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March 6, 1985

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TRANSMITTAL OF TENTH TAAG REPORT - JBC-33-84

Dear Sirs:

Enclosed herewith is the tenth report of the Technical Assistance and Advisory Group (TAAG). This report covers the TAAG activities during the period from August 1, 1984 to December 1, 1984.

Very truly yours,

J. B. Colson, Manager
Technical Information & Examination Program

mrr

Enclosure:
As Stated

cc: J. O. Zane, w/o enclosure

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TENTH REPORT

OF THE

Technical Assistance and Advisory Group (TAAG)

Three Mile Island Unit 2 (TMI-2)

For the Period August 1, 1984 to December 1, 1984

TAAG MEMBERS

W. H. Hamilton, Chairman
R. Brodsky
N. M. Cole
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CONTENTS

Section 1.0

INTRODUCTION

In a letter dated August 20, 1984, Mr. F.R. Standerfer, Director, Three Mile Island Unit 2 (TMI-2), requested tnat the Technical Assistance and Advisory Group (TAAG) address the following matters for the period ending March 1985:

1. Keep current on defueling plans and provide technical comments as designs are finalized.
2. Review the Technical Plan and Safety Evaluation Report for plenum removal. Provide comments relative to completeness and technical content and consistency.
3. Review the Technical Plan and Safety Evaluation Report for defueling. Provide comments relative to completeness and technical content and consistency.
4. Review and comment on the conceptual and detail design, testing, and implementation plans for core boring and discrete component removal devices provided by EG&G. Reference letter Hmb-140-84.
5. Continue to provide analytical personnel for the task of identifying sources in the Reactor Building.
6. Follow the B&W study for removal and storage of the Core Support Assembly. This may include providing experts for in-situ methods of disassembly to present the state-of-the-art and developments in underwater cutting of heavy components.
7. Investigate methods to find and remove fuel from discrete locations in the Reactor Coolant System that are likely to have collected fuel material. Review related Technical Planning reports.
8. Evaluate criticality implications for ex-core defueling effort, including sampling requirements, technical basis for determination of non-criticality potential, etc.
9. As opportunities occur, on a continuing basis, arrange presentations by technical persons from other projects such as Sodium Reactor Experiment, Shippingport, West Valley, LOFT, and others which TAAG may feel are appropriate. These presentations should address subjects such as cleanup methods, residual contamination and radiation endpoint criteria, disposition of large components, and other subjects for which there may be some TMI-2 applicability. The objective of this work is to provide input to assist in determination of Phase III endpoints.

10. Prepare scope definition for sample packages for CSA data acquisition for clearances, damage, radiological conditions, and others in tne judgement of TAAG that are required to support CSA removal.

1.1 SCOPE AND APPROACH

This report responds to these work items. One section of the report addresses each of the work items. The recommendations are summarized in Section 2. In the last section of this report the GPU Nuclear responses to the Ninth TAAG Report recommendations are tabulated.

Section 2.0

RECOMMENDATIONS

2.1 DEFUELING PLANS AND PROGRESS

- The movable sleeve should be eliminated from the transfer cask. Plans should call for use of a static transfer boot over the upender. The recommended approach is consistent with previous experiences with this type of fuel handling operation and avoids potential contamination problems that can result from wetting the exterior surfaces of the cask. (12/18)

- A 6"-thick, one-piece body should be designed and used for the transfer cask and static transfer boot over the upender. This configuration would allow immediate servicing if problems are encountered. Also, the static transfer boot could then be fitted with a funnel-type guide to facilitate canister-to-upender alignment. (12/18)

- A shielded door should be provided on the lower end of the transfer cask. This will prevent debris and/or water from falling out of the cask and onto the floor--presenting a potential contamination problem--while the cask is being moved back and forth. (12/18)

- The transfer cask can be significantly simplified. Also, additional shielding should be provided. Two transfer boots should be provided for discharging fuel from the transfer cask into the deep end pit. Further, the transfer boots should be 6" thick, rather than the 4" which is currently planned. The added thickness would alleviate the need for an exclusion area during canister handling and would avoid the access problems if difficulties are encountered during lowering of the canisters. (12/18)

- The seal design configuration for the dam gasket should be reassessed to ensure that if one gasket is lost, the dam will not move and cause the other gasket to leak. The dam should include at least one compression-type gasket seal, which could be loaded by jack screws that mount off the dam body and act against the existing dam embedments in the canal walls. (12/18)

- Further emphasis should be given to making the rotating work platform and associated tooling such that the IIF and support structures can be removed and the rotating work platform lowered down directly onto the reactor vessel flange. A specific design study should be prepared showing how this lowering can be done with the present defueling equipment and work platform. (12/18)

- Schemes that do not require any weighing of canisters in the reactor vessel are the ones that should be pursued. The canister's size and/or weight limit should be such that defueling personnel can completely fill a canister in the reactor vessel without the possibility of exceeding a weight limit. (10/12)

- The target dose in the working slot should be limited to about 2 mrem/hr from fuel canisters, based on the source terms currently being used by Westinghouse and Design Engineering. The recommendation to lower the carousel substantially would solve this radiation problem. (10/12)

- Westinghouse or Bechtel, as appropriate, should investigate design arrangements which would allow separation of the vacuum system and the carousel. Several possibilities appear feasible. (10/12)

- An effort should be made to reduce the carousel sweep radius about 50 inches. This should permit the carousel to be installed three feet further down than at present as soon as the loose debris and pieces generated from the plenum removal operation have been handled. (10/12)

- The stainless steel cover plate on the shielded work platform should be significantly reduced in thickness based on the GPUN indication that the water activity will be less than .1 microcuries/cc. (10/12)

- The defueling concept as presently configured is not satisfactory for manual defueling. This problem can be solved and still use the 150"-long canisters as planned, but it will involve a significantly different approach to canister/debris loading and transfer operations. (see Attachment A to 9/5 letter)

- A segmented, hinged door concept should be considered for the working slot so that only a small area of the working slot has to be open when the manual tools are being used. (9/5)

- The shielded work platform and transfer cask should be provided with adequate shielding so that the work platform area is not an exclusion area during transfer operations. (9/5)

- A major effort should be made to reduce the number of lines and/or the amount and frequency of platform rotation so that an elaborate cable handling system is not required. (9/5)

- Overall concept control drawings for each of the various phases of the defueling should be developed on a priority basis. (9/5)

2.2 CAMERA INSPECTION OF THE LOWER VESSEL

- TAAG sees no technical reason why the inspection of the lower reactor head region cannot proceed prior to the final removal of the upper plenum assembly, presently scheduled for April or May 1985.

2.3 CORE BORING

- Consideration should be given to having a TV camera in the lower plenum region (i.e., the bottom of the reactor vessel) to monitor conditions in this region during the drilling operation.

- The tooling and procedures should be developed and tested to allow a drill bit shaft with a stuck core sample to be removed as a unit.

- To avoid or minimize problems associated with metal pieces causing the drill shaft to be deflected from the required drilling path, it may be prudent to delay core boring until after the vacuuming of the loose core debris from TMI-2 has occurred.

- It would be prudent to develop tooling to remove objects (e.g., BPRA retainer) that may become stuck to the end of the drill bit.

- Manual sampling tools and techniques should be developed to retrieve samples of special interest at various elevations.

2.4 CORE SUPPORT ASSEMBLY

- The fuel debris in the lower regions of the reactor vessel should be characterized before any more work is done on the B&W study for the removal and storage of the CSA or the conclusion of that study.

- The B&W study does not address the removal of fused or monolithic fuel and structural material from the CSA. It would seem prudent to add this contingency to the planning to verify that the conclusion of the study is not altered.

- A thorough inspection of the CSA should be made, using fiber optics and/or small television cameras, to ascertain the quantities of fuel present. If the fuel quantities are small, CSA defueling should be deferred until the CSA disassembly/disposal effort commences.

- The underwater cutting technique for the CSA defueling presented to TAAG has been plasma arc cutting. There is some concern over using plasma arc cutting tools near the fuel or fuel debris. By the time the CSA cuts are required, this may no longer be an issue, but it does not seem wise to tie this concept to plasma arc cutting at this point in the planning.

- Plans to lower the defueling work platform and/or to add extensions onto the defueling booms should be incorporated into the defueling tool design.

2.5 EX-VESSEL DEFUELING

- The data acquisition effort must be intrinsic to the defueling program and should be formalized within defueling planning studies and reports. This will avoid expensive and time-consuming effort planning for conditions that may not exist.

2.6 PHASE III RADIOLOGICAL ENDPOINT CONDITIONS

- TAAG does not believe that the decontamination effort required to achieve the 2R/hr general area and 20 R/hr maximum hot spot radiation goals should be attempted during Phase III of the recovery program. Instead, this effort should be deferred until Phase IV, when the ultimate disposition of TMI-2 will be known.

- TAAG recommends that the reason for the low endpoint dose rate criteria (i.e., the need to send operators into the RB basement) be addressed by other means.

2.7 PHASE III ENDPOINT CRITERIA

- TAAG presents a method for determining Phase III endpoint criteria for residual fuel with respect to criticality concerns.

2.8 SOURCE IDENTIFICATION

TAAG has no recommendations on this subject during this period.

Section 3.0

DEFUELING PLANS AND PROGRESS

The letters contained in this section constitute TAAG reviews and recommendations for defueling of the core region.

MPR ASSOCIATES, INC.

December 18, 1984

Mr. William Hamilton
P.O. Box 613
Ligonier, PA 15658

Subject: TMI-2 Defueling Presentation to TAAG During the December 5, 1984 Meeting at TMI

Dear Mr. Hamilton:

A defueling presentation was made to TAAG during its December 5, 1984 meeting at TMI-2. In a portion of that presentation the general approach and status of the non-Westinghouse-supplied defueling gear was covered. In this regard, it is my understanding from GPUN that there are no planned formal design reviews for non-Westinghouse-supplied defueling gear. Accordingly, I think it appropriate that we at least comment on the information provided during the December 5 presentation on this category of defueling equipment. Our detailed comments are as follows:

I. The Fuel Transfer Cask (for movement of fuel canisters from over the reactor to the upenders in the deep end of the refueling cavity).

This proposed transfer cask has a movable three-ton shielded sleeve on the exterior diameter of the cask. This shielded sleeve moves through a stroke of about 4-5 feet by means of several telescoping hydraulic cylinders mounted near the top of the transfer cask (see Figure 1). It appears that one of the purposes for this movable sleeve is to allow the sleeve to be lowered while the cask's main body is held at a fixed elevation, thus providing some shielding down to the water level in the deep end of the refueling cavity as a fuel canister is lowered into the upending device. Our comments regarding this approach to the transfer cask are as follows:

A. Elimination of the Movable Sleeve from the Transfer Cask and Use of a Static Shielded Transfer Boot.

Lowering the movable sleeve into the pool water for a foot or so for canister transfer means that part of the cask will be constantly wetted and dried and could be a source for tracking contamination across the top of the defueling service platform (see Figure 1). In this regard, it is suggested that consideration be given to going back to providing a static transfer boot over the upender. In such an arrangement the cask can be positioned on top of the transfer boot for canister discharge and the cask itself will not be wetted every time it discharges a fuel canister (see Figure 2). This use of a static shielded transfer boot to allow radioactive items to make the transition out of a cask into water has been used in many previous applications in the past. The reason for this approach is to avoid getting the exterior parts of the cask wet and having the contamination problems that can result from such wetting. Further, a single one-piece cask body and a static transfer boot eliminates the need for a three-ton movable sleeve with hydraulic cylinders and their associated control system for raising and lowering the lead sleeve. In essence, a static transfer boot, as shown in Figure 2, will result in a simpler and more inherently trouble-free tool for the TMI-2 defueling operation. This approach is consistent with previous experiences with this type of fuel handling operation, and avoids potential contamination problems due to wetting the exterior surfaces of the cask. It also avoids the probability of binding and hang-up of the telescoping sleeve mechanism.

B. The Use of a Thin Movable Shielded Sleeve May Restrict Access to Servicing of Transfer Cask if Problems Are Encountered.

