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US Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Dear Sirs:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Safety Evaluation Report to Remove Metallurgical Samples
From the TMI-2 Reactor Vessel

Attached for your review and approval is the Safety Evaluation Report (SER) for Removal of Metallurgical Samples from the TMI-2 Reactor Vessel (RV). The purpose of this SER is to demonstrate that the activities associated with removal of metallurgical samples from the inner surface of the bottom head of the RV can be accomplished without adversely affecting the health and safety of the public.

Sincerely,

MB Roche

M. B. Roche
Director, TMI-2

RDW/emf

Attachment

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A001
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SAFETY ANALYSIS

SA No. 4000-3555-89-01

Rev. No. 0

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TITLE

SAFETY EVALUATION REPORT
FOR
REMOVAL OF METALLURGICAL SAMPLES
FROM THE TMI-2 REACTOR VESSEL

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1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this Safety Evaluation Report (SER) is to demonstrate that the activities associated with the removal of metallurgical samples from the inner surface of the bottom head of the Reactor Vessel can be accomplished without adversely affecting the health and safety of the public.

1.2 Scope

This evaluation covers activities which will be performed for the removal of metallurgical samples from the inner surface of the bottom head of the Reactor Vessel. Samples will be removed at incore penetration locations and at areas other than incore penetrations.

The sample removal operations will be designed such that no through vessel holes will be made in the Reactor Vessel. As a result, the Reactor Vessel could still serve as a pressure boundary at a reduced pressure rating. The Reactor Vessel is approximately 5-3/8 inches thick and contains 52 penetrations for the incore instrument monitoring strings. General locations of incore penetrations are shown on Figure 1. A typical section view of an incore penetration is shown on Figure 2.

The samples will be used to determine the final post-accident condition of the vessel bottom head as it was affected by molten fuel or other core material during the TMI-2 accident. The samples to be removed will include approximately 2-1/2 inches of vessel wall material (from a total vessel wall thickness of 5-3/8 inches) in a shape similar to a "boat sample." The sample geometry is shown on Figure 3.

The samples will be loaded into shielded containers prior to removal from the Reactor Vessel.

Equipment expected to be used to support these activities consists of:

- Existing abrasive wheel cutting equipment, which was used in the cutting and disassembly of the lower core support assembly;

- A cutting head capable of performing metal disintegration machining (MDM) to cut the samples. The cutting head will attach to a remotely operated delivery system;

- Tooling to install an expandable seal plug into an in-core penetration bore;

- Shielded containers for transport of the samples outside of the Reactor Building; and

- Miscellaneous systems used during normal defueling activities (e.g., Defueling Water Cleanup System, off-gas)

As this operations proceeds, the potential exists that activities or equipment described in this report will need to be modified or new activities and/or tooling developed. Any modifications to existing activities or equipment or the introduction of new activities or equipment will be reviewed and documented in accordance with TMI-2 administrative procedures to ensure that no potential hazards or safety concerns, not bounded by this SER, are created. If no such hazards or safety concerns are created, this operation may proceed based on the new or modified activities or equipment without a requirement to revise this SER; however, such changes would be evaluated in accordance with and would be reported annually per requirements of 10 CFR 50.59, "Changes, Tests, and Experiments."

2.0 PREREQUISITES AND MAJOR ACTIVITIES

The sampling operations will be performed in accordance with detailed, approved procedures. Any of the approved activities performed or tools used during initial, core region, Lower Core Support Assembly/Lower Head (LCSA/LH) defueling, or Upper Core Support Assembly (UCSA) defueling are considered acceptable. Appropriate limits and requirements of the relevant SERs will be in effect when performing these approved activities.

2.1 Prerequisites

It is important to recognize that this operation is designed to take place after all RV defueling activities have been completed and it has been determined that the remaining residual fuel does not pose a criticality concern. Once this defueled condition exists, all remaining risks of operations in the Reactor Vessel, such as this sampling, are minimal. To put this in perspective, the following is a list of prerequisites that will be met prior to initiating any new activities associated with this sampling work.

- The Reactor Vessel and Reactor Coolant System will have been defueled to the extent reasonably achievable as required by the TMI-2 Technical Specifications. The remaining residual fuel will be in a subcritical configuration (Reference 1). This information will be provided to the NRC as part of the Defueling Completion Report (DCR). However, NRC acceptance of the DCR is not required prior to commencing this activity as Mode 1 controls will remain in place.

- Sections of the lower core support plates will have been disassembled and removed from the RV to allow sufficient access to the bottom head.

- The lower head will have been cleaned of fuel material and vacuumed of loose debris. A thin layer of tightly adherent non-conductive material may exist on the bottom head prior to sampling operations. Those areas will be cleaned locally as needed to cut samples.

- Sampling operations will be conducted from the defueling platform. The platform and other prerequisite equipment identified in plant procedures will be operational.

- Sampling operations will constitute a core alteration as defined in the TMI-2 Technical Specifications. Thus, they will be directly supervised by a senior licensed operator or a senior licensed operator limited to fuel handling.

2.2 Major Activities

Sampling operations on the surface of the Reactor Vessel bottom head will be conducted at incore penetrations and at areas other than incore penetrations. There will be maximum of 20 samples taken, at locations to be determined by the Nuclear Regulatory Commisison, MPR Associates, Inc., and GPU Nuclear. There is no safety concern regarding sampling location since less than 1% of the vessel lower head volume will be sampled. The major activities required for the sampling operations are described below.

2.2.1 Removing a Sample at an Incore Penetration

A typical incore penetration and incore nozzle are shown in Figure 2. As indicated by the sample geometry in Figures 3 and 4, the removal of a vessel sample at an incore location removes the pressure seal and retaining weld. Under existing conditions, this would open a small annular gap leak path of .005 to .010 inches between the outside diameter of the incore pipe and the vessel bore. To close this small gap, several preparation and sealing operations are performed prior to removing the sample and weld. These operations are discussed below.

a. At the locations to be sampled, the incore instrument strings will be cut off at the tops of the incore nozzles and retracted out of the way. The strings will be pulled from the incore seal table, approximately 2 to 3 feet to clear access to the bottom of the vessel. This step is shown in Figures 5 and 6. If necessary, the string may be poked down from above.

b. The top section of the incore nozzle will be cut off. The nozzles will be cut using the existing abrasive wheel equipment and delivery system which was used in the cutting and disassembly of LCSA. The nozzle will be cut approximately 2 to 4 inches above the Reactor Vessel surface. Some nozzles will be cut closer to the Reactor Vessel surface depending on the condition of the nozzles.

c. After the nozzle has been cut, the access opening in the remaining nozzle stub will be deburred and cleaned with simple file and wire brush type tools. The inside diameter of the pipe will be measured and an expanding plug tool will then be inserted into the incore pipe. The plug will be used to plastically expand the incore pipe outward into the vessel bore diameter to close the .005 to .010 inch gap between the pipe and bore. The expansion process uses an hydraulic cylinder which drives a wedge into an expander (see Figure 7). When the downward load on the wedge reaches the desired level, the expander separates at the notch (see Figure 7). The wedge and a portion of the expander remain in the penetration as shown in Figure 8. The seal made by this expansion process has been shown in documented qualification and repeatability tests to be leak tight at 1500 psig (Reference 2).

This expanding seal method has been used extensively in the repair of leaking steam generator tubes in PWRs and in the repair of leaking incore and control rod drive penetrations in BWRs. The expanded plug will also be used to retain the incore pipe in the vessel after the retaining weld has been removed. The load carrying capability of the expanded plug has been verified in qualification and repeatability tests to have an axial load carrying capability of 20 to 30 thousands pounds (Reference 2) It is estimated that the load on the seal, due to the static water head and dead weight of attachments, is about 100 lbs.

