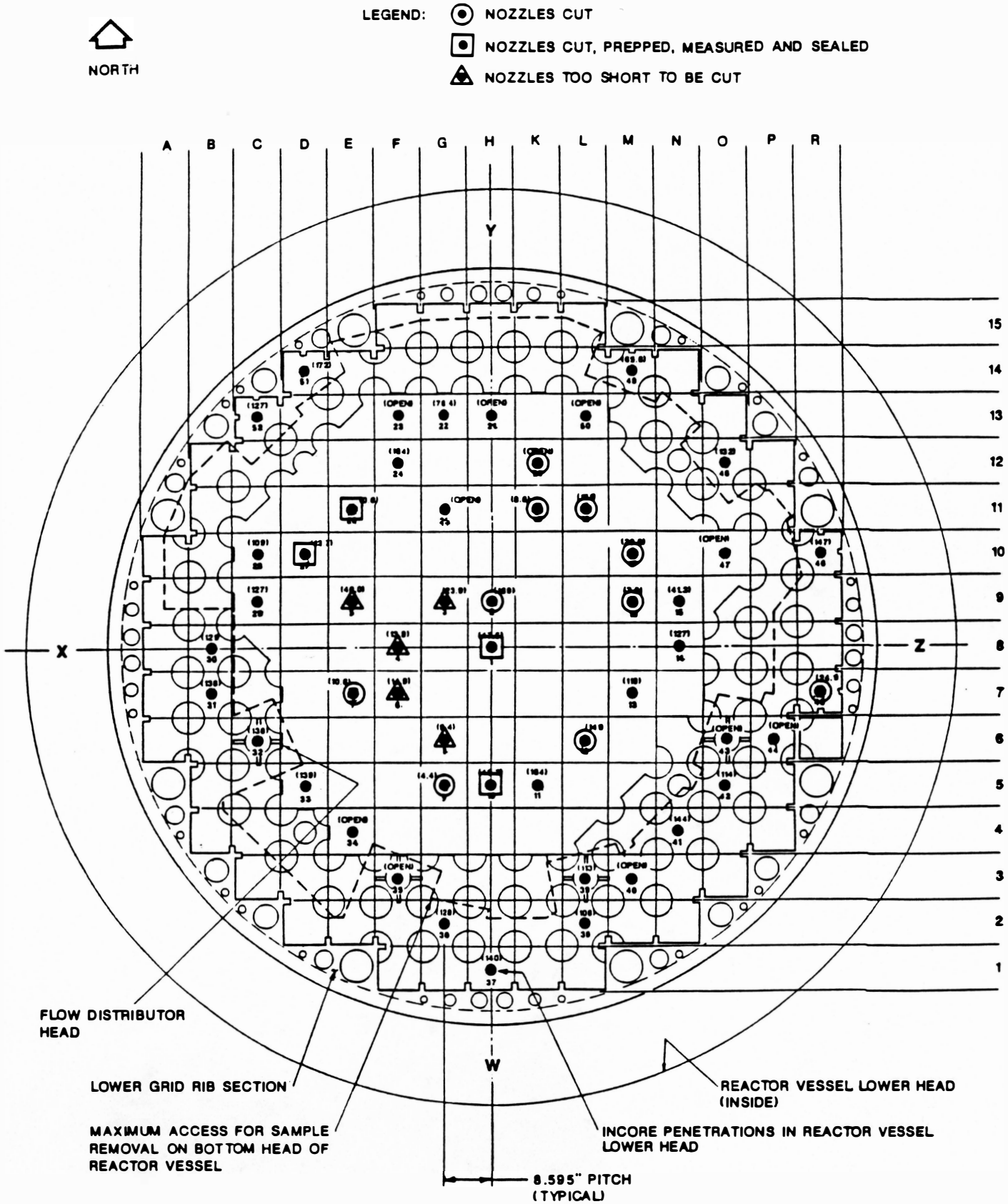
NORTH



LOCATION AND ORIENTATION OF REACTOR VESSEL SAMPLES

FIGURE 3-1

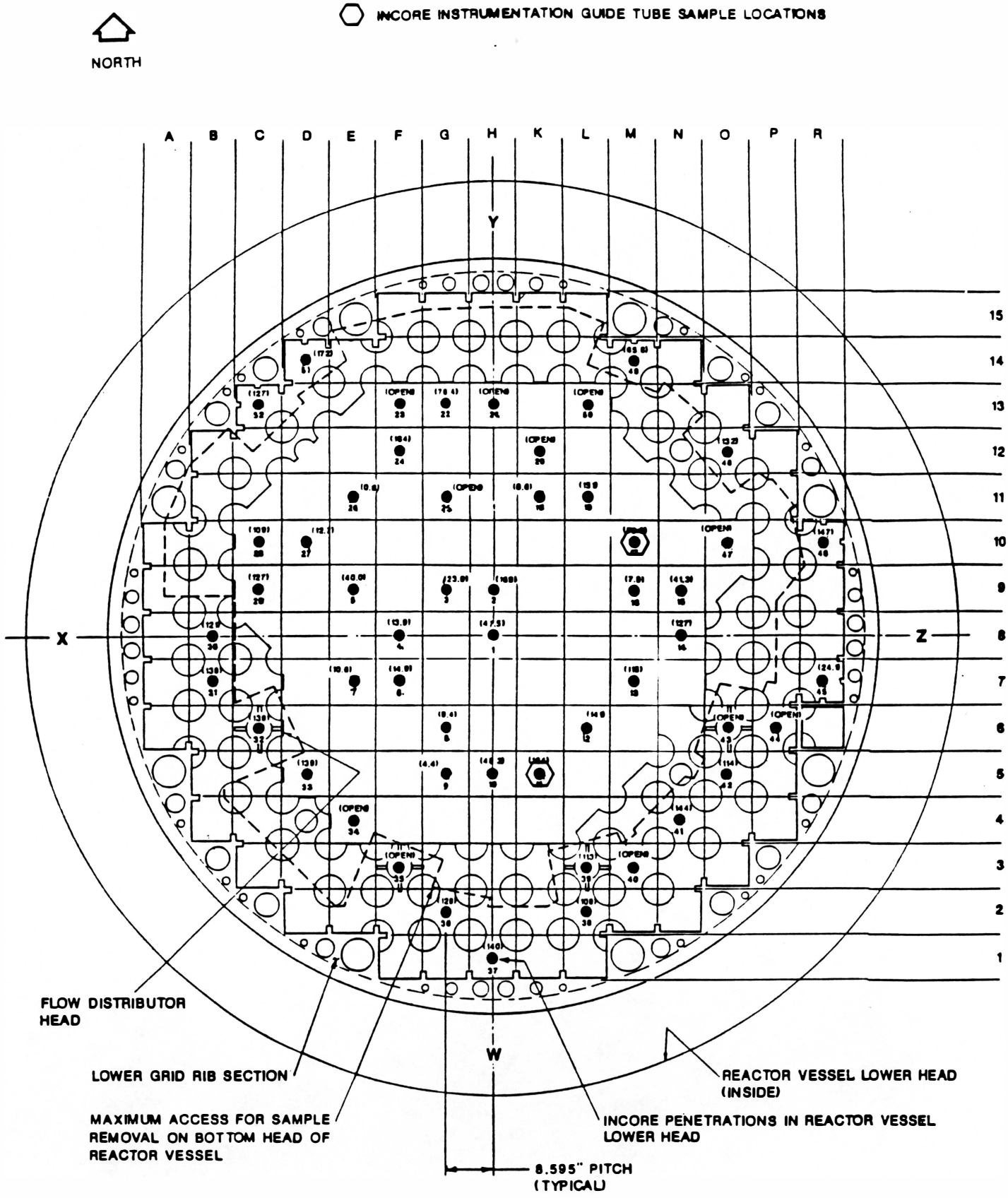
MPR ASSOCIATES
F-73-30-303
4/2/90



LOCATION OF INCORE NOZZLE SAMPLES

FIGURE 3-2

MPR ASSOCIATES
F-73-30-302
4/2/90



LOCATION OF GUIDE TUBE SAMPLES

FIGURE 3-3

MPR ASSOCIATES
F-73-30-304
4/2/90

APPENDIX A

DETAIL SUMMARY OF VESSEL SAMPLING ACTIVITIES

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
1/30/90 Day 1 0700 Hours	1	Completed connecting PCI MDM cutting system that was staged into the reactor building 1/29/90.	-----	-----
	2	Installed spooge can in CPS.	-----	-----
		Installed umbilical can in 18 inch work slot.	-----	-----
		Installed MDM Head Holding Can in 24 inch work slot.	-----	-----
		Removed TV camera from tool in rack and prepared it for installation in the MDM head.	-----	-----
		Installed MDM saddle plate on Thompson rails.	-----	-----
	3	Staged saddle plate for incore delivery system in RB.	-----	-----
		Finished assembly of the Modified Alternate Manual Tool Positioner (MAMTP).	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
1/30/90 Day 1 0700 Hours (Cont'd)	3 (Cont'd)	Placed umbilicals in umbilical can. Installed camera in MDM head. Connected MDM head to umbilicals and put in MDM Holding can. Started Operation Checks of MDM Head.	----- ----- ----- All worked stopped 0400 hours because required Unit Work Instruction signatures were not complete.	----- ----- ----- Cognizant Engineer (Defueling Support) was contacted to get signatures.
1/31/90 Day 2	1	Resumed Operation Checks.	Auxiliary transformer was blown during arc strike.	The transformer was checked which indicated a short in primary coil. The cause of the short circuit was not identified. Decided to replace the transformer with one from the spare power supply unit.
	2	Continued check of bad transformer. Installed Modified Alternate Manual Tool Positioner on saddle plate.	-----	-----
	3	Completed Operation Checks and started to deploy the MDM head at Location H-7.	-----	-----
2/1/90 Day 3	1	Centered saddle plate on the Thompson rails and delivered MDM head to Location H-7.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/1/90 Day 3	1 (Cont'd)	Started cutting.	Arcing in power supply relays caused cutting to be stopped.	Two relays were checked and found to be cycling. A ground wire was found burnt. An alternate ground loop through work platform and steel wheels on power supply was the suspected cause. The power supply was isolated by putting a rubber mat underneath the wheels.
	2	Resumed cutting at H-7 location.	Cutting stopped because "A" electrode turbine vibrator failed.	Lubricant sprayed into air supply and "A" and "B" air supplies were switched. "A" turbine vibrator would not start.
	3	Removed the MDM system from reactor vessel and completed MDM head Rebuild #1.	-----	-----
2/2/90 Day 4	1	Completed Rebuild #1 Operation Checks. Redeployed the MDM system at Location H-7. The head was positioned as close as possible ($\pm$ 1/4 inch) to the original location so that the electrodes would be in the slots of the previous partial cut.	----- The head was not in the same side-to-side location as original deployment.	----- -----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/2/90 Day 4 (Cont'd)	1 (Cont'd)	Resumed cutting.	-----	-----