We note that there is only 1-1/2" of lead in this movable sleeve for shielding when it is extended fully during lowering a canister into the upender. Apparently, this thin amount of shielding is to minimize the amount of weight that the hydraulic cylinders have to raise and lower. In this regard, if difficulties should arise with the canister in a partially lowered position, the

1-1/2" of shielding will preclude getting people down into this area to work on the problem without first providing additional shielding in some manner. Accordingly, we recommend the use of a 6"-thick one-piece body for the cask and static transfer boot over the upender to allow immediate servicing if problems are encountered. The static transfer boot can also be fitted with a funnel-type guide to assure aligning the canister with the upender (see Figure 2). This approach should eliminate most of the potential problem areas pertaining to transfer cask radiation levels.

C. Provision of Door in Bottom of Cask for Water and Debris Retention and for Shielding.

We note that the transfer cask is not provided with any type of door on its lower end. We recommend that a door be provided to ensure that as the transfer cask moves back and forth with canisters debris and/or water cannot fall out of the cask and onto the floor where it could present a potential contamination problem. The door should be shielded to avoid accidental high radiation exposures. As can be seen in Figure 1, there are some areas where personnel could be inadvertently subjected to a high dose of radiation during cask movement.

D. Radiation Levels from the Transfer Cask on Rotating Service Platform.

It is noted that the total shielding thickness of the transfer cask when it is on the rotating service platform is only 4" of lead (2-1/2" in the cask body proper and 1-1/2" in the movable sleeve - see Figure 1). It would appear this could result in a relatively high radiation level on the service platform and that steps would have to be taken to minimize having workers around the cask while it is loaded with a canister and/or limit workers on the rotating service platform during canister handling. We further note that another special cask is being designed for transferring fuel into the shielded rail shipping cask and it has 6" of lead shielding. It would appear to us that the 4" of lead on the transfer cask used in the reactor building is on the thin side and should be made thicker.

In summary, we consider that the cask can be significantly simplified and that more shielding should be provided, including a shielded bottom door. For discharging fuel from the transfer cask into the deep end pit we would suggest that one or preferably two transfer boots be provided. One of the transfer boots can be on a stand over the upender and the other over the canister storage area in the south side of the refueling cavity where the filters are located. Further, this transfer boot should have adequate thickness (6") rather than the present 1-1/2" which will require some kind of an exclusion area when canisters are being handled and create access problems if difficulties are encountered during lowering of canisters.

II. Refueling Canal Dam.

During the TAAG meeting a conceptual cross section of the refueling canal dam that is roughly 6 feet high was shown (see Figure 3). It includes two inflatable gaskets. However, the design of these two inflatable gaskets appears such that if either one fails, the other seal may also leak (e.g., when one seal leaks, the dam may move and cause the other seal to leak). Accordingly, we would suggest that the seal design configuration for the dam gasket be reassessed to ensure that if one gasket is lost, the dam will not move and cause the other gasket to leak. Specifically, we would recommend that this dam include at least one compression-type gasket seal which could be loaded by jack screws that mount off the dam body and act against the existing dam embedments in the canal walls.

III. Lowering of the Rotating Service Platform to Assist in Handling Defueling Operations Below the Elevation of the Lower Grid Plate Where Fuel Normally Stops.

Since more evidence is becoming available that significant quantities of fuel debris are in the lower region of the reactor vessel and that it was not transported there by primary coolant circulation (i.e., data from inspecting the bottom of the upper plenum assembly's outlet annulus), it is recommended that further emphasis be given to making the rotating work platform and associated tooling such that the IIF and support structures can be removed and the rotating work platform be lowered down directly onto the reactor vessel flange. This would allow the working depth to be lowered by up to 7'. This will help ensure that the defueling concept is not totally dependent on automated/remote tooling for the latter stage of removing fuel from the lower part of core support assembly. To this end, it is recommended that a specific design study be prepared showing how this lowering can be done with the present defueling equipment and work platform. Specifically, a quick review of present equipment designs indicates that it includes features which make the job of lowering more difficult. It would appear that some nominal amount of detailed analysis and preplanning might make the job of lowering the work platform significantly easier and less costly.

If you have any questions regarding this letter, please do not hesitate to call.

Sincerely,

Noman M. Cole, Jr.

cc: H. Burton, EG&G
E. Kintner, GPUN
F. Standerfer, GPUN
J. DeVine, GPUN
P. Bradbury, GPUN
TAAG Members