Following the preparation and sealing operations, vessel samples will be removed using an electrical discharge cutting technique referred to as metal disintegration machining (MDM). As with other electrical discharge cutting techniques, the MDM process cuts by sending a series of electrical arcs from a cutting electrode to the Reactor Vessel base metal. The arcing process slowly cuts away the base metal to provide the desired sample. This cutting technique has been used in a number of operating nuclear plants. Operations performed using electrical cutting methods include the cutting of holes in reactor internal upper former plates for flow reversal modifications (up flow modification performed on all early Westinghouse plants). The MDM cutting technique has the advantage of being a relatively slow cutting process which can be precisely controlled and monitored throughout the cutting operation. This eliminates the possibility for uncontrolled damage to the Reactor Vessel. In addition, the MDM process does not produce cutting reaction loads which could damage the Reactor Vessel. Details on how the MDM process will be used and how the samples will be taken are discussed below.

- The MDM head for cutting samples from the vessel is illustrated on Figure 9. The MDM head will be lowered down to the bottom head and positioned at the location to be sampled.

  The MDM cutting technique requires electrically conductive cutting surfaces. If ceramic or other non-conducting surface layers exists on the bottom head., they will be cleaned off locally to allow for MDM cutting.

- A mechanical delivery system will be used to position the MDM head on the Reactor Vessel lower head. Once the MDM cutting head has been delivered to the sampling location, one (1) electrode (of the two) in the MDM head will be lowered into the vessel wall. After cutting, the first electrode will be retracted approximately 1 to 2 inches to clear access for the second electrode. Then, the second electrode will be lowered into the vessel to complete the cutting process. The MDM cutting head is designed such that travel of the cutting electrodes is physically limited. As a result, the electrodes cannot penetrate the RV wall. A Quality Control inspection will be made to verify electrode travel.

2.2.2 Removing a Sample at Locations Other Than an Incore Penetration

Removal of a sample at areas other than incore penetrations will not include the nozzle cutting or sealing operations. Sampling operations will only include the cleaning and MDM cutting operations described above. The sample geometry at areas other than incore penetrations is shown in Figure 3.

Once each incore nozzle and vessel sample is cut, it will be placed into a shielded container using long-handled tools prior to removal from the vessel for subsequent off-site shipment.

3.0 COMPONENTS AND SYSTEMS AFFECTED

All known components and systems affected by the proposed sampling activities have been addressed in this SER or in Reference 3. This includes use of an available filter system with its established controls, and the criticality-safe canisters used for defueling. If other components or systems in addition to those described here are required to conduct the sample removal activities, these will be evaluated to ensure that their use is bounded by this SER.

4.0 SAFETY CONCERNS

4.1 General

Because the sampling activities covered in this SER will not take place until all Reactor Vessel defueling activities are complete, any safety concerns associated with the sampling are much less than during the actual defueling operations. Nevertheless, evaluations are presented in this section that show, in detail, that the relevant safety concerns are satisfied.

The following areas are discussed in this section:

- Reactor Coolant System Criticality Control
- Boron Dilution
- Hydrogen Evolution
- Pyrophoricity
- Submerged Combustion
- Fire Protection
- Decay Heat Removal
- Instrument Interference

- Release of Radioactivity
- Reactor Vessel Integrity
- Heavy Load Drops
- Basement Criticality

4.2 Reactor Coolant System Criticality Control

The potential for a recriticality event during vessel sampling activities is greatly reduced from bulk defueling activities as the maximum amount of fuel remaining at the end of defueling is expected to be less than or equal to 1% of the original fuel load. However, a boron concentration equal to or greater than 4350 ppm will be maintained in the RCS during vessel sampling. Additionally, the remaining residual fuel will have been determined to be in a subcritical configuration. The commitments in Reference 3 regarding criticality safety/deboration control will be met and all current Technical Specifications and required surveillances relating to these issues will be in effect.

4.3 Boron Dilution

Various tools planned for use during these sampling activities are operated with water-based hydraulic fluids. The safety concern regarding the use of these fluids is that a leak may result in boron dilution of the vessel water.

As with past hydraulic tool operations, all hydraulic fluid used with sampling tools (with two exceptions described below) will be borated to at least 4350 ppm natural boric acid. This precludes the possibility of a hydraulic fluid leak leading to a boron dilution and possible criticality concern.

One exception is that the MDM system will use a separate hydraulic system with non-borated hydraulic fluid. The hydraulic cylinders in the MDM head are driven in a small oscillatory motion (about .005 to .010 inch amplitude and about 30 to 40 Hertz frequency) during the 10 hours of cutting required for one (1) sample. Testing has indicated that when borated hydraulic fluid is used, cylinder seals become badly damaged and prevent cylinder operation within one (1) to two (2) sample cuts. Use of unborated hydraulic fluid provides better lubrication and significantly reduces cylinder seal failures.

Hydraulic cylinder failures during sampling cuts will result in increased radiation doses to personnel involved in repair and refurbishment of the MDM head. Also, failure of a hydraulic cylinder during a sample cut will result in substantial loss of time in the sampling project due to removal of the MDM head and its delivery system from the Reactor Vessel. Precise repositioning of the MDM to resume cutting will require additional time and personnel dose during work on the defueling platform. Accordingly, it is considered that use of unborated hydraulic fluid is justified in this application.

The hydraulic system is set with a fixed 2 gallon volume for draindown. The physical design of the holding tank limits the maximum uncontrolled loss of hydraulic fluid into the vessel to 2 gallons. This is consistent with the 2 gallon limit for non-borated fluid established in Reference 4. As a result, use of this hydraulic fluid poses no risk of a recriticality event due to boron dilution.

The other exception is the expanding seal tool, which will use less than 1 gallon of unborated hydraulic fluid and is, therefore, also consistent with the 2 gallon limit.

4.4 Hydrogen Evolution

The MDM cutting equipment generates hydrogen and oxygen gas during operation. The safety concern is that the hydrogen gas could reach combustible concentrations on the work platform and in the Reactor Building (RB). During sampling activities, the Reactor Vessel will be covered by the shielded work platform. An off-gas system has been designed to provide an air in-flow through the top of work platform. This system dilutes gases that will be evolved during sampling activities before they are released into the Reactor Building. Any hydrogen evolved (calculated to be less than 1 scfm) will be diluted by the off-gas treatment system as required and, thus, will not reach a combustible concentration in the Reactor Building.

Other hydrogen-related safety issues, such as radiolytic generation of hydrogen in the canister transfer shield or in the Fuel Handling Building or Reactor Building, are discussed in and are bounded by the evaluations provided in Reference 3.

4.5 Pyrophoricity

No pyrophoricity problems have been experienced during operations; thus, pyrophoricity concerns during the sampling activities are bounded by evaluations provided in Reference 3.

4.6 Submerged Combustion

The MDM process generates electrical sparks between an electrode and the material being cut. This heat source is not expected to create a combustion concern since the sparks are being generated underwater. Combustion of the hydrogen and oxygen produced in the MDM process theoretically may occur between the electrode and material being cut. Combustion of fuel debris is not considered credible because: (1) no significant amounts of fuel are expected to be present in the material being cut by the MDM process, and (2) experience with plasma arc cutting in and around fuel debris in the LCSA did not produce any identified ignition.

4.7 Fire Protection

The evaluation provided by Reference 3 bounds this concern during sampling activities. Fire protection is provided in accordance with the Fire Protection Program Evaluation, Revision 2, and TMI-2 Administrative Procedure 4000-ADM-3680.02. Existing fire protection equipment is available during the sampling process.

4.8 Decay Heat Removal

Decay heat removal concerns are bounded by the evaluation provided in Reference 3 which states that ambient decay heat removal has been adequate throughout defueling. Therefore, it will be more than adequate during this post-defueling activity.

4.9 Instrument Interference

Plasma arc torch operation involved higher power levels than will be experienced during MDM cutting (i.e., plasma arc used cutting power of 200 VDC, 900 amps, and MDM uses 21 VDC, 100 amps). Since no instrument interference was experienced during plasma arc cutting, it is anticipated that MDM cutting will not result in instrument interference.

4.10 Release of Radioactivity

Use of the MDM equipment to cut the vessel samples is not considered to pose a safety concern related to the release of radioactivity. (The initial concern with the plasma torch operation was the high energy (200 VDC, 900 amps) burning of metal and possible oxidation of fuel material to a vapor state. This is not a concern with the relatively low energy (21 VDC, 100 amps) MDM cutting process.