	2	Completed "A" side cut. Started "B" side cut.	Drop in "A" electrode flush discharge pressure with no change in flow rate indicated an apparent leak.	"B" electrode flush checked and found OK indicating problem in "A" side downstream of flush box.
	3	-----	"B" side will not cut. Drop in flush discharge pressure with no change in flow noted for "B" side.	DWCS supply to the flush pump increased resulting in increase flow and pressure.
		-----	Cutting was sluggish apparently due to air in hydraulics fluid.	No action at this time.
		-----	Second auxiliary Transformer was blown.	Cutting stopped. Decision made to replace transformer but not include it in the cutting circuit. Decided to improve grounding on the vessel bottom head.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/3/90 Day 5	1	Made hardware improvements to the MDM system as follows:	-----	-----
		a) Separated the air supply to the vibrators and exhaust pumps. Pumps were supplied by local service panel and vibrators were supplied by air manifold on "A" D-Ring.	-----	-----
		b) Ordered a refrigerant air dryer to remove moisture from air supplied to vibrators.	-----	-----
		c) Attached MDM ground wires to nozzle G-13 to better ground the vessel bottom head.	-----	-----
		Installed a new auxiliary transformer, however, it was disconnected from the system until the causes for the transformer damage were known.	-----	-----
		Replaced several damaged relays in the power supply box. However, to prevent damage to the system due to relay chatter, the power supply box was rewired with jumpers installed to bypass relays which control cutting voltage. Cutting was done with 25 volts.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/3/90 Day 5 (Cont'd)	2	Removed the MDM system from the reactor vessel and completed Rebuild #2 and Operation Checks.	-----	-----
		Redeployed the head at Location H-7. Again the head was positioned as closely as possible to the original location.	-----	-----
		Resumed cutting.	"A" side electrode would not cut past 2.7" and "B" side cut very slowly.	Entry made to better position the electrodes in the partial cut slots.
	3	Repositioned the MDM head.	During repositioning the "A" electrode was broken inside the cut.	-----
		Removed the MDM system from the reactor vessel and started Rebuild #3.	-----	-----
2/4/90 Day 6	1	Completed Rebuild #3 and Operation Checks. Deployed MDM head at Location K-7 and started cutting.	Turbine vibrators on "A" electrode quit one hour into cut.	Decided to rebuild head and install a desiccant air dryer upstream of the turbine vibrators.
		Removed the MDM system from the reactor vessel and completed Rebuild #4.	-----	(Desiccant dryer available on site).
	2	Installed desiccant air dryer to dry the turbine vibrator air supply.	-----	Refrigerant dryer had not yet been delivered to site.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/4/90 Day 6 (Cont'd)	3	Completed Rebuild #4, Operation Checks and redeployed head at Location K-7, although not in cut slots of previous partial cut. Started cutting.	-----	-----
		Continued cutting at location K-7.	-----	-----
2/5/90 Day 7	1	Continued cutting at location K-7.	Cutting very slowly.	Continued cutting. Will adjust electronics later.
	2	Continued cutting at location K-7.	-----	-----