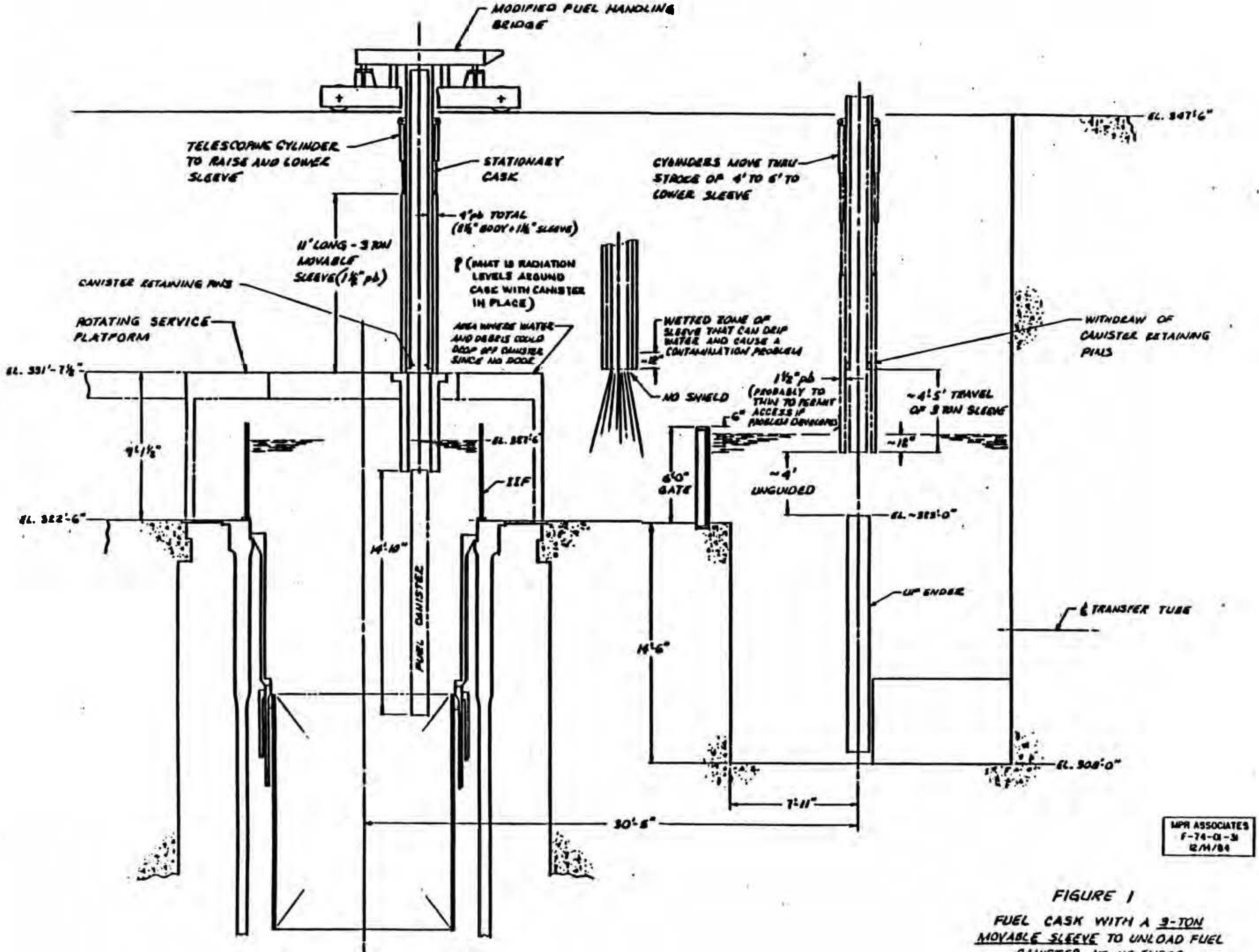


FIGURE 1

FUEL CASK WITH A 3-TON MOVABLE SLEEVE TO UNLOAD FUEL CANISTER AT UP-ENDER

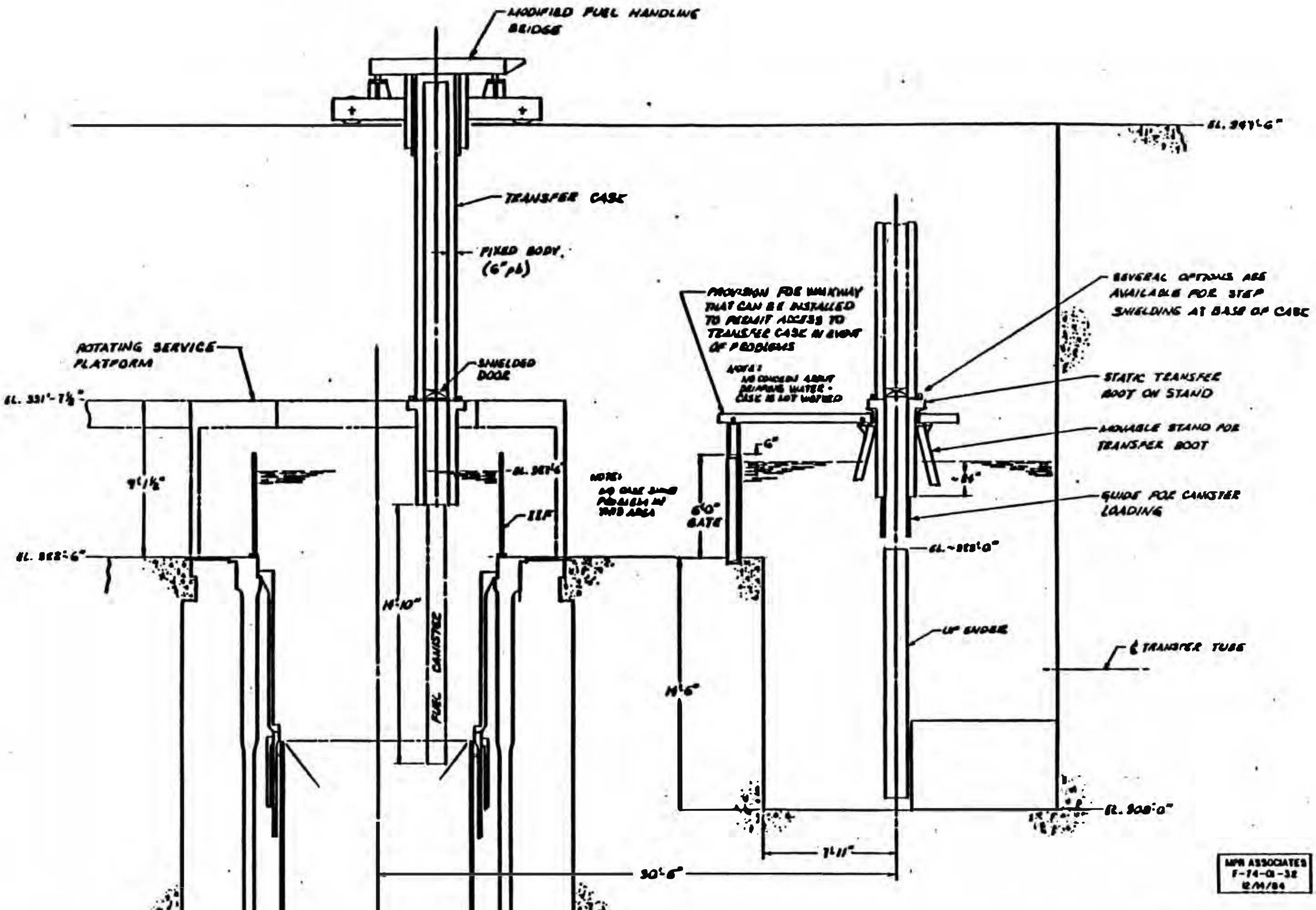


FIGURE 2

TRANSFER CASK USING A FIXED TRANSFER BOOT TO UNLOAD FUEL CANISTERS AT UP-ENDER

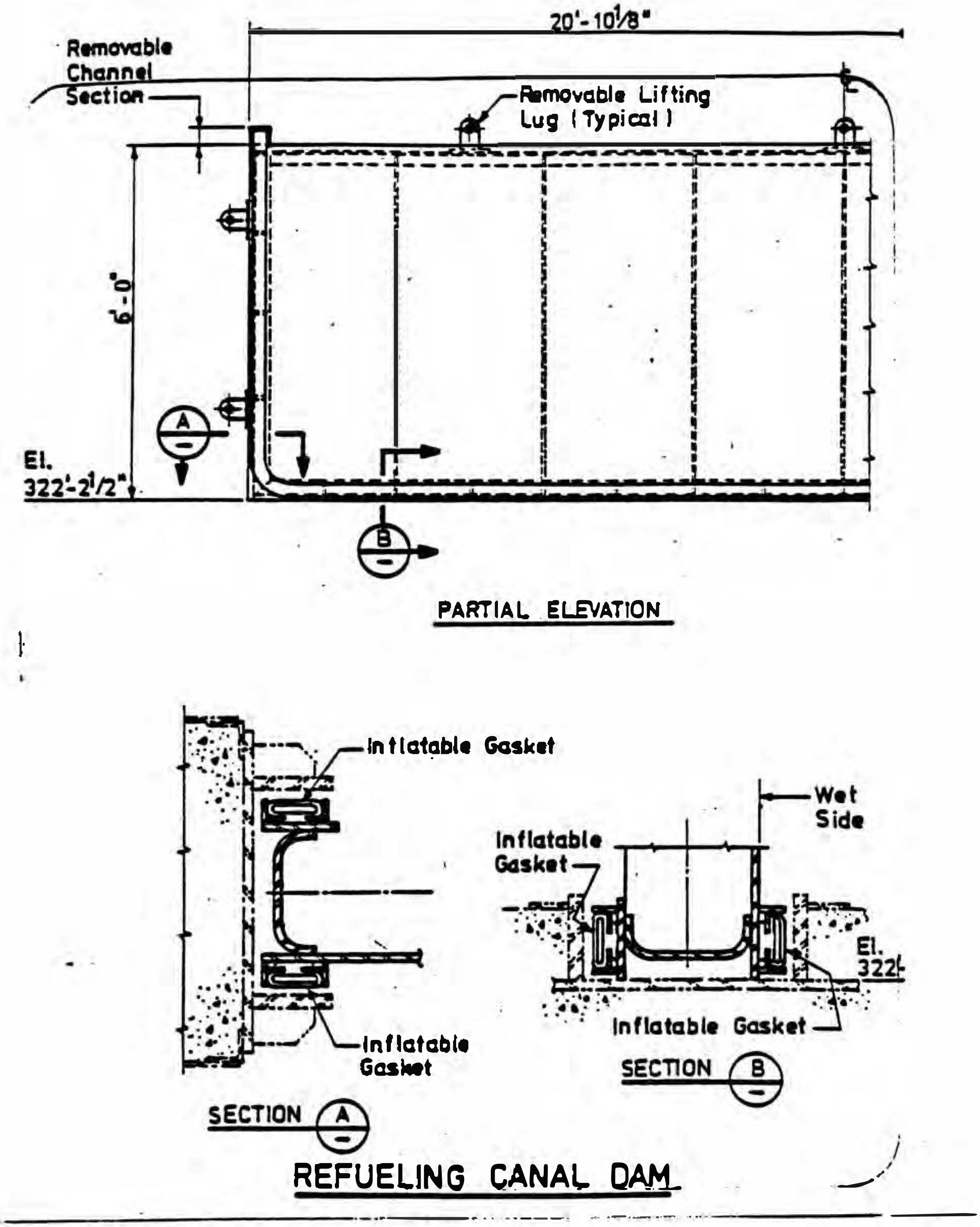

20'-10 1/8"
Removable Channel Section
Removable Lifting Lug (Typical)
6'-0"
El. 322'-2 1/2"
A
B
PARTIAL ELEVATION
Inflatable Gasket
Inflatable Gasket
SECTION A
Wet Side
Inflatable Gasket
El. 322'
Inflatable Gasket
SECTION B
REFUELING CANAL DAM

FIGURE 3

MPR ASSOCIATES, INC.

December 18, 1984

Mr. William Hamilton
P.O. Box 613
Ligonier, PA 15658

Subject: Design Review of Tooling for TMI-2 Defueling Which Was Held on November 15, 1984

Dear Mr. Hamilton:

Per your request, we attended the formal design review that occurred on November 15, 1984 at the Bechtel offices in Gaithersburg, Maryland. This design review concerned individual pieces of tooling that are to be used in defueling of TMI-2. The main areas covered during the review were the single canister positioning bracket, a manual tool positioner and the cable control system and other miscellaneous pieces of defueling equipment. Our major comments regarding this equipment and other related matters are as follows.

1. Use of the Manual Tool Post and Elimination of the Automated Rotating Tool Mast.

   Westinghouse is proposing a manual tool post device. This device is to provide a load capacity of 300 pounds for the tool end-effectors and a 500-pound reaction force. The manual tool post will basically allow various types of heavy duty end-effectors to be used for removing core debris. ROSA can also be used on this tool post. This manual tool post has the potential of being much simpler than the current automated rotating tool mast which was specifically designed for more remote automated defueling operations. It would appear that the manual tool post could be mounted on a carriage that would work up and down the open working slot. In this regard, this manual tool post also has the potential of performing the same basic functions as the more complex and costly automated rotating tool mast for use with remote automated equipment. While this manual tool post may be somewhat slower, this type of device should be quite adequate for a one-shot defueling operation such as TMI-2. Accordingly, GPUN should consider putting its primary

1050 Connecticut Avenue, N.W. Washington, D.C. 20036

effort into simplifying and improving this manual tool post and eliminating the need for the more expensive and involved automated rotating mast tool. With regard to the manual tool post design, as proposed by Westinghouse, there are certain motions that take place in underwater drives; namely the vertical positioning of the tool holder and the angular positioning of the tool holder. During the design review, GPUN and Design Engineering instructed Westinghouse to revise the design of the manual tool post so that the vertical and angular motions are driven by devices that are above the water rather than submerged.

2. Separation of Vacuum Systems and Carousel.

During the meeting it was noted that the vacuum system and the carousel are still integrally tied together. Westinghouse indicated they had made an evaluation of this and they concluded that the present approach of tying these two together was satisfactory. Upon questioning, they indicated that there was no documentation of such an evaluation. In view of the concern with tying these two systems together, we would recommend, as we indicated in our letter of October 12, 1984, page 3, comment B, that the vacuuming and carousel features should be separated. Accordingly, we would suggest that Westinghouse be requested to document their evaluation that concludes that the carousel and vacuum system should be tied together and made available for review. In this regard, GPUN asked if the single canister bracket could not also be designed to accommodate a knock-out canister and Westinghouse was requested to make such an evaluation. If this can be done, then it would allow vacuuming with a canister in the single holder bracket. Thus, vacuuming could possibly occur before the carousel is installed. This appears to be a step in the right direction, but the thrust of our comment is that in our opinion the system should allow vacuuming and canister loading in parallel.

3. Single Canister Positioning Bracket Still Needs Considerable Work.

The detailed design of single canister positioning bracket was in such a preliminary stage at this review it is too early to tell whether the proposed design will be satisfactory. Conceptually, the idea of a single canister bracket is a good one, but the detailed design still needs a lot of work.

4. Radiation Levels Over the Working Slot in the Rotating Platform.

During the October 3, 1984 design review, a Westinghouse study had indicated that the radiation levels over the working slot were still too high and that they had recommended doing further work to reduce them. We understand that Westinghouse is not undertaking this work, since they have not been authorized to proceed on this work. [For background, see MPR letter dated October 12, 1984, page 3, item A in the body of the letter and Sections II.A (page 3) and II.E.2 (page 7) in the letter's attachment.] Accordingly, we would like to see what has been done to lower the levels as recommended by Westinghouse. Specifically, exactly what are the predicted levels caused by each of the following: the water in the reactor vessel, the fuel canisters in the carousel, and the general background resulting from being down in the canal area as well as the basis for these radiation levels.

If you have any questions regarding this letter, please do not hesitate to contact me.

Sincerely,

Noman M. Cole, Jr.

cc: H. Burton, EG&G
E. Kintner, GPUN
F. Standerfer, GPUN
J. DeVine, GPUN
P. Bradbury, GPUN
TAAG Members

MPR ASSOCIATES, INC.

October 12, 1984

William Hamilton, Sr.
P.O. Box 613
Ligonier, PA 15658

Subject: TMI-2 Defueling Design Review of October 3, 1984

Reference: (a) MPR letter to W. Hamilton dated October 5, 1984: "Radiation Levels in Working Slot for the Manual Defueling Concept"

(b) MPR letter to W. Hamilton dated September 5, 1984: "TMI-2 Defueling System Design Review of August 21-22, 1984

Dear Mr. Hamilton:

Per your request we have attended the formal design review concerning the TMI-2 defueling concept held on October 3, 1984, at Bechtel's offices in Gaithersburg, Maryland. This review covered such areas as (i) the current arrangement of the main pieces of equipment on the rotating shielded work platform, (ii) the analysis of radiation levels in the working slot, (iii) the design of the carousel used to store and position canisters, and (iv) the Westinghouse proposed approach to handle debris resulting from the plenum removal operations.

Since the August 1984 design review, the principal change of note to the defueling system is that the shielded work platform arrangement has been revised as follows:

1. Removal of a fuel canister with the transfer cask does not require closing of the working slot used for manual defueling. Specifically, a separate transfer cask loading port with a shielded transfer boot has been provided so that the working slot can remain open during canister removal operations. Thus, the handling tools can remain and be used in the open working slot during fuel canister transfer operations.

2. The carousel has been repositioned so that it does not block direct vertical access via the working slot to the center portion of the core and its capacity has been reduced from six to five canisters. [Note: The present carousel design still cannot be lowered significantly deeper into the reactor vessel to decrease radiation levels in the open working slot - see Comment C below.]

3. The working slot has been extended to the full width of the shielded working platform so that full diameter of the core is accessible at one time.

We consider these design changes will improve the overall defueling system. Figures showing the key features of the defueling system as presented at the subject design review meeting are included in Attachment C.

One major problem area is being encountered for which, at this stage, there does not appear to be a straightforward or practical solution based on information provided by Westinghouse. Specifically, the current limit for the total loaded dry weight of a canister is 2,800 pounds. At present there is no simple and reliable way to measure the weight of three different types of canisters while they are being loaded with debris in the reactor vessel. The difficulty in obtaining a practical weighing system is caused by several factors -- the expected wide variation in the density of the debris and the series of mechanical and operational conditions during which the weighing system must be able to function. For example, if the density of the debris in a filled 150"-long fuel canister exceeds about 5 gm/cc, the canister will exceed the 2,800 lb. limit. Further the multi-elevation positions of canisters on the carousel and the rotational motion of the carousel makes it difficult to develop a simple and reliable scheme for weighing the fuel canisters. There are also similar practical problems with weighing the "knock-out" and "filter" canisters as they are being loaded. We consider that a major effort will be required to bring this issue to a head so as to obtain a practical solution within the current constraints. Possible approaches to solving this problem are discussed in Attachment A. Basically, we consider schemes that do not require any weighing of canisters in the reactor vessel are the ones that should be pursued. Specifically, the canister's size and/or weight limit should be such that defueling personnel can completely fill a canister in the reactor vessel without the possibility of exceeding a weight limit. This approach would greatly simplify the defueling equipment and its control system, would require no weighing equipment in the reactor vessel, and would also simplify administrative control procedures required.

Our major comments regarding the current defueling system design are summarized below. These comments are discussed in further detail and in the same order in Attachment A.

A. Reduction of Radiation Levels in the Working Slot for Manual Defueling - Present Level Is Still Too High

Westinghouse analysis of the new additional features to reduce the radiation in the working slot due to fuel canisters indicates that the level is still too high (about 8 mrem/hr). Westinghouse recommended that an effort be undertaken to reduce the dose a factor of two or more. We would recommend that the target dose in the working slot be limited to about 2 mrem/hr from fuel canisters, based on the source terms currently being used by Westinghouse and Design Engineering [see Reference (a) and the details in Attachment A]. In this regard, the recommendation in Comment C below, to lower the carousel substantially, would solve this radiation problem as well as provide margin for handling errors, water level variations, etc.