4.11 Reactor Vessel Integrity

After removal of the samples, a local minimum wall thickness of at least 2 inches will remain in the lower head. This is sufficient to withstand an internal pressure which is significantly higher than the water head (about 20 psig) imposed on the vessel in its present configuration. The new pressure rating will be very nearly the design pressure rating (2500 psig) because a relatively small percentage of the total pressure boundary area (less than 1%) will have been sampled.

Five (5) scenarios could be hypothesized during activities associated with removing the vessel wall samples which would affect the RV integrity. These scenarios are considered to have an extremely small possibility of occurrence since procedural restrictions and hardware designs will be provided to prevent the specific occurrences. For completeness of evaluation, these scenarios are discussed below:

1. Abrasive Wheel Operation

   The abrasive wheel equipment will be used to cut off the incore nozzles. The nozzles will be cut approximately 2 to 4 inches above the surface (or possibly closer for special cases). During this cutting operation, it could be postulated that the abrasive wheel might inadvertently contact with the vessel wall due to temporary loss of control resulting in damage to the vessel. Administrative controls will be used to assure the abrasive wheel is not operating unless in position at an incore nozzle. In addition, the abrasive cutting is a relatively slow process (about

1 hour to cut a 2 inch diameter nozzle) and is continuously monitored with TV cameras. Any problems with the abrasive cutting operation would be detected before vessel damage could occur.

2. Incore Pipe Seal Plug Operations

Preparation and sealing steps at incore nozzles locations are discussed in Section 2.2.1 of this report. As discussed, an expansion seal plug is to be used to seal a .005 to .010 inch annular leak path around the outside diameter of the incore pipe. This expansion plug is also to be used to retain the pipe after the retaining weld is removed. It could be postulated that this seal plug may be installed incorrectly or in such a manner that the seal was inadequate. The leak path developed as a result of this condition has been evaluated in Reference 5 and is calculated to be no more than about 0.4 gpm per nozzle. This is well within the present level monitoring and coolant makeup capabilities of the plant. As a worst possible case, Reference 5 shows that TMI-2 makeup capability exceeds the 125 gpm flow postulated for an opening caused by complete ejection of an incore tube, even though no clear mechanism exists to cause such a catastrophic failure. A back up plug will be available, if such an event were to occur. The plug is a simple wedge which can be inserted into the bore hole in the vessel. The plug will be installed to limit leakage. However, no credit is taken for this plug. Existing leakage monitoring and makeup operations will continue in accordance with existing procedures during sampling activities.

3. <u>Cleaning Operations</u>

In the local areas where samples of the reactor are to be removed, cleaning operations (such as grinding or wire brushing) may be performed to remove debris from the vessel surface. This is needed to assure an electrically conductive surface for the MDM process. Penetration of the vessel wall by these cleaning steps is not credible.

In addition, the existing incore instrument penetrations may be cleaned to allow the installation of the expanding seal plug described in Section 2.0. It could be postulated that the cleaning operation may affect vessel integrity by puncturing the incore tube. If puncture of the incore tube were to occur, the resulting leakage would be less than and bounded by ejection of an incore tube, as discussed in Section 4.11-2 above.

4. Penetration of the Vessel Wall During MDM Operations

As described in Section 2.0 of the report, an electrical discharge type of machining operation (MDM) will be used to cut samples from the RV. The MDM head is shown in Figure 9. It could be postulated that this cutting technique could accidentally penetrate through the vessel wall. This event is not considered credible. The MDM tools are designed such that the cutters are incapable of reaching through the full vessel wall thickness. Even if adjacent cuts were made, the area covered by the foot of the MDM cutting head would preclude (see Figures 3 and 4) cutting deeper than a single sample depth. In addition, the cutting process is very slow. It is expected that the cutting process to remove a single sample will take between 4 and 10 hours. During this time, the cutting operation will be monitored continuously. Any problems with the MDM operations would be spotted and corrected before through vessel damage could occur.

5. Corrosion

Post-sampling corrosion is not considered to be a concern as it is a slow, self-limiting process and it is currently planned to drain the Reactor Vessel following Facility Mode 1.

4.12 Heavy Load Drops

References 6 and 7 bound the issues concerning load drops in the Reactor Vessel up until the time when the samples are removed from the Reactor Vessel. All lifting and handling shall conform with the TMI-2 lifting and handling program for samples, containers, and tools. In addition, lifting and handling loads are expected to be less than loads during LCSA disassembly and removal. For sample locations away from incore nozzles, calculations indicate the remaining two inches of Reactor Vessel wall thickness will withstand postulated load drops (Reference 8).

Once a sample is removed at an incore penetration, the retaining weld will be removed. The remaining incore pipe will be held in place by the expander seal plug as discussed in Section 2.0. By test results, the axial strength developed by this seal joint is approximately 20 to 30 thousands pounds. As illustrated in Figure 3, the upper end of the incore penetration pipe is less exposed to damage than the existing incore nozzles; accordingly, the risk of contact by dropped loads is lower. Under an extreme circumstance in which the incore pipe and seal joint are knocked out of the vessel by a load drop accident, it has been calculated that a 125 gpm leak would occur. This leakage can be managed by plant coolant makeup capability (Reference 5). In addition, a back-up seal will be available to limit this type of leakage. Accordingly, risks related to load drops are not increased as a result of sample removal.

4.13 Reactor Building Basement

The potential for a criticality event in the Reactor Building basement was previously addressed in Reference 9.

The controls discussed in Section 4.13 of Reference 9 to ensure subcriticality of potential leakage into the Reactor Building basement will continue to be maintained during the sampling activities; therefore, criticality will be precluded.

5.0 RADIOLOGICAL CONSIDERATIONS

Based on a comparison of activities associated with Reference 2 to those associated with the sampling activities, it is concluded that the radiological considerations associated with these activities are bounded by Section 5 of Reference 3.

However, special precautions will be taken to minimize exposure of operating personnel during transport of the samples and nozzles from the RV to temporary storage within the Reactor Building. Methods employed to reduce personnel exposure include cleaning of the samples and nozzles of fuel debris before removal, use of shielded canisters, etc. The samples are expected to be radioactive due to soluble fission products.

The samples and nozzles to be removed per this SER are expected to be less radioactive than the lower grid assembly or support plates and, therefore, represent less of a radiation hazard. The adequacy of the proposed personnel exposure control practices has been demonstrated by previous defueling activities.

The overall estimated occupational exposure to complete the sampling project is 53 person-rem. A summary of activities and person-rem are provided in Table 5.1.

TABLE 5.1

ESTIMATED JOB-HOURS AND PERSON-REM TO COMPLETE THE SAMPLING PROJECT

ACTIVITY	JOB-HOURS	PERSON-REM
Containment Entry Support	2016	< 1
Cut Nozzles	528	< 6
Retract Incore	123	4
Install Plugs	888	11
Clean Sample Locations	848	10
Cut Out Samples	1268	15
Remove and Ship Samples	100	2
Remove Equipment	250	4
TOTAL	6021	53

6.0 IMPACT ON PLANT ACTIVITIES

The sampling activities presented in this report are expected to have no impact on plant activities and operations in TMI-1. Previous SERs for activities at TMI-2 were concerned with the impact of fuel movement in TMI-2 and effects from this on TMI-1 operations. Sampling activities described herein will be performed in accordance with approved plant procedures. Operations and effects on plant activities are bounded by Reference 3.

7.0 10 CFR 59 EVALUATION

10 CFR 50, Paragraph 50.59, permits the holder of an operating license to make changes to the facility or perform a test or experiment, provided the change, test, or experiment is determined not to be an unreviewed safety question and does not involve a modification of the plant Technical Specifications. The following presents bases on why the proposed sampling activities are considered acceptable in accordance with 10 CFR 50.59.

10 CFR 50, Paragraph 50.59, states that a proposed change involves an unreviewed question question if:

a. The probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report may be increased; or

b. The possibility of an accident or malfunction of a different type than any evaluated previously in the safety analysis report may be created; or

c. The margin of safety, as defined in the basis for any Technical Specifications, is reduced.

A variety of postulated events were analyzed in this SER for the sampling activities. The analysis of these events provided in Section 4.0 results in the conclusion that the postulated events are bounded by previous evaluations and/or do not result in an unanalyzed condition.