	3	Continued cutting at location K-7.	-----	-----
2/6/90 Day 8	1	Completed cutting at K-7 location after approximately 23 hours of cutting. Severance of the sample was verified. Made entry to retrieve the sample.	During retrieval, the sample was not retained in the MDM head due to operator error.	The sample was picked and placed in the canister using the sample grabber tool.
		Picked and placed the K-7 sample in canister MPR-5-7 using the sample grabber tool.	-----	-----
		Removed MDM system from reactor vessel and started Rebuild #5.	-----	-----
	2	Completed Rebuild #5 and Operation Checks. Deployed MDM head at F-10 location and started cutting.	-----	-----
	3	During cutting, the electronics were adjusted which improved cut rate significantly. Cut rate was increased to 0.6 inch per hour which decreased total cut time to about 10 hours.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/7/90 Day 9	1	Rewired the auxiliary transformer back into the system with cutting voltage set at 30 volts. Modified fuse arrangement for transformers to provide separate fusing for each transformer. Installed an accelerometer or the MAMTP to monitor operation of the turbine vibrators.	-----	-------
	2	Completed cutting at F-10 location after approximately 12 1/2 hours of cutting. Severance of the sample was verified. Retained the sample in the MDM head and dropped it into Canister MPR-5-8.	-----	-----
	3	Removed MDM system from reactor vessel and completed Rebuild #6 (included modifications to cut with MDM head rotated 90° from standard orientation). Completed operation checks and started to deploy the head at location E-6.	-----	Head rotated 90° to access crack indications adjacent to penetration E-7.
2/8/90 Day 10	1	Continued deploying MDM head at E-7 crack location.	Head would not sit properly on the vessel surface and it was noticed that the MDM head support structure interfered with hydraulic fittings.	Decided to remove the MDM system from the reactor vessel and move the hydraulic fittings.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/8/90 Day 10 (Cont'd)	1 (Cont'd)	Removed MDM system from reactor vessel and moved hydraulic fittings such that interference was no longer possible. Redeployed the MDM head at Location E-6 over the lower crack extending from incore nozzle E-7. Started cutting.	-----	-----
	2	Completed cutting at E-6 location after approximately 10 hours of cutting when severance of the sample was verified. Retained the sample in the head and dropped it into Canister MPR-5-9.	-----	-----
	3	Removed MDM system from the reactor vessel and completed Rebuild #7 and Operation Checks.	-----	-----
2/9/90 Day 11	1	Deployed of MDM head at Location G-8.	MDM head would not sit properly on the vessel surface.	Several attempts were made at the various locations in the G-8 area, however none were successful. Decided to abandon G-8 and try again later.
		Started deploying at L-9 location.	During platform rotation camera was damaged.	Entry made to repair camera.
		Repaired camera and deployed head at Location L-9. Started cutting.	"A" electrode turbine vibrators quit twenty minutes into the cut.	Decided to pull tool and rebuild head.
	2	Removed MDM system from reactor vessel and completed Rebuild #8 and Operation Checks.	------	------