B. Separate the Vacuum and Carousel Systems; These Systems are Presently Interconnected

At present during defueling operations, the vacuum system's operation is limited to the carousel being in one specific position (i.e., the position where the "knock-out" canister can be connected to the vacuum lines). This will result in having to make and break vacuum connections in order to position the other canisters for loading debris. This tieing of the vacuum and carousel systems together also requires the carousel to be installed before the vacuum system can be used. Accordingly, we consider that Westinghouse or Bechtel, as appropriate, should investigate design arrangements which would allow separation of the vacuum system and the carousel. Several possibilities appear feasible; for example, relocate the "knock-out" canister on the other side of the working slot, opposite the filter canisters. Further, such separation would also reduce the high radiation levels in the working slot caused by having a fuel canister in the up position and directly in the working slot during vacuuming operations (see detailed discussion in Comment II.A of Attachment A).

C. Reducing Carousel's Sweep Radius to Allow the Carousel To Be Initially Lowered Approximately Three Feet Further Under Water

The present carousel has a sweep radius around the center of the core of 60 inches; this is essentially out to the edge of the core former plates. Therefore, before a carousel with such a large sweep radius could be lowered, at least the upper third of approximately 45 fuel assemblies along the periphery of the core former would have to be removed. It is also our understanding that the present carousel is not designed to be lowered even if these fuel assemblies were out of the way. Accordingly, we consider that an effort should be made to develop a carousel with a sweep radius of about 50 inches. This may even require reducing the carousel's capacity to four fuel canisters. Such a 50" sweep radius should permit the carousel to be installed three feet further down than at present as soon as the loose debris and pieces generated from the plenum removal operation have been handled (i.e., beginning of vacuum). This lower carousel position eliminates radiation from the fuel canisters being a concern in the working slot (see Comment A above) as well as provides margin for handling errors, water level variations, etc.

D. Reducing Thickness of Stainless Steel Cover Plate on the Shielded Work Platform

The present cover plate (approximately 17.5 feet in diameter) is 6 inches thick and made of stainless steel. It is currently made up of two 3-inch-thick plates, one on top of the other. It is our understanding from the GPUN Defueling Task Force report of June 12, 1984, that this thickness was set based on a water activity of 10 µci/cc. Since GPUN has indicated that the water activity is down to .02 µci/cc and since a shielded transfer boot is now to be provided for transfer of canisters out of the reactor, it would appear that thickness of the cover plate can be significantly reduced (e.g., to about 2 inches or possibly less). This should still provide adequate shielding even if the DWCS design water activity is off by a factor of 5 (i.e., up to .1 µci/cc).

E. Comments on "Draft" System Design Description (SDD) Dated October 3, 1984

1. These documents do not contain "concept control drawings." Such drawings should be developed on a priority basis for each of the four phases of debris removal and included in the SDD (see Attachment A - Comment II.E).

2. It is recommended that the total radiation dose rate over the open working slot of 12 mrem/hr in Section 2.13 be broken into the three individual sources that contribute to total dose. Specifically, the background dose from the reactor canal area, the water activity dose, and the canister dose. This will allow monitoring of these various sources and the actions taken to minimize each contributing source.

3. In regard to the canister contribution to the dose in the working slot, we recommend that this be limited to about 2 mrem/hr [see Reference (a) and the additional information contained in Attachment A - Comment II.E].

4. The total radiation level specified in section 2.1.3 of the SDD for the area above the open working slot of 12 mrem/hr is too high and should be lowered (see Attachment A - Comment II.E).

5. Figure A.3-15 of the Interface Control Documents shows that the canister transfer cask has a side wall thickness of 2 1/2" and no bottom shield door. As discussed in Reference (b) on page 2 of Attachment A, we still consider that the shielding on the cask be about 6" (i.e., to achieve approximately 2 1/2 mrem/hr at 1 meter) and that the cask should have a shielded door at its lower end.

6. It is recommended that general criteria concerning shielding and exclusion areas, as covered in Attachment B, be included in the system design descriptions.

If you have any questions concerning this letter or the attachments, please do not hesitate to call.

Sincerely,

Noman M. Cole, Jr.

Attachments

cc: H. Burton, EG&G
E. Kintner, GPUN
F. Standerfer, GPUN
J. DeVine, GPUN
P. Bradbury, GPUN
TAAG Members

DETAILED COMMENTS RELATIVE TO THE TMI-2 DEFUELING DESIGN REVIEW OF OCTOBER 3, 1984

DETAILED COMMENTS RELATIVE TO THE TMI-2 DEFUELING DESIGN REVIEW OF OCTOBER 3, 1984

I. Problem Area - Weighing of Canisters in the Reactor Vessel

One major problem area is being encountered for which, at this stage, there does not appear to be a straightforward or practical solution based on information provided by Westinghouse. Specifically, the current limit for the total loaded dry weight of a canister is 2,800 pounds. At present there is no simple and reliable way to measure the weight of three different types of canisters while they are being loaded with debris in the reactor vessel. The difficulty in obtaining a practical weighing system is caused by several factors -- the expected wide variation in the density of the debris and the series of mechanical and operational conditions during which the weighing system must be able to function. For example, if the density of the debris in a filled 150"-long fuel canister exceeds about 5 gm/cc, the canister will exceed the 2,800 lb. limit. Further, the multi-elevation positions of canisters on the carousel and the rotational motion of the carousel makes it difficult to develop a simple and reliable scheme for weighing the fuel canisters in the reactor vessel. There are also similar practical problems with weighing the "knock-out" and "filter" canisters as they are being loaded in the reactor vessel. It is considered that a major effort will be required to bring this issue to a head so as to obtain a practical solution within the current constraints for the three different types of canisters. Possible approaches to solving this problem are as follows:

1. Obtain significant relaxation on the present 2,800-lb. limit per canister. It is our understanding that this limit was set by EG&G facilities in Idaho and has been used by EG&G as a limit on the canisters to be shipped in the new NUPAC spent fuel shipping cask now under design. As an upper limit, the maximum dry weight of a 150"-long

canister completely filled with debris of a density of about 10 gm/cc is approximately 4,900 lbs. [i.e., 700 (canister) + 4,180 (debris)].

2. Use mainly short canisters (e.g., 75"-long canister, where two such canisters could be inserted in one 150"-long storage rack or in each of the seven fuel positions in the shipping cask). This approach might allow short canisters to be filled to their maximum physical capacity without regard to weight [e.g., a 75"-long canister fully loaded with debris of an upper density of 10 gm/cc will weigh about 2,800 lbs. (2,100 + 700)]. Some canisters 150" long could still be used for handling long fuel assemblies (potentially a maximum of about 45) that could be reasonably intact (i.e., assembly around the periphery of the core).

3. Use the existing 150" canister and establish a single maximim wet weight based on low density material filling canisters. This approach will still require the development of three different balance scale systems for use in the reactor vessel. It will also result in a somewhat inefficient loading of canisters (but the canisters would always be under the 2,800-lb. limit) and thus result in more canisters being required to handle the TMI-2 core debris. At present, such weighing systems in the reactor vessel look very complex and unattractive.

A task force to develop various practical approaches to resolving this problem area may be warranted. Basically, we consider schemes that do not require any weighing of canisters in the reactor vessel are the ones that should be pursued. Specifically, the canister's length and/or weight limit should be such that defueling personnel can completely fill a canister in the reactor vessel without the possibility of exceeding a weight limit. This approach would greatly simplify the defueling equipment and its control system, would require no weighing equipment in the reactor vessel, and would also simplify administrative control procedures required.

II. Major Comments Concerning Present Defueling System Design

A. Reduction of Radiation Levels in the Working Slot for Manual Defueling - Present Level is Still Too High

The radiation levels in previous defueling arrangements [see Reference (a)] were too high in the working slot for manual defueling. A possible solution to this problem was analyzed by Westinghouse which involved the following changes:

1. Lowering the carousel so that there will be an additional 3" inches of water over the canisters.

2. Reducing the carousel from six canisters to five canisters and then assuming only four of the five canisters are in the raised position which can contribute to the radiation problem in the working slot. (See comment on this item below.)

3. Providing shielded collars around the top two feet of each canister position in the carousel.

4. Providing shielding in top of each canister cap.

Westinghouse analysis of these new features to reduce the radiation in the open working slot due to fuel canisters indicates that the level is still too high (e.g., about 8 mrem/hr at EL. 331'-6"). Accordingly, Westinghouse recommended that an effort be undertaken to reduce this dose rate a factor of two or more.

We also concur with this radiation reduction recommendation and would also recommend that further radiation analysis be performed on the bases of the following:

1. The target dose rate in the open working slot be about 2 mrem/hr from fuel canisters, based on the source terms currently being used by Westinghouse and Design Engineering [see Reference (a)]. In this regard, the recommendation in Comment C below, to lower the

carousel substantially, would completely solve this radiation problem as well as provide margin for handling errors, water level variations, etc.

2. All five fuel canisters (instead of just four) should be in the raised position of the carousel for the radiation analysis. This will cover the case where a loaded fuel canister has to be rotated into the working slot position so that a vacuum system can be connected to "knock-out" canister. [Note: Vacuum systems and carousel are interconnected - see Comment B below.] In such a case, a loaded fuel canister can be in the "up position" of the carousel and also be positioned in the open working slot at the same time manual vacuum operations are in process.

B. Separate the Vacuum and Carousel Systems; These Systems Are Presently Interconnected

At present during defueling operations, the vacuum system's operation is limited to the carousel being in one specific position (i.e., the position where the "knock-out" canister can be connected to the vacuum lines). This will result in having to make and break vacuum connections in order to position the other fuel canisters for loading debris. This tieing of the vacuum and carousel systems together also requires that the carousel be installed before the vacuum system can be used. It would be desirable to have the vacuum system available during the defueling operation before the carousel is installed (e.g., during the handling of debris resulting from the plenum removal operation). It would appear that separating the vacuum system's operation from all carousel operations during bulk defueling would be superior from an operational standpoint (i.e., vacuum system would always be available and independent of carousel position). This separation would also result in simpler equipment designs for both the carousel and the vacuum systems. Accordingly, we consider that Westinghouse or Bechtel, as appropriate, should investigate the design arrangements which would allow separation of the vacuum system and the carousel. For example, there appears to be space on the opposite side of the working slot from where the vacuum filters are located to position a "knocked-out" canister, thus separating the vacuum system from the carousel. The tool rack presently in this area could be located to the right side of the ROSA Mast now that the working slot is opened all the way across the full core diameter. This separation should also reduce the radiation concern caused by tieing the vacuum system and carousel together as discussed in Comment A above.

C. Reducing Carousel's Sweep Radius to Allow the Carousel To Be Initially Lowered Approximately Three Feet Further Under Water

With the present carousel size and its location on the work platform, it has a sweep radius of about 60 inches as the working platform rotates around the center of the core. This 60" sweep radius covers the area out to the edge of the core former plates. Accordingly, before the carousel can be lowered in this arrangement, at least the upper third of approximately 45 fuel assemblies that may still remain along the periphery of the core former would have to be removed. Accordingly, we consider that an effort should be made to develop a carousel with a sweep radius of about 50 inches. This may even require reducing the carousel's capacity to four fuel canisters instead of the present five. Such a 50" sweep radius should permit the carousel to be installed three feet further down than at present as soon as the loose debris and pieces generated from the plenum removal operation have been handled (i.e., at beginning of vacuuming operations). This might also involve removing about a half dozen partial fuel assemblies that could still be standing within the 50" sweep radius after the plenum is removed.

As indicated in Comment A above, effort is still in progress to lower the radiation levels in the open working slot due to fuel canisters to a more reasonable level. To accomplish this reduction, the design is very tight. Further, this current effort is not addressing other issues such as "margin" for handling errors, water level variations, etc. and these will have to be addressed separately. Accordingly, designing in the ability to lower the carousel would provide such margin for the bulk of the defueling. It is therefore considered that the carousel design should have the ability to permit readily lowering the unit about 3 feet.