To demonstrate that the sampling activities do not involve an unreviewed safety question, the following questions have been evaluated:

Has the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report been increased?

A variety of events were analyzed in Reference 3 (TMI-2 defueling activities). It was demonstrated that these events were bounded by comparable events analyzed in the FSAR. It was shown that the potential consequences from the events discussed in Reference 3 were substantially less than the potential consequences of comparable events analyzed in the FSAR. References 6 and 8 evaluate the consequences of potential events during LCSA/LH defueling and demonstrate that LCSA/LH defueling can be performed safely.

This SER demonstrates that the sampling activities do not result in consequences greater than those analyzed in References 3, 5, 7, and 8.

Therefore, it is concluded that the proposed activities associated with sampling work do not increase the probability of occurrence or the consequences of an accident or malfunction of equipment ITS previously evaluated in the safety analysis report.

Has the possibility of an accident or malfunction of a different type than any evaluated previously in the safety analysis report been created?

The variety of postulated events analyzed in References 3 and 8 considered a spectrum of event types which potentially could occur as a result of the defueling process. A comparison of those events with comparable events in the FSAR demonstrated that the event types postulated for the defueling process are similar and bounded by the FSAR. In addition, no new event type was identified which was different than those previously analyzed in the FSAR. Section 4.0 of this SER evaluates events postulated for sampling activities which are bounded by those of References 3 and 8. As a result, events postulated for the sampling do not present any different types of accidents or malfunctions.

Has the margin of safety, as defined in the basis for any Technical Specifications, been reduced?

Technical Specification safety margins at TMI-2 are primarily concerned with criticality control. Applicable Technical Specification safety margins will be maintained throughout the sampling process. Subcriticality is ensured by establishing the RCS boron concentration at greater than 4350 ppm or equivalent and ensuring that this concentration is maintained by monitoring the boron concentration and inventory levels and by isolating potential deboration pathways. Technical Specification required systems will remain in place to add borated cooling water to the core in the event of an unisolable leak from the Reactor Vessel.

No Technical Specifications changes are required to conduct activities bounded by this SER.

In conclusion, the sampling activities do not:

- Increase the probability of occurrence or the consequences of an accident or malfunction of equipment ITS previously evaluated in the safety analysis report; or

- Create the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report; or

- Reduce the margin of safety as defined in the basis for any Technical specifications.

Therefore, the sampling activities do not constitute an unreviewed safety question.

8.0 ENVIRONMENTAL ASSESSMENT

Based on Section 8.0 of Reference 3 and noting the similarities between the activities considered in Reference 3 to those activities within the scope of this SER, it can be concluded that the proposed sampling activities can be performed with no significant environmental impact. Releases to the public resulting from planned sampling activities are expected to be less than releases during past defueling activities. Past releases of radioactivity to the environment have been well within the limits of the TMI-2 Environmental Technical Specifications. Sampling activities will also be bounded by these limits. The environmental impact from planned sampling activities resulting from occupational exposure will be significantly less than during defueling activities. Therefore, the sampling activities will be performed with no significant environmental impact.

9.0 CONCLUSIONS

Activities associated with metallurgical sampling have been described and evaluated. The evaluations have shown that the radioactivity releases to the environment that will result from the planned activities will not exceed allowable limits. Releases associated with this activity are expected to be less than releases during past defueling activities. Sampling activity radioactive releases will be bounded by the TMI-2 Environmental Technical Specifications. It has been demonstrated that the consequences of postulated accidents will not compromise plant safety. Therefore, it is concluded that the sampling activities can be performed without presenting undue risk to the health and safety of the public.

10.0 REFERENCES

1. TMI-2 Operating License No. DPR-73 with Technical Specifications.

2. In-Core Expansion Tool Prototype Test Report, October 17, 1988, MPR Associates.

3. Safety Evaluation Report for Defueling the TMI-2 Reactor Vessel, Revision 10, 4350-3261-85-1.

4. Report on Limits of Foreign Materials Allowed in the TMI-2 Reactor Coolant System During Defueling Activities, Revision 1, 15737-2-N-09-002, September 1985.

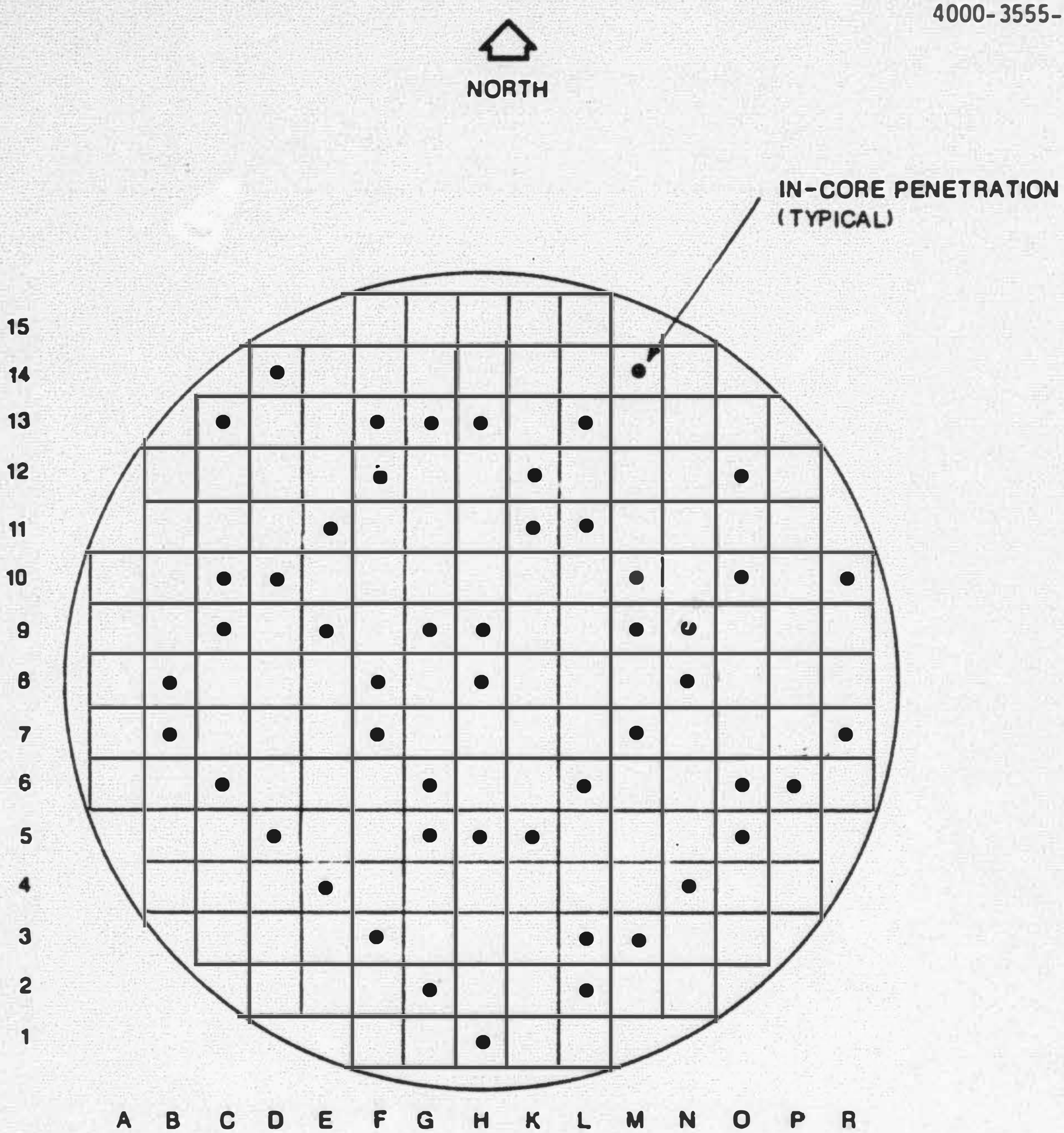
5. GPU Nuclear letter 4410-86-L-0122, dated July11, 1986, "Extended Core Stratification Sample Acquisition Activity."