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/9/90 Day 11 (Cont'd)	3	Redeployed head at Location L-9 in a position away from the partial cut.	-----	-----
2/10/90 Day 12	1	Completed cut at Location L-9 after approximately 9 1/2 hours of cutting when severance of the sample was verified. Retained the sample in the MDM head and dropped it into Canister MPR-5-10.	-----	-----
		Staged a nitrogen bottle and the refrigerant air dryer into the reactor building. The nitrogen bottle was to provide dry air to test turbine vibrators during rebuilds.	-----	-----
		Installed the refrigerant air dryer.	-----	-----
		Removed MDM system from reactor vessel and completed Rebuild #9 and Operation Checks.		
	2	Deployed MDM head at Location H-4. Attempted cut.	Neither "A" or "B" turbine vibrators worked.	The tool was removed from the reactor vessel and rebuilt.
		Removed MDM system from reactor vessel and completed Rebuild #10.	During rebuild, "A" turbine vibrator air supply quick disconnect was found to be loose.	The quick-disconnect was tightened.
		Started Rebuild #10 Operation Checks.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/10/90 Day 12 (Cont'd)	3	Resumed Rebuild #10 Operation Checks.	Electrode clearance measurements could not be taken because of failed solenoid valve that locks the "B" electrode position.	A spare valve was not available. Piping was installed to bypass the failed valve.
		Completed Rebuild #10 Operation Checks, deployed the MDM head at Location H-4 and started cutting.	Air supply to turbine vibrators was 65 psi instead of 100 psi.	Troubleshooting cause of low air pressure while cutting.
2/11/90 Day 13	1	Continued to troubleshoot air supply pressure problem.	Problem with turbine vibrator air supply discovered. Flow limiter closed upstream of air dryer during automatic blowdown of refrigerant air dryer. Meanwhile "A" turbine vibrators stopped.	Decided to remove flow limiter and replaced it with a higher capacity one if possible.
		The flow limiting check valve was removed and air supply was back to 100 psi.	-----	-----
	2	Continued cutting at H-4 location with intermittent turbine vibrators.	Cut progressed very slowly.	Decided to continue cutting.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/11/90 Day 13 (Cont'd)	3	"A" side cut completed and "B" side started.	2 hours into cut "B" turbine vibrators failed and will not restart.	In a previous design iteration of MDM system, vibration was provided solely by sinusoidal pressure applied to hydraulics. This hardware was still in system. The decision was made to reconnect this hardware to finish the cut.
		Reconnected hydraulic vibration hardware and restarted cutting with performance comparable to cutting with turbine vibrators. Completed cutting at H-4 location after approximately 15 1/2 hours of cutting. Severance of the sample was verified.	-----	-----
2/12/90 Day 14	1	Retained sample in the head and placed it in sample Canister MPR-5-11. Removed MDM system from reactor vessel and completed Rebuild #11 and operation checks. Deployed head at E-8 location.	-----	-----
	2	Started cutting at Location E-8. On the "A" side cut, both hydraulic and turbine vibration were turned on, however only the hydraulic vibration worked.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/12/90 Day 14 (Cont'd)	3	Completed "A" side cut. When "B" side cut started, turbine vibrator worked. Hydraulic vibration was turned off to determine if cutting with just turbine vibrators was better than with both turbine and hydraulic vibration.	-----	No significant performance difference was found between cutting with both turbine and hydraulic vibration versus turbine vibration only.
		Completed cutting at Location E-8 after approximately 13 hours of cutting when the "B" electrode would not cut any further.	-----	Small tabs left on sides of E-8. Sample will be removed later.
2/13/90 Day 15	1	Removed MDM system from reactor vessel and completed Rebuild #12 and Operation Checks.	-----	-----
		Attempted to deploy head at Location G-8 for second time.	Again, the head would not sit properly at this location.	Decided to deploy at F-5 and would try to deploy the head at G-8 location later with head rotated 90° from standard orientation.
	2	Deployed head at Location F-5 and started cut with turbine and hydraulic vibration.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/13/90 Day 15 (Cont'd)	3	Completed cutting at F-5 location after approximately 9 hours of cutting when "B" electrode would not cut any further.	Similar to E-8, small tabs left on sides of sample.	Sample will be broken free with a chisel tool and retrieved with the sample grabber tool. Decided to do this later.
		Removed MDM system from reactor vessel and completed Rebuild #13 (included modification to rotate MDM head 90° from standard orientation).	-----	-----
2/14/90 Day 16	1	Completed Rebuild #13 Operation Checks. Moved saddle plate outward 10" to facilitate deploying at G-8. Successfully deployed MDM head at Location G-8.	Bottom of vessel was convex versus concave apparently due to fabrication process (high weld overlay area).	Movement of saddle plate 10" allowed deployment.
	2	Completed cut at G-8 location after approximately 8 1/2 hours of cutting when "B" electrode would not cut any further.	Small tabs left on sides of sample.	Sample will be broken free with a chisel tool and retrieved with the sample grabber tool. Decide to remove MDM system and then retrieve E-8, F-5 and G-8 samples.
		Removed MDM system from vessel, depowered electronics and removed saddle plate.	-----	-----
		Completed Rebuild #14.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/14/90 Day 16 (Cont'd)	3	Staged and assembled chisel tool and sample grabber tool. Used chisel tool to break samples from G-8, E-8 and F-5 locations.	----- -----	----- -----
2/15/90	1	Retrieved samples from the bottom head and placed them into canisters below: a) G-8 placed in Canister MPR-5-14. b) E-8 placed in Canister MPR-5-12. c) F-5 placed in Canister MPR-5-13. Removed chisel tool and staged and assembled abrasive saw tool. Replaced grabber jaws for sample retrieval with jaws for nozzle retrieval.	----- ----- ----- ----- -----	----- ----- ----- ----- -----
	2	Cut Nozzle L-11. Attempted to cut Nozzle E-7 with the abrasive saw tool positioned on Nozzle F-7.	----- Blade touched vessel before cutting E-7.	----- Positioning sleeve must be raised to cut E-7. Tool could not be removed with out a Health Physics Technician, so decision was made to cut H-9.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/15/90 (Cont'd)	2 (Cont'd)	Cut Nozzle H-9.	-----	-----
		Placed Nozzles H-9 and L-11 in sample Canister MPR-5-15 using the sample grabber tool.	-----	-----
	3	Cut Nozzle H-5.	-----	-----
		Notched and cut Nozzle D-10.	-----	-----
		Placed Nozzles H-5 and D-10 in Canister MPR-5-16 using the sample grabber tool.	-----	-----
2/16/90 Day 18	1	Cut Nozzle K-11.	-----	-----
		Cut Nozzle H-8.		
		Placed Nozzles H-8 and K-11 in Canister MPR-5-17 using the sample grabber tool.	-----	-----
		Cut Nozzle E-11.	-----	-----
		Notched Nozzle L-6 to distinguish it from Nozle E-11. Cut Nozzle L-6.	-----	-----
		Placed Nozzles E-11 and L-6 in Canister MPR-5-1 using the sample grabber tool.	-----	------