D. <u>Reducing Thickness of Stainless Steel Cover Plate on the Shielded Work Platform</u>

The present cover plate (approximately 17.5 feet in diameter) is 6 inches thick and made of stainless steel. It is currently made up of two 3-inch thick plates, one on top of the other. It is our understanding from the GPUN Defueling Task Force report of June 12, 1984, that this thickness was set based on a water activity of 10 μci/cc. Since GPUN has indicated that the water activity is down to .02 μci/cc and since a shielded transfer boot is now to be provided for transfer of canisters out of the reactor, it would appear that thickness of the cover plate can be significantly reduced (e.g., to about 2 inches or possibly less). This should still provide adequate shielding even if the DWCS design water activity is off by fact of 5 (i.e., up to .1 μci/cc). Accordingly, consideration should be given to significantly reducing the thickness of this stainless steel cover plate in view of the design bases water activity of DWCS being so low (i.e., .02 μci/cc).

E. <u>Comments on the "Draft" System Design Description for Defueling Dated October 3, 1984</u>

At the design review, Design Engineering indicated that the final system design description would be issued in late October 1984. Draft versions of both the System Design Description and Interface Control Drawings were issued October 3, 1984. Our overall comments on these draft documents are as follows:

1. <u>These documents do not contain concept control drawings.</u> Such concept control drawings should be developed for each of the various phases of the defueling operation on a priority basis and included with the system description. In this regard, it appears that there needs to be four series of such concept control drawings for the four phases of debris removal.

a. One showing manual removal of debris knocked off the plenum and transfer of canisters out of the reactor and into the deep end of the canal.

b. A second showing how the loose debris would be vacuumed out based on a manual vacuuming system and canister transfer operations.

c. A third showing manual methods for pick and place bulk defueling and canister transfer operations.

d. A fourth showing automated bulk defueling and transfer operations.

These concept control drawings should show such things as: where all the manual tool handling cranes would be located and their lift heights, where the people will be located for all the various operations, general radiation levels, minimum water shielding, water heights available for loading canisters, tool lifting heights and other controlling features from a system point of view (exclusion areas, if any, etc.) for each of the four phases of the defueling operation [see Reference (b), page 4].

2. Section 2.1.3 in the System Description Document concerns dose rates. This section indicates that the dose rate over the shielded work platform will be 2 mrem/hr and 12 mrem/hr over the open working slot for manual defueling. Our comments on this section are as follows:

a. While total radiation dose rate objectives are needed, it is also important to provide a breakdown of this total dose rate to control the individual dose from the various sources that contribute to the total dose rate. For each of the two positions where total dose rate goals are established (e.g., over the working slot and over the shielded work platform), provide the radiation dose rate goals for the following contributing sources:

1) Background dose rate from being in the reactor canal area.

2) Dose rate from the water activity.

3) Dose rate from canisters in the water of the reactor vessel.

b. It is considered that total radiation level above the open working slot of 12 mrem/hr is too high. From the numbers provided at the October 3, 1984, design review and the number of 12 mrem/hr over work platform given in the system design description, it would appear that the breakdown of this 12 mrem/hr over the working slot is about as follows:

1)	Background from being in reactor canal area	2 mrem/hr
2)	Dose from water activity (.02 µci/cc)	2 mrem/hr
3)	Dose from fuel canisters in water	8 mrem/hr
		12 mrem/hr

It is recommended (i) that the dose rate goal over the open working slot from fuel canisters be set at about 2 mrem/hr at 18" over the top of the work platform as discussed in Reference (a), and (ii) that the System Design Description be revised to reflect this lower dose rate goal. In this regard, the effort as recommended by Westinghouse at October 3, 1984 (see Comment II.A above) to reduce the working slot dose rate by a factor of two or more appears headed in the right direction and should bring the radiation level in the working slot due to canisters down to this 2 mrem/hr range at 18" above the top surface of the shielded work platform.

c. The total radiation level specified in Section 2.1.3 of the SDD for the area above the open working slot of 12 mrem/hr is too high and should be lowered.

3. It is recommended that general criteria concerning shielding and exclusion areas, as covered in Attachment B, be included in the system design description.

III. References

(a) MPR letter to W. Hamilton dated October 5, 1984: "Radiation Levels in Working Slot for the Manual Defueling Concept."

(b) MPR letter to W. Hamilton dated September 5, 1984: "TMI-2 Defueling System Design Review of August 21-22, 1984."

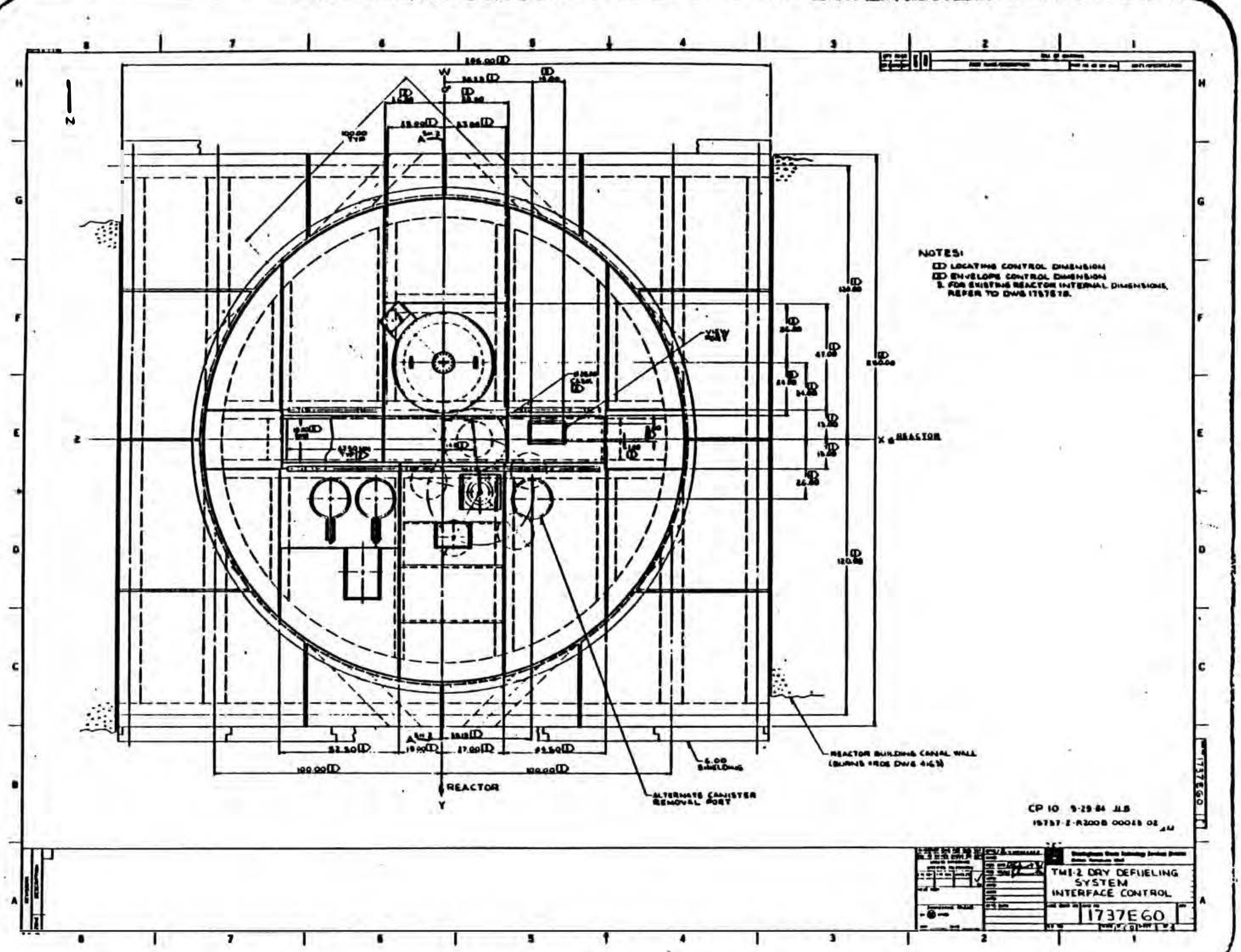
RECOMMENDED GENERAL CRITERIA
TO BE ADDED TO THE "DRAFT" SYSTEM DESIGN
DESCRIPTION DOCUMENTS
(SEE DESIGN ENGINEERING'S LETTER DEOE -DATED 10/3/84)

1. The shield design and features of the work platform and its transfer boots and the transfer cask shall be such that the rotating work platform area is not an exclusion area during canister transfer operations. Specifically, the levels during transfer cask operation shall be no greater than during normal manual defueling operations. (Add to Section 2.1.3 of the SDD.)

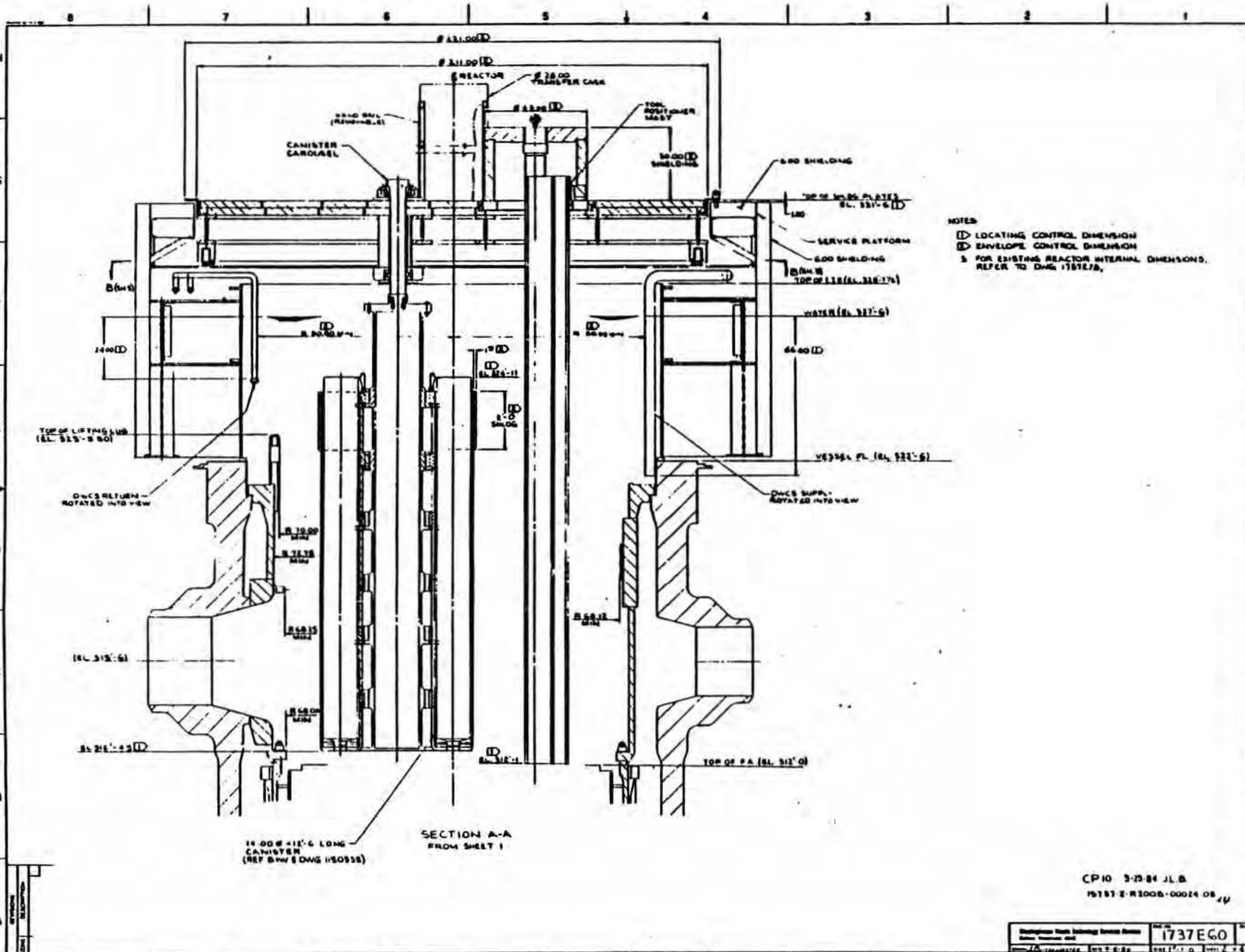
2. The design of the rotating work platform and its transfer boot, the transfer cask, and the working slot covers shall be such that manual operation of defueling tools through the working slot can proceed at the same time canisters are being removed from the reactor vessel. This is to allow operations personnel to have the option of performing canister transfer operations in either parallel or in series with manual defueling operations. (Add to Section 2.1.1 of the SDD.)