6. Safety Evaluation Report for Completion of Lower Core Support Assembly and Lower Head Defueling, 4710-3221-88-01, Revision 1.

7. Safety Evaluation Report for Heavy Load Handling Over the TMI-2 Reactor Vessel, 4350-3153-85-01, Revision 3.

8. Punch-Through Potential For Load Drops in Samples Holes: Calculation (Task 7 - 30), dated July 21, 1989.

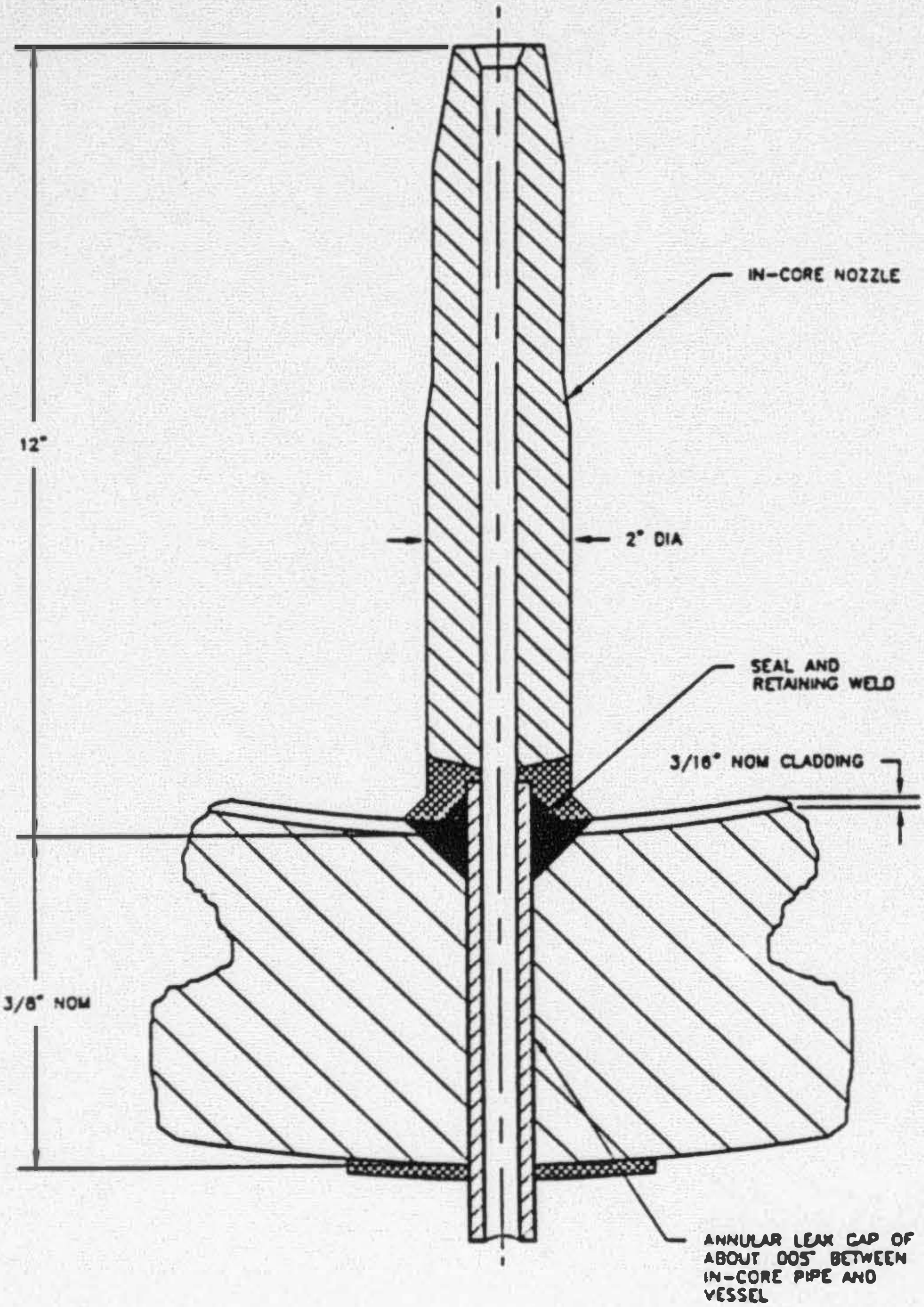
9. Safety Evaluation Report for Lower Core Support Assembly Defueling, 4710-3221-86-0011, Revision 2.