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/16/90 Day 18 (Cont'd)	2	Attempted to cut Nozzle G-5 anchoring the saw tool on Nozzle H-5. Cut Nozzle K-12. Attempted to cut Nozzle E-7 positioning the abrasive saw tool on Nozzle F-7 again. Cut Nozzle M-10. Placed Nozzles M-10 and K-12 in Canister MPR-5-2 using the sample grabber tool.	The tool could not be anchored on Nozzle H-5 because the H-5 nozzle stub was too short. There was no alternate anchor nozzle for cutting Nozzle G-5. 1/4" into nozzle the blade started to cut into the vessel. -----	When the saw blade extension is mounted on the tool for cutting peripheral nozzles, an attempt will be made to cut Nozzle G-5 anchoring the saw tool on Nozzle K-5. Sleeve must be raised again or smaller blade (6" or 8" diameter) should be used. -----
	3	Cut Nozzle M-9. Attempted to cut Nozzle G-6.	----- Approximately 1 1/2 inches into cut, blade started to cut into vessel.	----- A second attempt was made to cut this nozzle higher which was unsuccessful. Cut was made through the incore string.
2/17/90 Day 19	1	Attempted to cut Nozzle E-7 positioning from F-7 again using a higher sleeve position.	Again the tool cut into the vessel.	The sleeve could not be raised any higher. Decided to attempt to cut E-7 using F-8 as anchoring nozzle.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/17/90 Day 19 (Cont'd)	1 (Cont'd)	Attempted to cut Nozzle E-7 anchoring the saw tool on Nozzle F-8.	Again the tool cut into the vessel.	Although this attempt failed, it was obvious that the cut could be made. The blade needed to be raised only slightly. Decided to raise the blade by tilting the tool in the work slot instead of raising the sleeve extension.
		Tilted the saw tool and cut Nozzle E-7. Nozzle sliver about 1/2 inch high was cut off.	Nozzle sliver was too small to grab with sample grabber tool.	Decided to use vise grip tool to retrieve this sample later.
		Placed Nozzle M-9 is canister MPR-5-3. Second nozzle stub will be loaded in this canister later.	-----	-----
		Remaining nozzles to be cut with saw tool in conventional configuration were judged to be too short.	-----	-----
	2	Assembled the saw tool extension and corresponding sleeve for cutting peripheral nozzles.	-----	------
		Cut Nozzle R-7.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/17/90 Day 19 (Cont'd)	3	Notched Nozzle P-6 then attempted to cut it. Cutting Nozzle P-6 postponed in favor of Nozzle L-2.	When the saw tool was turned on, the tool was not properly secured. The tool jumped and shattered the blade. Potential interference with vessel. -----	Tool had to be removed and new blade installed. -----
2/18/90 Day 20	1	Attempted to cut Nozzle L-2. Cut Nozzle G-5 positioning from Nozzle K-5.	Tool could not be positioned to cut L-2 because of interference between tool and other nozzles and flow distributor plate. -----	No practical solution found. Cutting Nozzle L-2 was abandoned after second unsuccessful attempt. -----
	2	Placed Nozzle E-7 in Canister MPR-5-3.	-----	-----
	3	Placed Nozzles R-7 and G-5 in Canister MPR-5-4. Removed saw tool. Installed punch tool on two 20 ft poles.	----- -----	----- -----
2/19/90 Day 21	1	Pulled incore strings as follows: a) E-11 string was retracted by pulling at the seal table and poking into the nozzle.	----- -----	Pull load/retraction length 2000 lb/36 inches