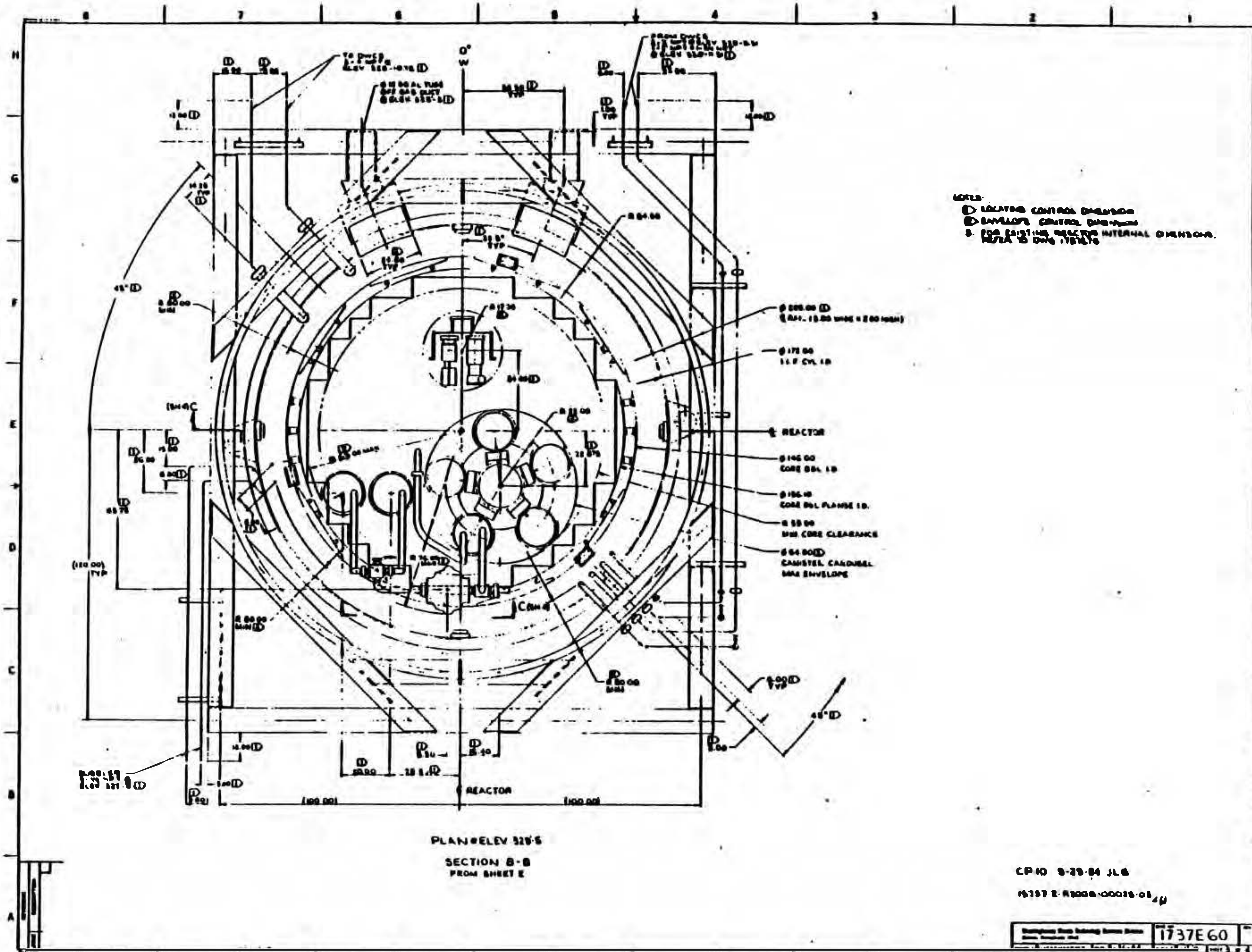
3. The transfer cask shall have about 6" of lead side shielding and a shielded door at its lower end. The cask radiation level shall be less than 2-1/2 mrem/hr at 1 meter which has been the normal practice for such a cask in previous designs. If small local areas of the cask cannot meet the approximate 6" thickness requirement (e.g., such as near the "up-ender" fuel transfer device), this can be addressed separately by the designer and proposed approaches made to handling such areas. (Add to Section 2.1.3 of the SDD.)

WESTINGHOUSE FIGURES CONCERNING THE DEFUELING SYSTEM PRESENTED AT THE OCTOBER 3, 1984 DESIGN REVIEW



NOTES:
LOCATING CONTROL DIMENSION
ENVELOPE CONTROL DIMENSION
3. FOR EXISTING REACTOR INTERNAL DIMENSIONS, REFER TO DWG 1737E78.
REACTOR BUILDING CANAL WALL (BURNS & ROE DWG 4163)
ALTERNATE CANISTER REMOVAL PORT
6.00 SHIELDING
VIEW PORT
REACTOR
X REACTOR
100.00
120.00
250.00
186.00
CP 10 9-29-84 JLB
TMI-2 DRY DEFUELING SYSTEM INTERFACE CONTROL
1737E60


CANISTER CAROUSEL
REACTOR
TRANSFER CASK
TOOL POSITIONER MAST
SERVICE PLATFORM
TOP OF LIFTING LUG
DWCS RETURN - ROTATED INTO VIEW
DWCS SUPPLY - ROTATED INTO VIEW
NOTES:
LOCATING CONTROL DIMENSION
ENVELOPE CONTROL DIMENSION
3. FOR EXISTING REACTOR INTERNAL DIMENSIONS, REFER TO DWG. 1737E78.
SECTION A-A
FROM SHEET 1
CP10 5-23-84 JLB
1737E60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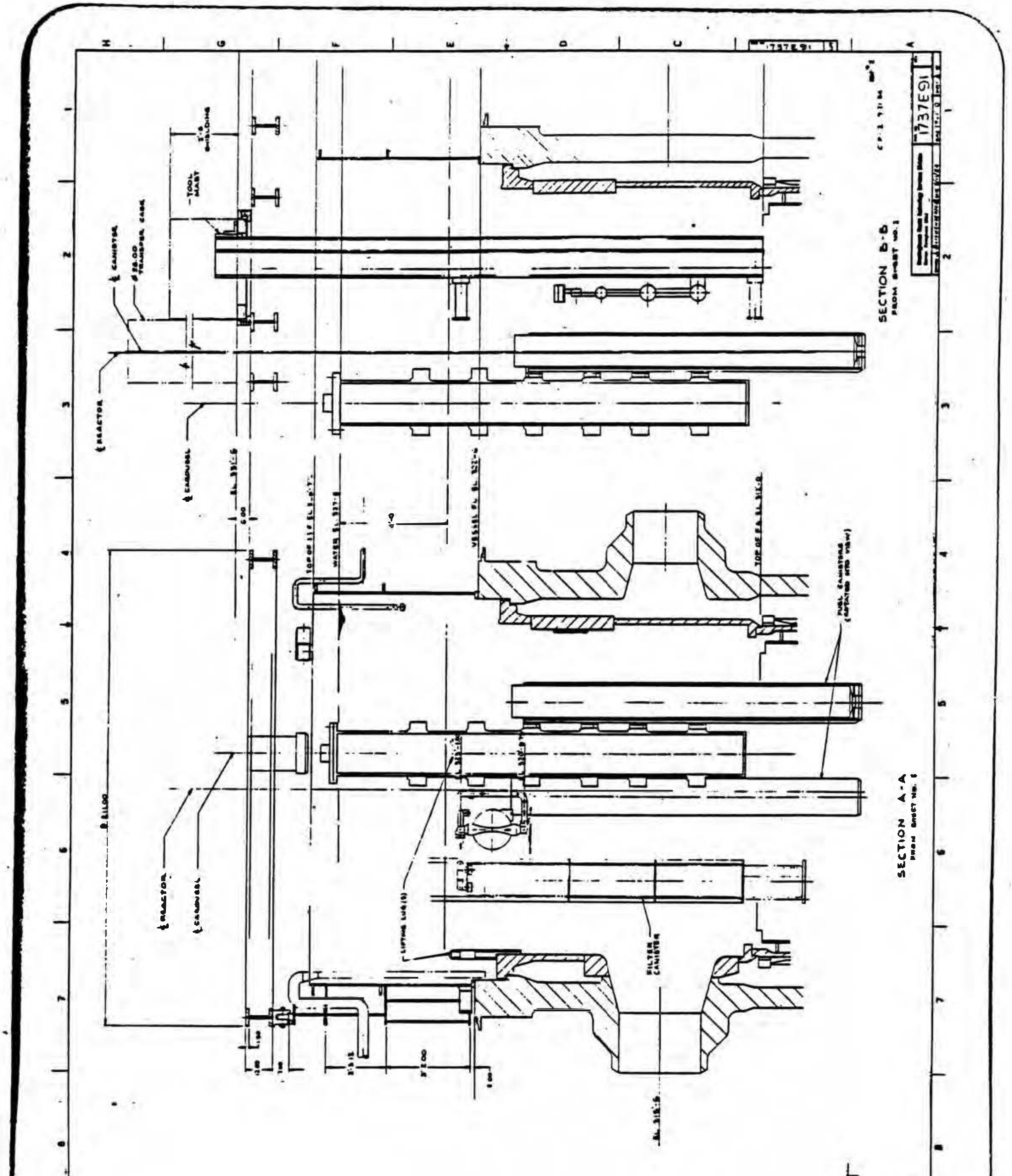
NOTES:
LOCATING CONTROL DIMENSION
ENVELOPE CONTROL DIMENSION
3. FOR EXISTING REACTOR INTERNAL DIMENSIONS REFER TO DWG 1737E16
℄ REACTOR
CORE BBL I.D.
CORE BBL FLANGE I.D.
MIN CORE CLEARANCE
CANISTER CAROUSEL MAX ENVELOPE
℄ REACTOR
PLAN @ ELEV 320'-6
SECTION B-B
FROM SHEET E
CP10 9-29-84 JLB
1737E60



SECTION A-A
SECTION B-B
FUEL CANISTERS
FILTER CANISTER
LIFTING LUG(S)
TOOL MAST
1737E91

MPR ASSOCIATES, INC.

October 5, 1984

William Hamilton, Sr.
P.O. Box 613
Ligonier, PA 15658

Subject: Radiation Levels in Working Slot for the Manual Defueling Concept

Reference: (a) GPUN Memorandum, 4300-84/B-0058 dated June 12, 1984 Defueling Options Task Force Report.

Dear Mr. Hamilton:

Our letter of September 5, 1984, raised concerns about the radiation levels in the working slot area of the rotating platform to be used for manual defueling at TMI-2. Specifically, we were concerned that due to the shallowness of the water covering fuel canisters in the carousel the radiation levels would be too high for manual defueling operations in the defueling concept shown at the August 21, 1984, review meeting.

GPUN arranged a meeting with the design personnel performing the shielding analysis at Bechtel to go over both our and their analysis on September 26, 1984. The review of their analysis, while indicating a lower radiation level in the working slot than our analysis for the August 20, 1984, design configuration, still indicated that the radiation levels in the working slot due to fuel canisters is too high for manual defueling. Specifically, the Bechtel analysis resulted in 211 mr/hr compared to our 1,555 mr/hr, both of which are unacceptably high for manual defueling. Bechtel initially tried one possible fix for the August 20, 1984 design configuration to lower this radiation level to the 3 mr/hr range; however, it created other interference problems. Accordingly, they are investigating other solutions to the problem. Specifically, they indicate that they were currently considering such things as the following to obtain a low radiation level in the working slot area.