TMI-2
LOWER REACTOR VESSEL HEAD
LOCATIONS OF INCORE PENETRATIONS

FIGURE 1

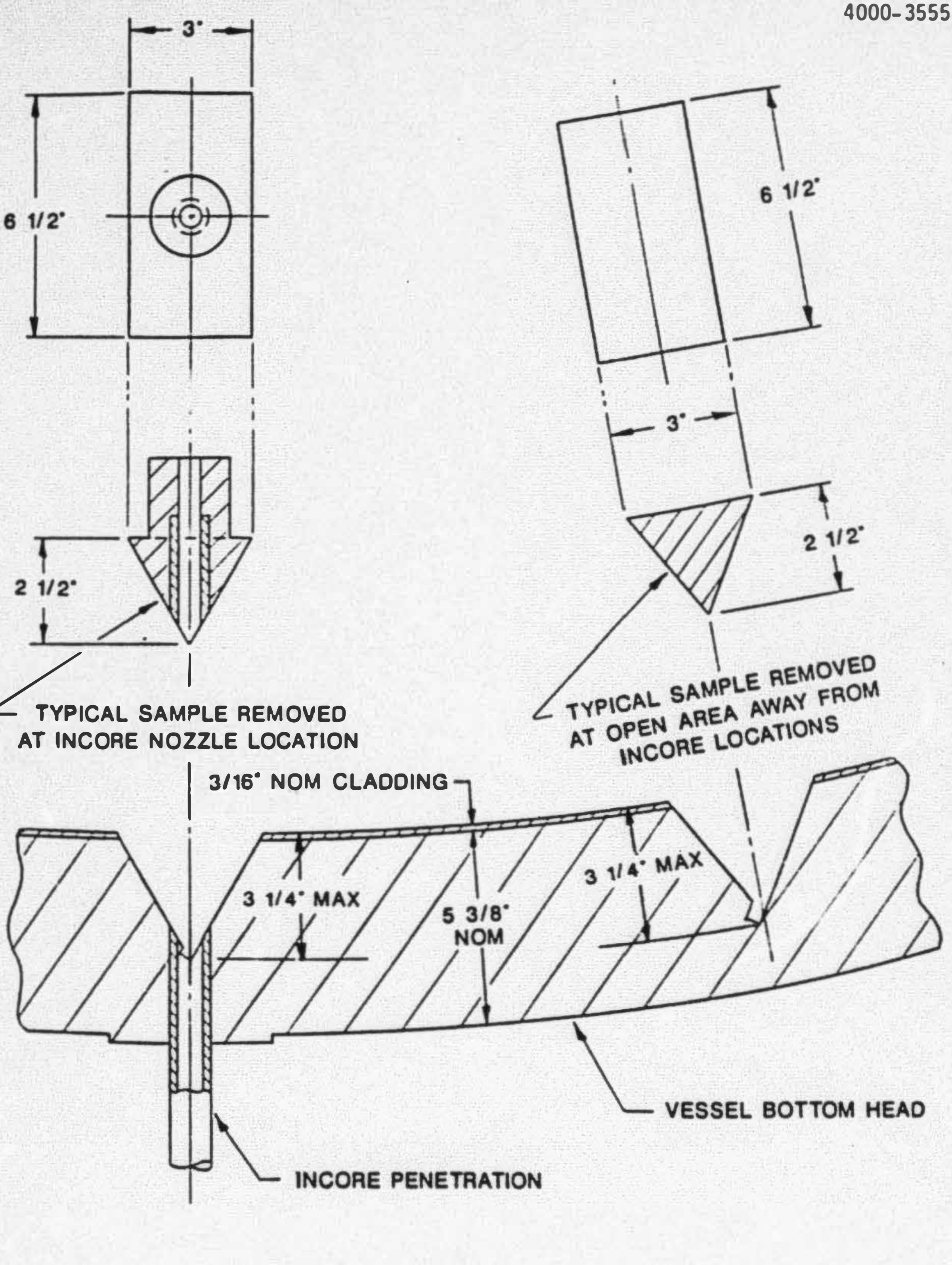
MPR ASSOCIATES
F-73-30-84
7/21/89



TYPICAL IN-CORE NOZZLE
WITH SEAL AND RETAINING WELD

FIGURE 2

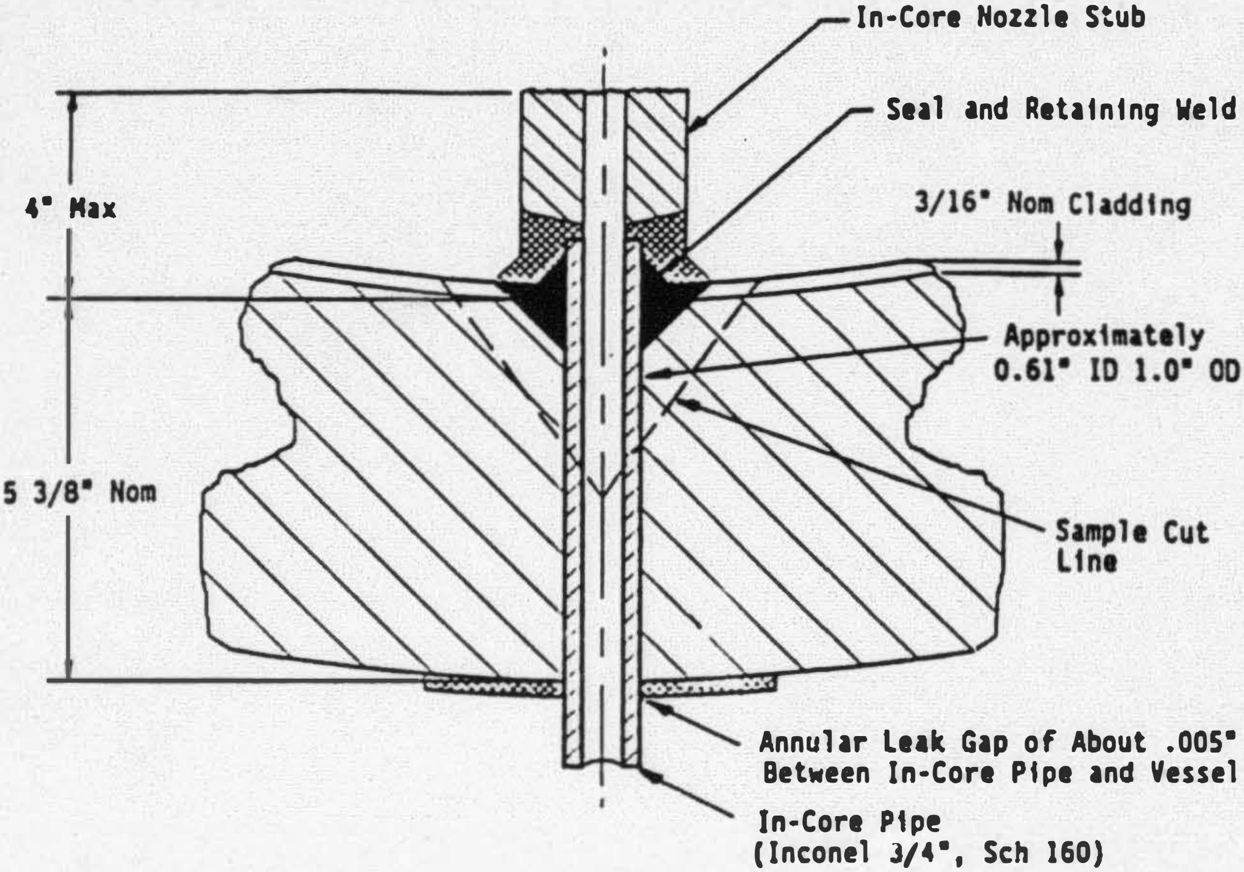
MPR ASSOCIATES
F-73-30-42
7/21/89



SAMPLES BEING REMOVED
FROM BOTTOM OF REACTOR VESSEL

FIGURE 3