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/19/90 Day 21 (Cont'd)	1 (Cont'd)	b) D-10 string retracted by pulling at the seal table only.	-----	Pull load/retraction length 1200 lb/>12 inches
		c) H-8 string retracted by pulling and poking.	-----	2000 lb/>12 inches
		d) G-5 string retracted by pulling only. The poker could not be inserted.	-----	1700 lb/12 inch
		e) E-7 string retracted by pulling only.	-----	1650 lb/10 inches
		f) H-5 string retracted by pulling only.	-----	1400 lb/24 inches
		g) G-6 string could only be retracted about four inches. Punch could not be used because nozzle cut was not completed.	-----	2000 lb/4 inches
		Staged the incore delivery system into the reactor building.	-----	-----
	2	Installed countersink tool on incore delivery system. Installed system in vessel.	-----	------
		Countersunk Nozzles E-7, G-5, H-8 and D-10.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/19/90 Day 21 (Cont'd)	3	Countersunk Nozzle E-11 and attempted to countersink Nozzle H-5.	Nozzle H-5 could not be countersunk. The counter sink tool could not be mounted on H-5 because this nozzle was cut flush with the vessel.	Decided to attempt brushing measuring and sealing Nozzle H-5 without countersinking. If these operations were too difficult, modifications to the tool could be made to countersink Nozzle H-5.
2/20/90 Day 22	1	Removed incore Delivery System. Countersink tool was replaced with the brush tool.	-----	-----
		Brushed Nozzle H-8.	-----	-----
		Brushing of Nozzle E-11 started.	During brushing, the brush unthreaded from the brush holder and was left in the nozzle.	A modification was made to the brush tool. A cotter pin was installed to prevent the brush from unthreading.
	2	Installed new brush and completed brushing of E-11.	-----	The brush tool left in Nozzle E-11 was pushed down and out of the way by the new brush tool.
		Brushed Nozzle D-10.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/20/90 Day 22 (Cont'd)	2 (Cont'd)	Partially brushed Nozzle E-7.	The brush bent when trying to brush Nozzle E-7. The brush tool could only be inserted 5" and it appeared that the nozzle bore at the top was not concentric with the vessel penetration bore.	A drill tool would be used later to try to clear out the top of the nozzle bore.
		Brushed Nozzle H-5.	-----	-----
		Removed brush tool and installed inside diameter measurement probe. Measured the inner diameter of Nozzles E-11 and D-10.	-----	-----
	3	Measured the inner diameter of Nozzle H-5.	-----	-----
		Measured the inner diameter of Nozzle H-8.	-----	-----
		Began assembly of drill tool for Nozzle E-7.	All of the necessary parts could not be located.	Decided to drill Nozzle E-7 later.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/21/90 Day 23	1	Installed plugging equipment on incore delivery system. Installed expander plug in Nozzle E-11 and expanded nozzle.	-----	------
		Installed expander plug in Nozzle H-8 and expanded nozzle.	-----	-----
		Installed expander plug in Nozzle H-5 and expanded nozzle.	-----	-----
		Installed expander plug in Nozzle D-10 and expanded nozzle.	-----	-----
	2	Attempted to use drill bit with end rounded off to clean out E-7 nozzle bore.	Drill bit broke off inside nozzle flush with top of nozzle. Two inch piece of drill in nozzle.	Decided to resume MDM operations. While cutting, possible methods for removing the drill bit will be investigated.
	3	Reinstalled MDM system. Completed Rebuild #14 Operation Checks. Deployed head at Location K-13 and started cutting.	During deployment, hydraulic bypass valve on side of the MDM head caught on something and was partially opened.	A weight on a rope was lowered onto the valve handles to close the valve. The valve handles were removed prior to deploying the head on all later cuts.
2/22/90 Day 24	1	Completed cutting K-13 after 9 hours of cutting. Severance of the K-13 sample was verified. Retained the sample in the head and dropped it into Canister MPR-5-5.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/22/90 Day 24 (Cont'd)	2	Removed MDM system from the reactor vessel and completed Rebuild #15 and Operation Checks.	The iris in the camera in the MDM head was not working.	Judgement was made that picture quality was acceptable to deploy the MDM head.
		Deployed head over Nozzle E-11 and started cutting.	-----	-----
		Completed cutting at E-11 location after 11 hours of cutting when "B" electrode would not cut any further.	The sample was not severed. Picture from the camera in the MDM head indicated that a "B" electrode flush fitting was interfering with Nozzle E-11 preventing full electrode travel.	Decided to remove the tool and break out the E-11 sample with a chisel tool later. The electrode design was modified to place flush fittings where interference with a nozzle was not possible.
2/23/90 Day 25	1	Removed MDM system from reactor vessel and completed Rebuild #16 and Operation Checks.	-----	-----
		Deployed head over Nozzle H-5 and started cutting.	-----	-----
		Possible methods for removing drill bit from Nozzle E-7 were conceptualized as described below:	-----	-----
		a) Design a tool with angled dowel pins that would be inserted into the drill bit flutes. Once inserted, the tool would be used to twist the drill bit free.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/23/90 Day 25 (Cont'd)	1 (Cont'd)	b) Modify the MDM head to allow use of a stud electrode to MDM the drill bit.	-----	-----
		Another possible solution was to drive the drill bit deeper into the nozzle until deep enough so as not to interfere with expander plug.	-----	-----
	2	While cutting H-5, attempts were made to remove the drill bit using two of the manual bit-removal tools.	Both tools were able to be inserted into the drill bit flutes, however, when extracting loads were applied these tools bent and failed.	Sturdier versions of these tools would be made.
		Attempted to force drill bit out by pushing on the incore string at seal table.	Incore string too flexible to provide sufficient force to free the drill bit.	-----
	3	Completed cutting on H-5 after 8 1/2 hours of cutting when "B" electrode would not cut any further.	Slightly larger tabs, about 3/16" wide, remained on both sides of the sample.	Decided to suspend cutting at nozzle locations until effort required to break tabs and free samples was known.
		A mockup of the E-7 nozzle with a broken drill bit was designed to test any further designs for drill bit removal.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/23/90 Day 25 (Cont'd)	3 (Cont'd)	Another possible drill bit removal tool was made by grinding the jaws of needle nose vise grip tool to fit inside flutes of drill bit.	-----	-----
		Removed MDM system from reactor vessel and completed Rebuild #17. Operation Checks started.	-----	-----
2/24/90 Day 26	1	Started paper work to allow crust impact tool use to break free samples.	-----	-----
		Completed Rebuild #17 Operation Checks.	-----	-----
		Attempted to deploy head at Location M-6.	MDM head would not fit between Nozzles L-6 and M-7. Also very possible that flow distributor plate interfered with umbilical loop.	Abort M-6 and attempt to deploy at M-8 location.
		Fabricated angled chisel end effector for crust impact tool.	-----	-----
	2	Deployed head at Location M-8 and started cutting.	-----	-----
		While cutting M-8, the sample at Location H-5 was broken free using the chisel tool.	-----	-----
		A sturdier chisel tool was made from the angled chisel crust impact tool end effector. This tool will be used later.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/24/90 Day 26 (Cont'd)	3	Completed cutting at Location M-8 after 8 1/2 hours cutting when "B" electrode would not cut any further.	Severance of the sample could not be verified because the camera in the MDM head was not working.	"B" electrode travel of 3.5" was equal or greater than usually required to sever the sample. Decided to try to retain the sample in the head.
		Attempted to retain the sample in the head.	-----	Decided to break tabs and free the sample later using the chisel tool.
		Removed MDM system from the reactor vessel and completed Rebuild #18 and Operation Checks.	Tabs on the sides of the sample did not break. Electrodes broke instead.	-----
		One tab of M-8 sample broken. Because unsevered H-5 and M-8 samples were being freed with minimal effort, the decision was made to resume cutting at nozzle locations.	While using the chisel tool, the pan and tilt camera failed.	Camera was removed and fixed.
2/25/90 Day 27	1	Made broom tool and cleared debris around H-8 location.	-----	-----
		Deployed head at H-8 location with platform rotated so that E-11 sample could be broken free while cutting.	Positioning over H-8 was extremely difficult because light ring and iris were not working on camera in the MDM head.	Decided that picture was adequate to deploy head.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/25/90 Day 27 (Cont'd)	1 (Cont'd)	Started cutting.	-----	-----
		A sturdier drill bit extraction tool was fabricated and more work on the MDM head modification was done to remove the drill with an MDM electrode.	Modification of the MDM head to MDM the drill bit was abandoned. There were safety concerns that if the stud electrode could not be positioned accurately enough, it could cut through the nozzle seal weld creating a leak path.	-----
		Attempted to break free E-11 sample.	The pan and tilt camera was damaged by the chisel tool.	The camera was removed and fixed.
	2	Broke free Sample E-11 with chisel tool.	-----	-----
		Completed cutting at H-8 location after approximately 10 hours of cutting when "B" electrode would not cut any further.	-----	Decided not to try to retain the H-8 sample in the head. Decided to free it later with a chisel tool.