(a) Lowering the carousel so that there will be an additional 3" of water over the canisters.

1050 CONNECTICUT AVENUE, N.W. WASHINGTON, D.C. 20036 202 659-2320

(b) Going from a six-canister carousel to a five-canister unit.

(c) Providing shielded collars around the top part of each canister position in the carousel.

(d) Providing shielding in top of each canister cap.

To resolve the differences between the absolute radiation levels Bechtel and ourselves had predicted for the working slot, a review was made of the assumptions used. These are tabulated in the attached table. Our assumptions are under the Bases 1 column and Bechtel's are given under the Bases 2 column. To determine whether the difference in absolute radiation levels was due to assumptions or analysis method, we used our analysis method and the assumption of the Bases 2 column as a check. This check indicated we would obtain the same approximate radiation level (approximately 200 mr/hr) as Bechtel when we used our analysis method and their assumptions as listed in the Bases 2 column of the attached table (see lines 6 and 7 for comparison of radiation levels). Accordingly, the difference in the absolute radiation levels appears to be due to the difference in the source term assumptions and assumed water depth, and not due to difference in analysis method.

The differences between the basic source term assumptions in the Bases 1 and Bases 2 cases are covered in lines 2 through 5 of the attached table. These include source strength, density of debris, volume and number of canisters. We believe that Bases 2 can be used as a design bases provided the acceptance criteria for this bases is approximately 2 mr/hr or less. This low radiation level will in essence allow "a margin" to cover other things or conditions that can cause the basic source values to be higher (e.g., density, source strength, all canisters in up position, etc.). It should be noted that the above margin <u>does not cover</u> or provide margin for cases of water level variations, handling errors involving raising a radioactive object too high, etc. Margin for such cases must be addressed separately.

In summary, (i) we would like to have the opportunity to review the results of the current effort to lower the radiation levels in the working slot due to fuel canisters as discussed above and, (ii) if the source terms of Bases 2 (see table) are used in the analysis associated with this effort to lower the dose levels, we recommend that an acceptance criteria for radiation on the work platform due to fuel canisters be approximately 2 mr/hr for the reason indicated above.

With regard to radiation levels in the working slot area due to <u>just the activity in the water</u>, the GPUN design report on the dry defueling concept (Reference (a) - section 3.3) indicates a realistic value for Cs_{137} activity in the water was 1 µci/ml. This Cs_{137} concentration would cause a high dose just from activity in the water alone. However, GPUN personnel indicate that the design bases concentration for the defueling water cleanup system (DWCS) should be .02 µci/ml of Cs_{137} which results in a dose of only about 2 mr/hr. Even if the concentration of Cs_{137} in the water should get as high as .1 µci/ml, the dose would only be about 10 mr/hr from this source. Accordingly, if the DWCS system works as claimed and keeps the water activity low, then water activity should not be a major dose source in the working slot area during manual defueling and the 6" thick stainless steel cover plate on the rotating platform can be significantly reduced in thickness.

If you have any questions concerning this letter, please do not hesitate to call.

Sincerely,

Noman M. Cole, Jr.

cc: H. Burton
E. Kintner
F. Standerfer
J. DeVine
P. Bradbury
TAAG Members

Parameter	Shielding Design Estimates	
	Bases 1	Bases 2
1. Water Depth	26"	33" (28" + 5")(C)
2. Source Term, μci of Cs_{137}/gm of debris (a) Average	8,060 (Based on Average Core Power, assumes all debris is UO_2)	5,620 (UO_2 mixed with other core materials, e.g., diluted by other debris)
(b) Nominal peak	13,700 (Based on normal peak power and a Peak to Avg. of 1.7 to 1 for first 90 days of core operation)	-- (No power peaking was considered)
3. Density of debris in g/cm^3	5.52 (Note: Could have much higher local debris density, e.g., ~8 to 9)	4.57
4. Assumed Container Cross Section	9.5" x 9.5" (This is slightly larger than the actual current dimension)	9.06 x 9.06
5. Number of Canisters	Six canisters in the raised/stored position (the 6th canister was assumed to be raised to cover the case of debris being loaded into a lowered canister)	5 - Canisters in the raised/stored position 1 - canister (the nearest to access port) in the lowered position for debris loading (Note: since lowered, this canister did not contribute to dose)
6. Calculated Radiation Level	1,555 mr/hr(A) (at 8,060 μci/gm)	211 mr/hr(B) (Point S_3, Table 1, Derm-0403, 9/26/84)
7. Check of calculation technique		~200 mr/hr(A) (Check of Bases 2 using the same analysis technique as for Bases 1, but source strength, density and other parameters from Bases 2)

Notes:

(A) Analysis using Rockwell shielding hand calculation.
(B) Analysis using computer shielding analysis.
(C) The 5" of water in the total water depth assumes the debris starts 5" down from the

September 5, 1984

William H. Hamilton, Sr.
P.O. Box 613
Ligonier, PA 15658

Subject: TMI-2 Defueling System Design Review of August 21-22, 1984

Dear Mr. Hamilton:

Per your request we have been monitoring for TAAG the development of the TMI-2 defueling concept. Mr. Bradbury of GPUN invited me to attend the design review on the TMI-2 Defueling System which was held August 21-22, 1984, in Gaithersburg. This design review covered mainly the individual components that are associated with the shielded work platform from which defueling operations will be performed. It also covered the vacuuming system and other miscellaneous tooling.

Our major comments regarding the defueling design concept as presented at the Design Review Meeting are summarized below. These comments deal more with the overall concept rather than with the detailed features of individual components.

1. The defueling concept as presently configured is not satisfactory for manual defueling. (See the Westinghouse sketches of the present concept - Figures 1, 2, & 3 in Attachment A). Specifically, only about two feet of water cover the six fuel canisters contained in a large carousel mounted off the work platform. These canisters are estimated to cause a radiation field of 1.5 to 2r/hr in the open working slot area. In addition, there are other sources which can further increase this radiation level in the working slot (e.g., vacuum system piping and pump, filter canisters, the contamination in the water itself). In this regard, lowering the radiation field in the working slot by simply lowering the carousel does not appear to be a reasonable solution since it appears to require

removal of most of the outer peripheral rings of fuel assemblies.

The sources of this problem appears to be (i) the requirement from Bechtel-Gaithersburg that there be six to eight canisters stored within the reactor vessel at any one time, and (ii) the shielding and radiation analysis is not being done concurrent with the mechanical design arrangement to ensure that TMI-2 has a manual defueling system. In this regard, we believe this problem can be solved and still use the 150"-long canisters, but it will involve a significantly different approach to canister/debris loading and transfer operations (see discussion in Attachment A).

2. Radiation levels in the proposed working slot arrangement are too high for manual defueling due to just the activity in the water in the reactor vessel. Even if the radiation problem discussed in Item 1 above were solved, this problem would still exist. The proposed working slot concept uses 6"-thick steel plugs for the covers and these plugs are removed and re-installed over the working slot by crane. It is our understanding that for manual defueling operations, it is planned that all the plugs associated with the working slot would be removed to create an open slot of about 18" wide by 9' long. If this long working slot is left open, the radiation level that the workers will be exposed to during manual tool operation will be over 100mr/hr just from the water activity of 1 µci/cc. This radiation level is considered too high for a practical manual defueling system. As a result, the large slot cannot be left open and a crane will be required to constantly remove and re-install plugs over the working slot when using manual defueling tools. Such plug movements also do not appear practical. Accordingly, we recommend that a segmented hinged door concept be considered so that only a small area of the working slot has to be open when the manual tools are being used (see Figure 4 in Attachment A). It appears that correcting this problem will require re-designing the current proposed rotating work platform.

3. The transfer cask and work platform features to accommodate canister transfers are being designed such that the shielded work platform area is an exclusion area during canister removal operations (e.g., the radiation levels are reported to be over 100mr/hr at 7 feet from the transfer cask). Basically, the shielding for the transfer cask is currently inadequate and no work plat-

form features are being provided to minimize radiation levels during loading of canisters into the cask. As a result, personnel operating stations for canister transfers are up at the 347' level which has a high background radiation level rather than down at the work platform. In this regard we recommend that the shielded work platform and transfer cask be provided with adequate shielding so that the work platform area is not an exclusion area during transfer operations. This will also allow all operations to still take place down in the low radiation fields on top of the work platform. Eliminating the requirement that the work platform be an exclusion area during canister transfer may also help simplify the rotating platform's cable handling system (see Item 4 below). Arrangements and features to avoid having the work platform be an exclusion area are discussed in Attachment A.

4. It appears that the present approach will lead to an involved and complex cable handling system for rotating the shielded work platform. With the present concept there are many TV cables, power cables, lights, water spray systems, position indication cables for the positioning mask and ROSA, load cells for the carousel, vacuum system instrumentation, etc., all of which are on the rotating shielded work platform. This array of cables indicates that the current approach will result in an involved and complex cable handling system. It is our experience that such cable handling systems can very easily become far more complex than anyone had originally anticipated. At the design review meeting, Westinghouse did take an action item to make a detailed list of every line (power, instrumentation, water, or air) that is associated with each individual component on the rotating platform. Once this list is completed, we would suggest that a major effort be made to reduce the number of lines and/or the amount and frequency of platform rotation so that an elaborate cable handling system is not required. For example, the use of a standard rotational position for the loading of canisters into the transfer cask may be a major reason for rotation through large angles. If this is the case, the use of a standardized position should be reconsidered. If this simplification effort is not successful, the cable handling system could have a major effect on delivery of the system and its availability to start defueling operations as presently scheduled.

5. We recommend that overall concept control drawings (coupled with the appropriate system descriptions) for each of the various phases of defueling be developed on a priority basis. Hopefully, these drawings would help avoid having problems with the development of the defueling concept such as: too high radiation levels for the working slot for manual defueling (e.g., Items 1 & 2 above), avoid having the design develop on the bases of using exclusion areas for major operations during the defueling (e.g., Item 3 above), etc. In this regard, it appears that there needs to be four such concept control drawings for the four phases of debris removal.

   - One showing manual removal of debris knocked off the plenum and transfer of canisters out of the reactor and into the deep end of the canal.
   - A second showing how the loose debris would be vacuumed out based on a manual vacuuming system and canister transfer operations.
   - A third showing manual methods for pick and place bulk defueling and canister transfer operations.
   - A fourth showing automated bulk defueling and transfer operations.

   These concept control drawings should show such things as: where all the manual tool handling cranes would be located and their lift heights, where the people will be located for all the various operations, general radiation levels, minimum water shielding, water heights available for loading canisters, tool lifting heights and other controlling features from a system point of view for each of the four phases of the defueling operation.

In summary, we believe that major changes must be made to the concept shown at the August 20-21, 1984, meeting before TMI-2 has a viable manual defueling concept. As presently shown, the defueling system is basically a remote/automated scheme. In revising the present concept to make it a practical manual defueling concept, it is recommended that general criteria in Attachment B be used to ensure we have a manual system. In revising the design, it would also be very helpful if the top end of the canister had a ledge or other provision (e.g., a removable clamp) by which the canister could be suspended from the various loading brackets from its top end. Presently canisters are suspended in a tube-type bracket that runs the full length of the canister. Thus, this type of loading bracket itself projects deep in the reactor vessel and thereby restricts rotation of the work platform even when these loading brackets contain no canisters.

With regard to the overall concept, an alternate approach shown by Mr. Austin of GPUN for handling the debris knocked off during plenum removal appeared to come closer to the approach considered in earlier studies and we recommend that it be pursued. Basically, the approach Mr. Austin presented was quite simple and it was clear that he understood the functional requirements that such a system had to meet. The method shown had a minimum of 4 feet of water for handling of 150" canisters and for loading debris into canisters, used a simple bracket-type canister holder rather than the carousel, and recognized the depth of water available to handle core debris based on the configuration of existing core void (e.g., took advantage of deep holes in the debris bed). We suggest this concept be pursued at the earliest date since this is the first phase of defueling operations in which the shielded platform will have to be used after the plenum is removed. When revising the overall concept, we would suggest you also review Figure 4 in Attachment A for a concept that meets the criteria in Attachment B.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Noman M. Cole, Jr.

cc: H. Burton, EG&G
E. E. Kintner, GPUN
F. Standerfer, GPUN
J. C. DeVine, Jr., GPUN
P. Bradbury
TAAG Members

Comments and Recommendations Relative to Defueling Design of August 21-22, 1984

Our comments and recommendations regarding the defueling design concept as presented at the Design Review Meeting are summarized below.