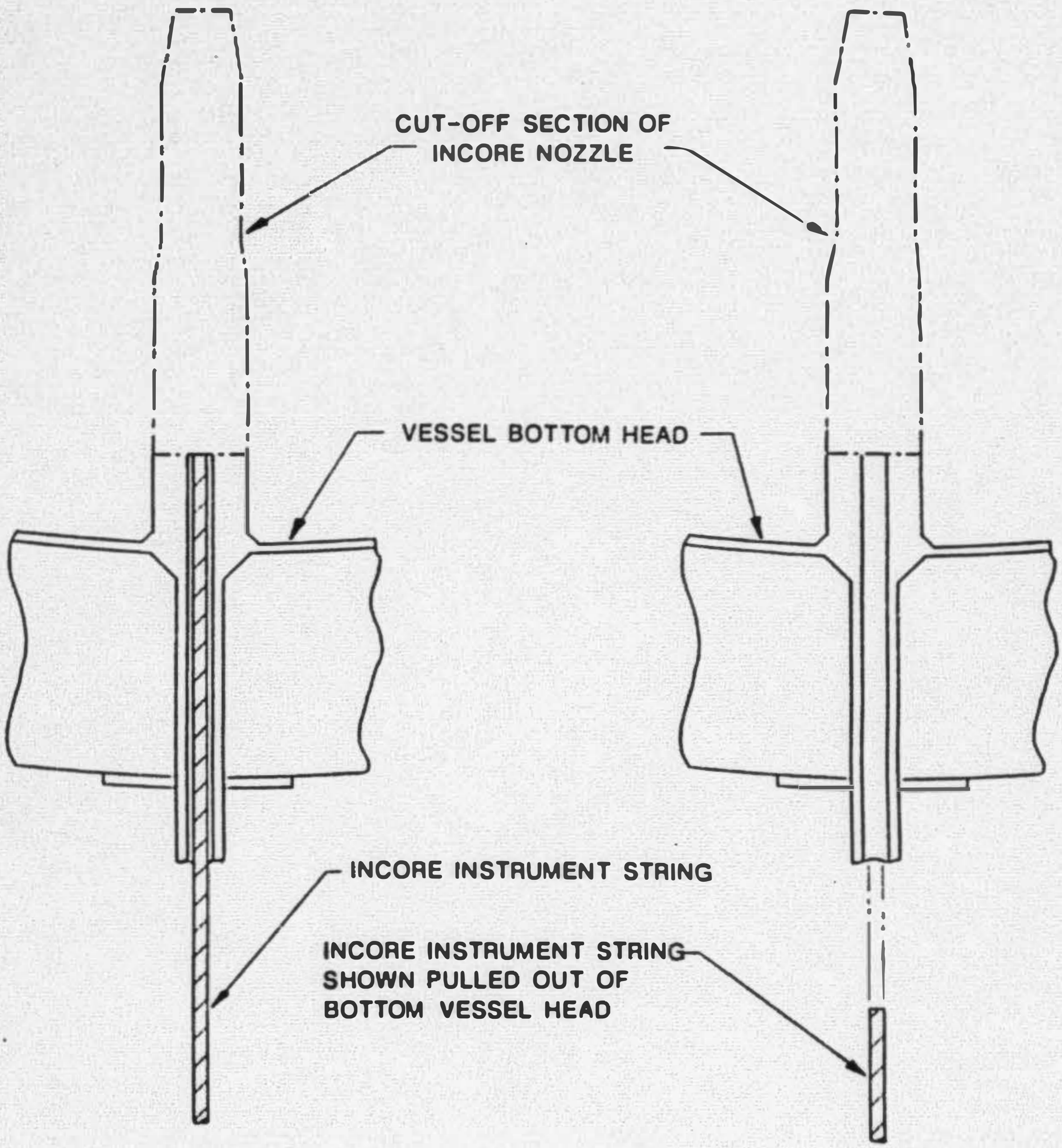
MPR ASSOCIATES
F-73-30-21
7/21/89



TYPICAL IN-CORE NOZZLE
WITH SEAL AND RETAINING WELD

FIGURE 4

MPR ASSOCIATES
F-73-30-23
7/21/89

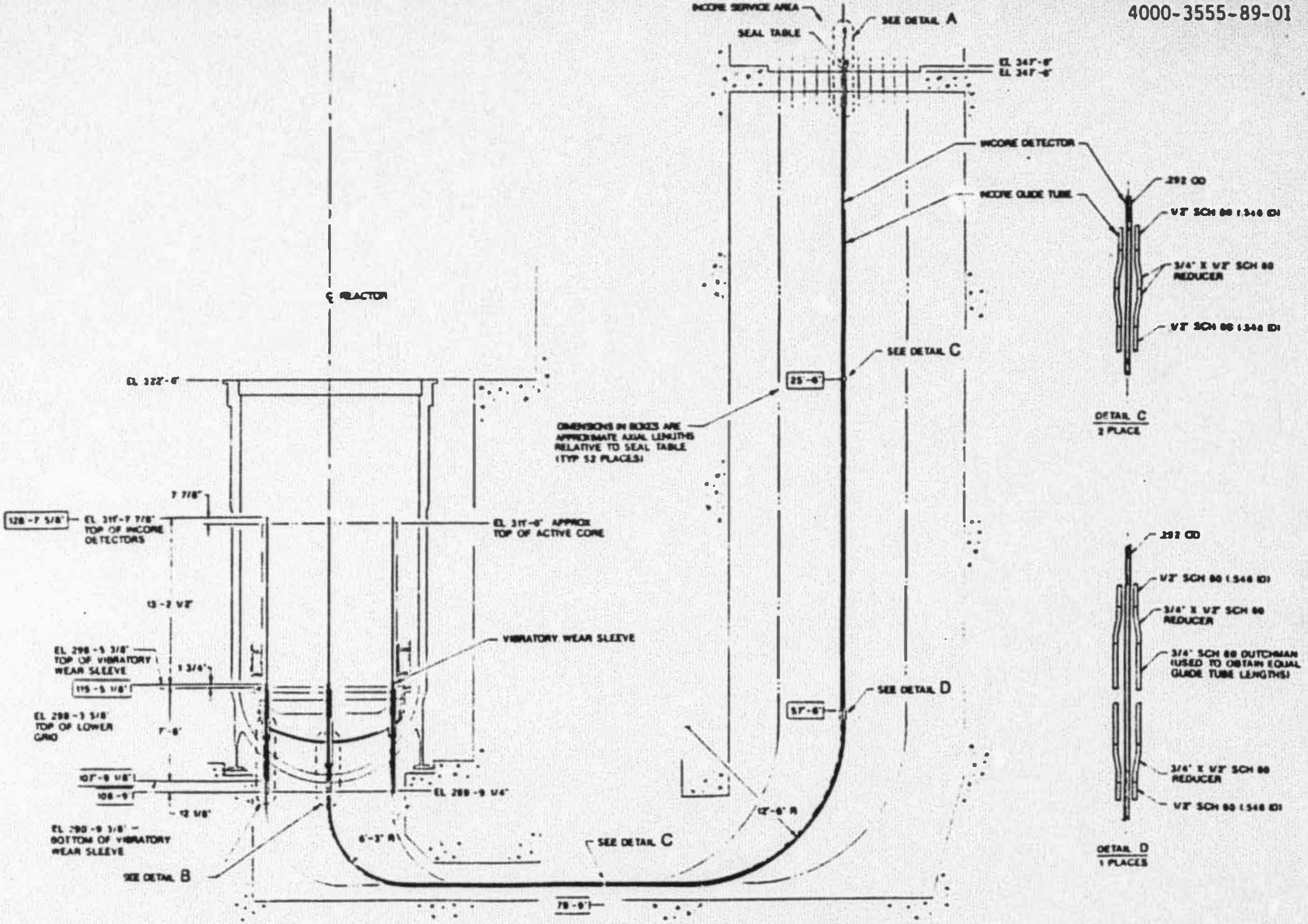


PULLING INCORE INSTRUMENT STRING
OUT OF BOTTOM VESSEL HEAD

FIGURE 5

MPR ASSOCIATES
F-73-30-56
7/21/89

4000-3555-89-01

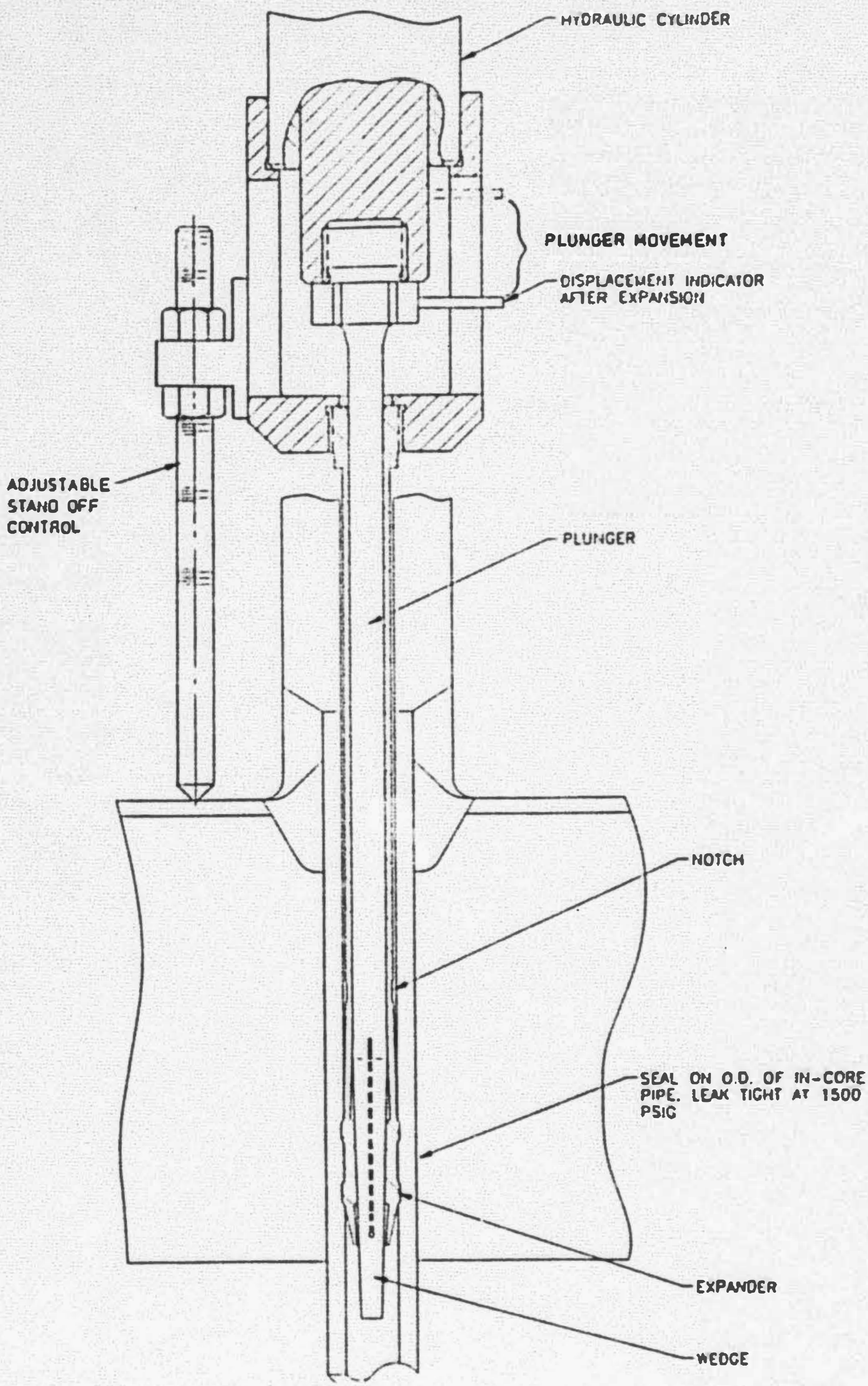


INCORE DETECTOR ARRANGEMENT