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/25/90 Day 27 (Cont'd)	3	Removed MDM system from reactor vessel and completed Rebuild #19 and Operation Checks.	-----	-----
		During rebuild, attempted to extract drill bit with sturdier extraction tool.	The tool was easily inserted into the flutes but when load applied the tool unscrewed and was bent slightly.	The operation of the tool looked promising and two more tools would be built. During next attempts more effort would be made to keep tool from unscrewing out of flutes.
		Deployed MDM head at Location M-11 and started cut.	-----	-----
2/26/90 Day 28	1	Completed cutting at M-11 location after approximately 9 hours of cutting. Severance of the sample was verified. The sample was retained in the head and dropped on the vessel surface to be picked up later.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/26/90 Day 28 (Cont'd)	2	Attempted to extract the drill bit from Nozzle E-7 with the second drill bit extraction tool.	The attempt was unsuccessful.	Decided that the drill bit was lodged too securely to be removed with this type tool. Decided to try to punch the drill deeper into the nozzle.
		Attempt was made to punch the drill bit 8 1/2 inches into the nozzle to provide the required clearance for expander plug.	The drill bit could only be punched 5 1/2 inches into the nozzle.	A longer punch was fabricated.
		Removed MDM system from the reactor vessel and completed Rebuild #20 and started Operation Checks.	-----	-----
	3	Attempt was made to punch drill bit with longer punch.	The punch could only be inserted approximately 2 3/4 inches into the nozzle.	Use of this punch was aborted.
		Attempt was made to break free H-8 sample with heavy duty chisel tool.	The sample did not break free.	Decided to try crust impact tool later.
2/27/90 Day 29	1	Completed Rebuild #20 Operation Checks. Deployed head over Nozzle D-10 and started cutting.	-----	-----
	2	Completed cut at D-10 location after 11 hours of cutting. Severance of the sample was verified. The sample was retained in the MDM head and was dropped into Canister MPR-5-21.	-----	-----

Table A-1

DETAILED SUMMARY OF VESSEL SAMPLE CUTTING
AND INCORE NOZZLE CUTTING OPERATIONS

Date/Day	Shift	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/27/90 Day 29 (Cont'd)	3	Placed Sample H-5 placed in Canister MPR-5-43 using the vise grip tool.	-----	-----
2/28/90 Day 30	1	Placed Sample E-11 in Canister MPR-5-44 using vise grip tool. Placed Sample M-11 in Canister MPR-5-42 using vise grip tool.	-----	-----
	2	Attempted to punch drill bit further into Nozzle E-7. Little, if any, progress was made. Sample M-8 broken free with heavy chisel tool.	----- -----	----- -----
	3	Grabbed and placed Sample M-8 into Canister MPR-5-19 using the vise grip tool. Used crust impact tool to break tabs on Sample H-8. Although tabs were broken, the sample was not freed.	----- ------	----- -----
3/1/90 Day 31 1100* Hours	1	Rocked Sample H-8 back and forth until it broke free. There was an area approximately 1/2 inch x 2 inches at the bottom of sample which was not cut by the electrode. Failure to cut this area was attributed to electrode damage sustained when the head was deployed. Sample H-8 was placed in Canister MPR-5-6.	-----	-----

* Four hours past 30 days.

Table A-2

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/16-2/20 (Prepration Work)		Performed preparatory activities for incore instrument guide tube sampling as follows : a) The top of the "A" D-ring was cleared of tools and debris b) Scaffolding was built c) The cutting tank was staged and filled d) The Tri-Tool cutter was staged	-----	———
2/21/90 Day 1	12:15	Loaded Island #9 into tank.	-----	-----
	14:00	Setup tri-tool on guide tube M-9 to cut a 7 inch sample	-----	------
	14:23	Started cutting.	At 14:25 cutting halted because tool was walking along guide tube.	Tool secured.
	14:30	Started cutting again.	-----	-----

Table A-2

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/21/90 Day 1 (Cont'd)	14:40	Removed the tool from the tank to check the tool cutting inserts.	The screw which feeds the cutting inserts into the guide tube was found to be broken. Apparently the guide tube was much harder than the mockups. One of the two cutting inserts was thrown from its holder.	Repaired the tri-tool. Decided to use abrasive saw tool in the mean time to continue cutting M-9 guide tube.
2/22/90 Day 2	9:15	Staged abrasive saw cutter and associated hardware.		
	11:45	Abrasive saw tool was secured to M-9 guide tube and the cut was started.		
	13:20	Tri-tool feed screws replaced.		
	11:45	Abrasive saw had cut two inches into guide tube.	At 15:05 tool jammed and abrasive saw blade broke.	Abrasive saw tool will be repaired. Meanwhile, island will be repositioned and tri-tool will be used to cut M-10.
2/23/90 Day 3	9:35	Removed abrasive saw tool from tank.	During removal it was noticed that one of the clamp bolts attaching the tool to the guide tube was loose. This loose bolt may have caused the blade to jam and break.	-----