FIGURE 6

MPR ASSOCIATES
F-73-30-179
7/21/89

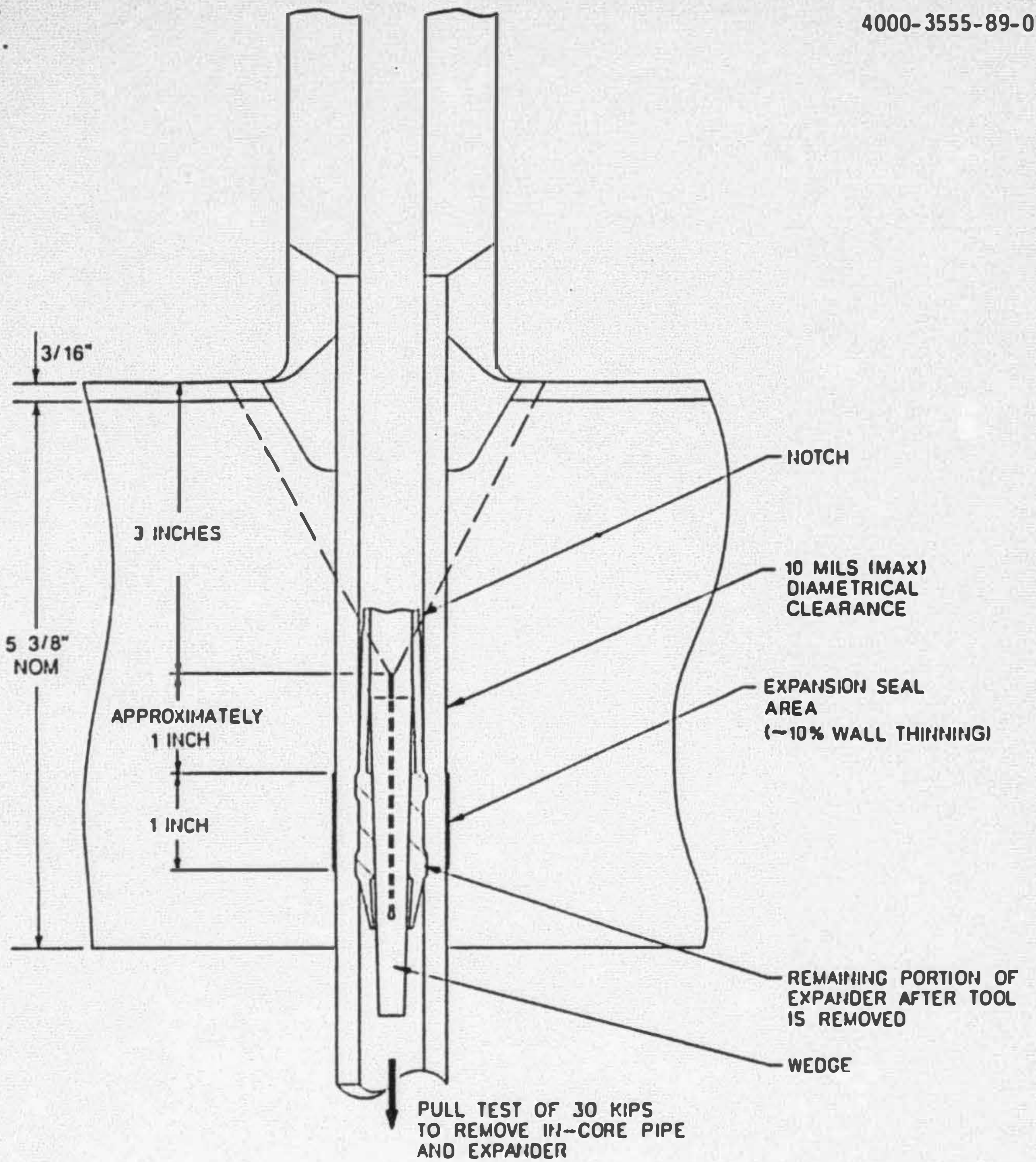
Rev. 0/0480P



INSTALLATION OF PLUG

FIGURE 7

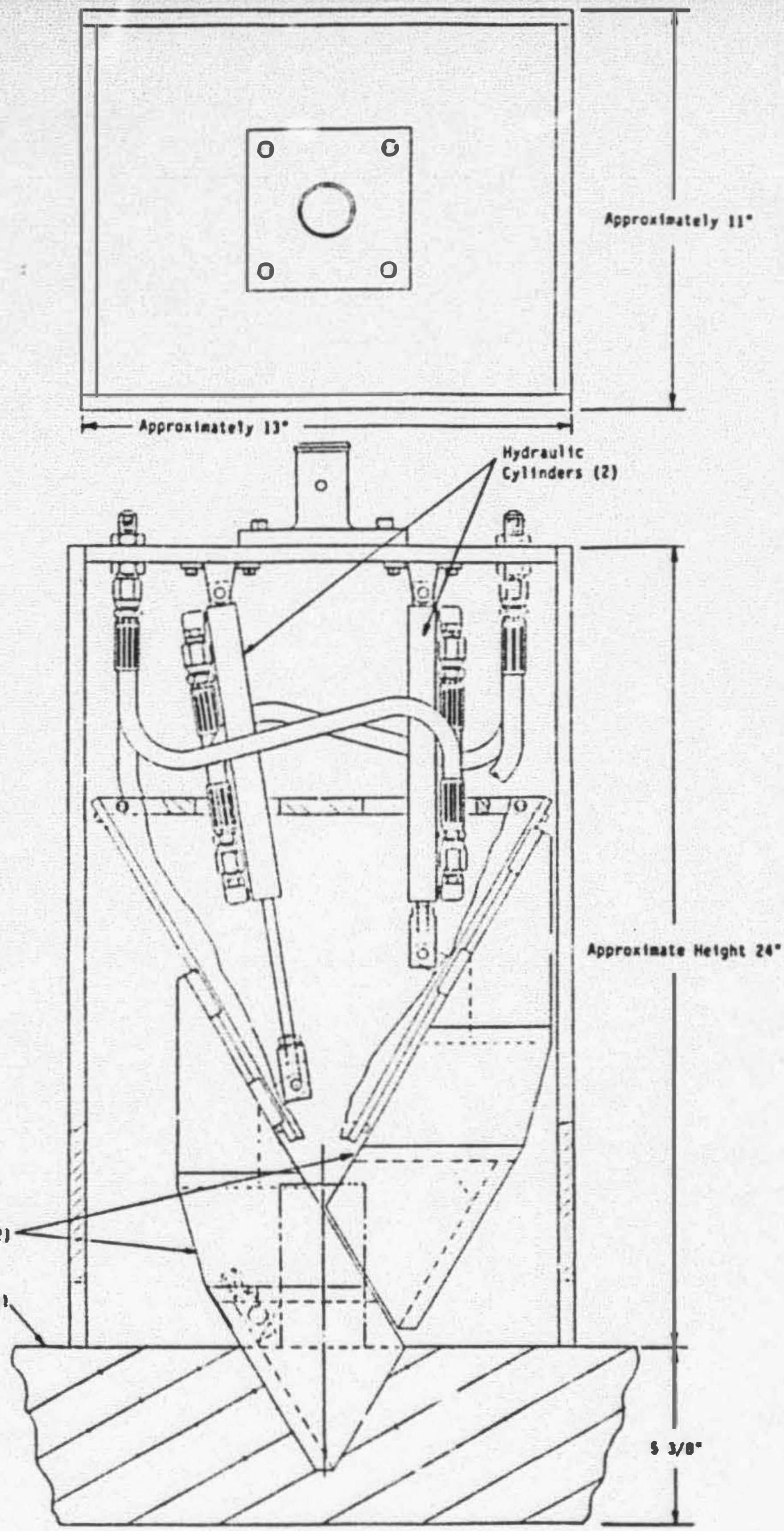
MPR ASSOCIATES
F-73-30-63
5/11/89



LOCATION OF EXPANDER SEAL PLUG

FIGURE 8

MPR ASSOCIATES
F-73-30-64
5/25/89



MDM HEAD
GENERAL ARRANGEMENT
FIGURE 9

MPR ASSOCIATES
F-73-30-85
7/21/89