Table A-2

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/23/90 Day 3 (Cont'd)	10:15	Island was repositioned for cutting M-10 guide tube.	-----	-----
	10:30	Tri-tool was attached to M-10 guide tube.	-----	-----
	10:55	Started cutting M-10 guide tube.	At 10:57 the tool started jumping and cutting was stopped.	-----
	11:00	Started cutting again.	At 11:02 stopped cutting because the one of the cutting inserts was lost again.	-----
	11:25	Backed the tool out of the cut.	Both cutting inserts were gone and both tool holders were loose.	The tool holders were tightened, and the cutting inserts were replaced.
	12:20	Started cutting again on M-10.	At 12:26 cut had to be stopped because cutting inserts were lost again.	The tool was backed off and removed from the guide tube. Decided to try to finish cutting the M-10 sample with the abrasive saw tool.
	14:07	Secured the abrasive saw cutter to guide tube M-10 and attempted to start cut.	Could not start cutting because there was air in the hydraulic lines.	Hydraulic lines were bled.

Table A-2

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/23/90 Day 3 (Cont'd)	15:11	Started cutting with abrasive saw.		
	15:26	Cut completed at M-10. Will finish M-9 cut tomorrow.	Abrasive saw blade fragments were left in M-9 cut.	Attempt will be made to remove blade fragments.
2/24/90 Day 4	9:21	Staged four canisters into RB.	-----	-----
	10:45	Attempted to remove abrasive saw blade frequent from M-9 guide tube.	Saw blade could not be removed.	-----
	11:20	Resumed aborted 2/22/90 cut on M-9 guide tube with abrasive saw tool but at a different angle.	At 11:30 stopped cutting because clamp bolts were loose.	Bolts were tightened and cutting resumed.
	13:20	Stopped cut to change personnel in building.	-----	-----
	13:50	New team resumed cutting.	-----	-----
	14:25	While cutting with abrasive saw, Tri-Tool was inspected.	One nut in the tool feeding mechanism was damaged and both tool holder units needed repair.	Feed nut replaced and one tool holder unit was repaired.
	16:25	Team stopped cutting and exited RB.	-----	-----

Table A-2

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/25/90 Day 5	9:15	Continued abrasive saw cut on M-9 while repairing second Tri-Tool tool holder unit.	-----	-----
	10:30	Stopped cutting while M-10 sample was placed in Canister MPR-5-23.	Water clarity was very poor due to metal and saw blade grit generated by abrasive saw cutting.	When opportunity exists, the tank would be drained and refilled.
	12:50	Removed saw for sample after 8 hours of cutting abrasive.	After 8 hours, abrasive saw had only cut one half of the way through guide tube M-10.	Decided to abandon M-10 sample, place Island #9 back in the D-ring and try to cut Island #11.
	13:50	Pulled island from tank and placed it back in original storage location in "A" D-ring.	-----	-----
2/26/90 Day 6	2:00	Entry made to drain tank and refill tank.	-----	-----
	4:00	Completed refilling tank.	-----	-----
	9:00	Started to place Island #11 in the tank.	-----	-----
	10:15	Completed placing Island #11 in the tank.	-----	-----
	10:35	Prepared Tri-Tool to cut K-5 sample approximately 8" long.	-----	-----

Table A-2

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/26/90 Day 6 (Cont'd)	11:05	Started cutting.	At 11:25 the tool jammed.	-----
	11:45	Attempted to back out tool holder units.	Experienced major difficulty backing out tool holder units.	Decided to remove the Tri-Tool from the guide tube without backing out tool holders.
	15:00	Disassembled tool holder unit to remove bit that would not back out of tool.	-----	-----
		Tri-tool was removed from guide tube and tool holder unit was rebuilt.	-----	-----
2/27/90 Day 7	9:00	Entry made to setup Tri-Tool to cut G-5 guide tube.	-----	-----
	10:30	Attached tool to G-5 guide tube.	-----	-----
	10:50	Started cutting G-5 guide tube.	10:55 cutting stopped to tighten tool.	-----
	11:05	Resumed cutting.	Only one tool holder unit was feeding into the guide tube. No chips were being generated.	Cutting stopped.

Table A-2

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/27/90 Day 7 (Cont'd)	11:50	Removed tool from guide tube.	Feed mechanisms for both tool holders OK but inserts were missing.	Replaced cutting inserts.
	12:07	Redeployed tri-tool on guide tube G-5 and started cutting.	No chips were generated.	Decided to remove Tri-Tool and finish cut with abrasive saw.
	13:30	Tri-tool was removed.	-----	-----
	14:00	Secured abrasive saw tool to K-5 guide tube to finish Tri-Tool cut. Started cutting.	At 14:05 the abrasive saw blade broke.	Replaced blade.
		Resumed cutting K-5 guide tube sample.	-----	-----
	14:15	Completed cutting K-5 guide tube sample.	-----	-----
	14:45	Tri-Tool and abrasive saw were removed from the tank.	-----	-----
2/28/90 Day 8	9:24	Team entered RB to retrieve K-5 sample and place Island #11 back in "A" D-ring.	-----	-----
	10:15	Sample K-5 placed in Canister MPR-5-24.	-----	-----

DETAILED SUMMARY OF
GUIDE TUBE CUTTING OPERATIONS

Date/Day	Time	Sampling Activities Performed	Problems Encountered	Solution/Comments
2/28/90 Day 8	11:35	Island #11 is placed back in "A" D-Ring.	-----	-----
	12:05	Shavings from Tri-Tool cutting were collected and placed in Canisters MPR-5-25 and MPR-5-26.	-----	-----
	12:30	Handling tools were removed from the tank. The tank was ready to be drained and flushed.	-----	-----

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

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