1. The defueling concept as presently configured is not satisfactory for manual defueling. (See the three attached Westinghouse sketches of the present concept - Figures 1, 2, & 3). Specifically, there are six fuel canisters in a large carousel with only about 2' of water covering the canisters. These are estimated to cause a radiation field of 1.5 to 2r/hr in the open working slot area. In addition, there are other sources which can further increase this radiation level in the working slot (e.g., vacuum system piping and pump, filter canisters, the contamination in the water itself). In this regard, lowering the radiation field in the working slot by simply lowering the carousel does not appear to be a reasonable solution since it appears to require removal of most of the outer peripheral rings of fuel assemblies.

   The sources of this problem appear to be (i) the requirements from Bechtel-Gaithersburg that there be six to eight canisters stored within the reactor vessel at any one time, and (ii) the shielding and radiation analysis is not being done concurrent with the mechanical design arrangement to ensure that we have a manual defueling system.

   Possible Solution to Problem and Recommendation

   A. Have the shielding and radiation analysis done concurrent with development of proposed mechanical design arrangements.

   B. It is our opinion that this problem can be solved and still use the 150"-long canisters, but it will involve a significantly different approach to canister/debris loading and transfer operations. For example, simple canister loading brackets can be provided adjacent to the working slot to position canister to take advantage of the existing deep depressions in the core. This will allow the canisters to be lowered considerably deeper than previously and still allow adequate shielding water depth for loading debris up to 4 feet long into the canister. Further, if the working slot is extended over the entire diameter of the reactor vessel and a cask transfer boot is located at one end where there is another deep hole in the core debris, adequate depth for transferring canisters is provided while still meeting the general criteria discussed in Attachment B. See Figure 4 for water depths and equipment arrangements for such a design approach. The arrangement of this concept also permits direct vertical access to all regions of the core (e.g., the present concept arrangement has about a 20-24" diameter area in the center of the core where there is not adequate vertical access). In this regard, this suggested approach will require relaxation of the requirement that six to eight canisters be stored in the reactor vessel at one time.

2. The transfer cask and the work platform features accommodating canister transfers are being designed such that the shielded work platform area is an exclusion area during canister removal operations (e.g., the radiation levels are reported to be over 100mr/hr at 7 feet from the transfer cask). The shielding for the transfer cask is currently inadequate and no work platform features are being provided to minimize radiation levels during loading of a canister into the cask. As a result, personnel operating stations for canister transfers are up at the 347' level which has a high normal background radiation level rather than down at the work platform elevation (331').

Possible Solution to Problem and Recommendation

A. We recommend that the shielded work platform and transfer cask be provided with adequate shielding so that the work platform area is not an exclusion area during transfer operations. This will also allow all operations to still take place in the low radiation fields on top of the work platform. Eliminating the requirement that the work platform be an exclusion area during canister transfer may also help simplify the rotating platform's cable handling system.

B. To develop such an arrangement which meets the above objectives and the general criteria in Attachment B, it will involve such things as the following:

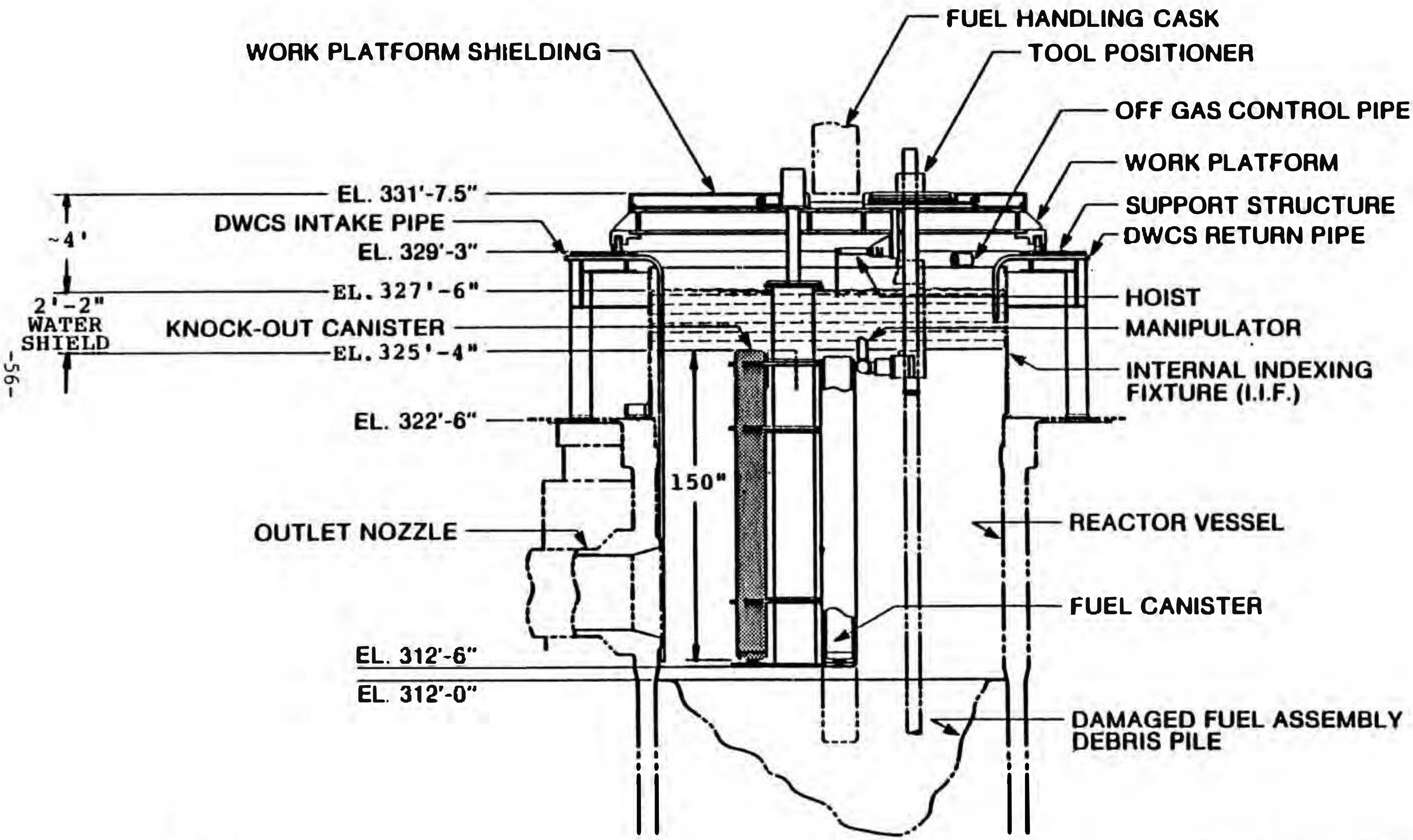
(1) Provide a shielded transfer boot that projects from the work platform down several feet into the water to the canister transfer position (see Figure 4).

(2) Provide a transfer cask which has about 6" of lead side shielding and a shielded door at its lower end. Such a cask will weigh about 20 tons and should have radiation levels of less than 2-1/2mr at 1 meter which has been the normal practice for such a cask in previous designs. Since the cask will come close to the wall at "up-ender" position, it may require either (a) locally thinning the shield to about 4 inches in a 2-foot-long local area, or (b) providing the thin area of the cask with depleted uranium if that is necessary (see Figure 5). In any case, it should be a relatively small area of the cask that may require special attention to obtain low radiation levels in that area.

(3) Another alternate approach to resolving the cask interference at the "up-ender" position is to ask Westinghouse if the thickness of the work platform (i.e., presently 3'-1.5") can be reduced to 1.5' to 1' since the shielding on this platform only has to accommodate the activity in the water. This would lower the cask 1' to 1.5' and thus should help avoid or minimize the cask interference problem at "up-ender" positions.

3. To avoid potential schedule delays that may be associated with modifying the existing fuel handling bridge so it can handle the transfer cask, the transfer cask should be designed so it can be handled by either the modified fuel handling bridge <u>or</u> the polar crane.

DEFUELING SYSTEMS ELEVATIONS

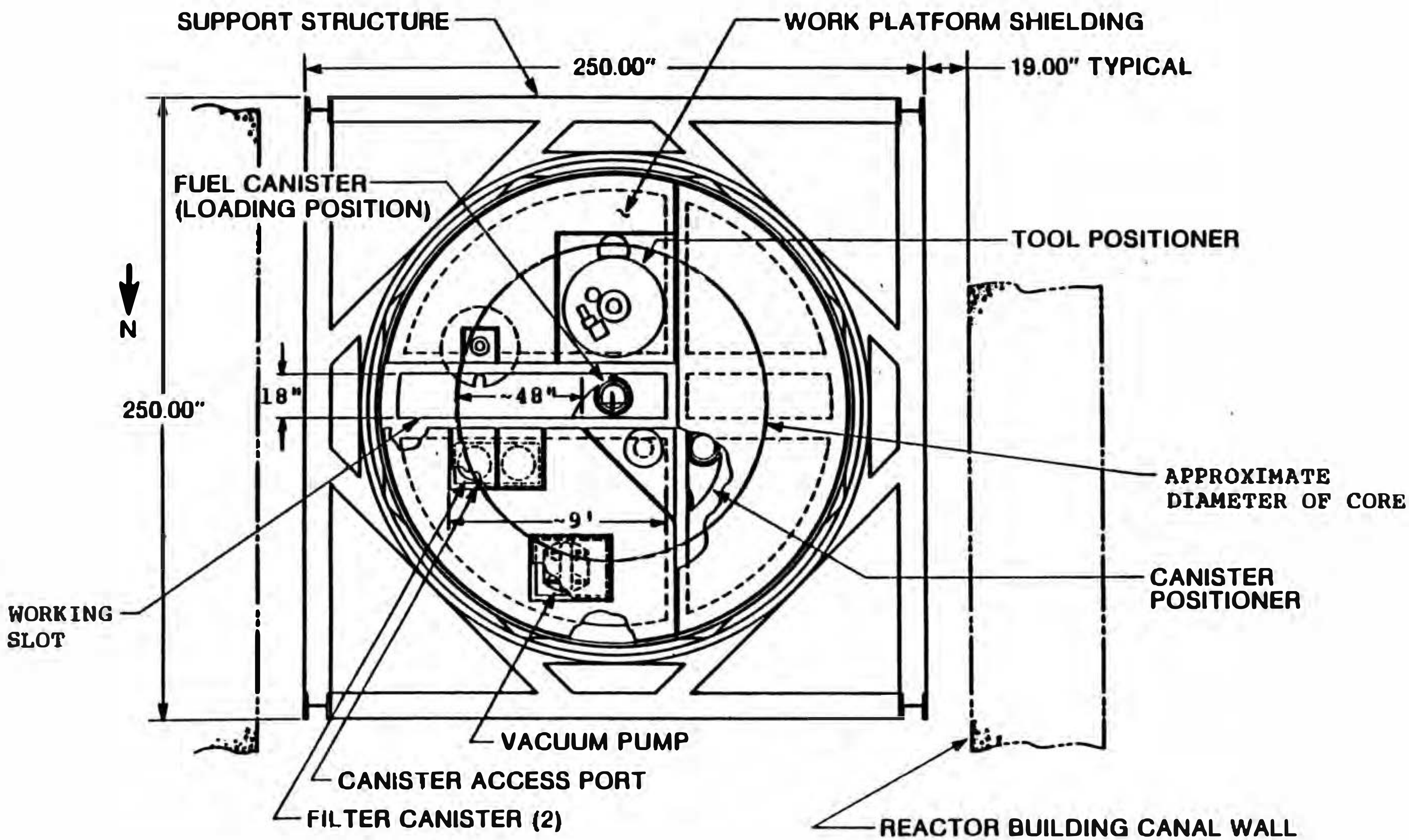


WTSD

FIGURE 1

FIGURES MODIFIED BY MPR ASSOCIATES

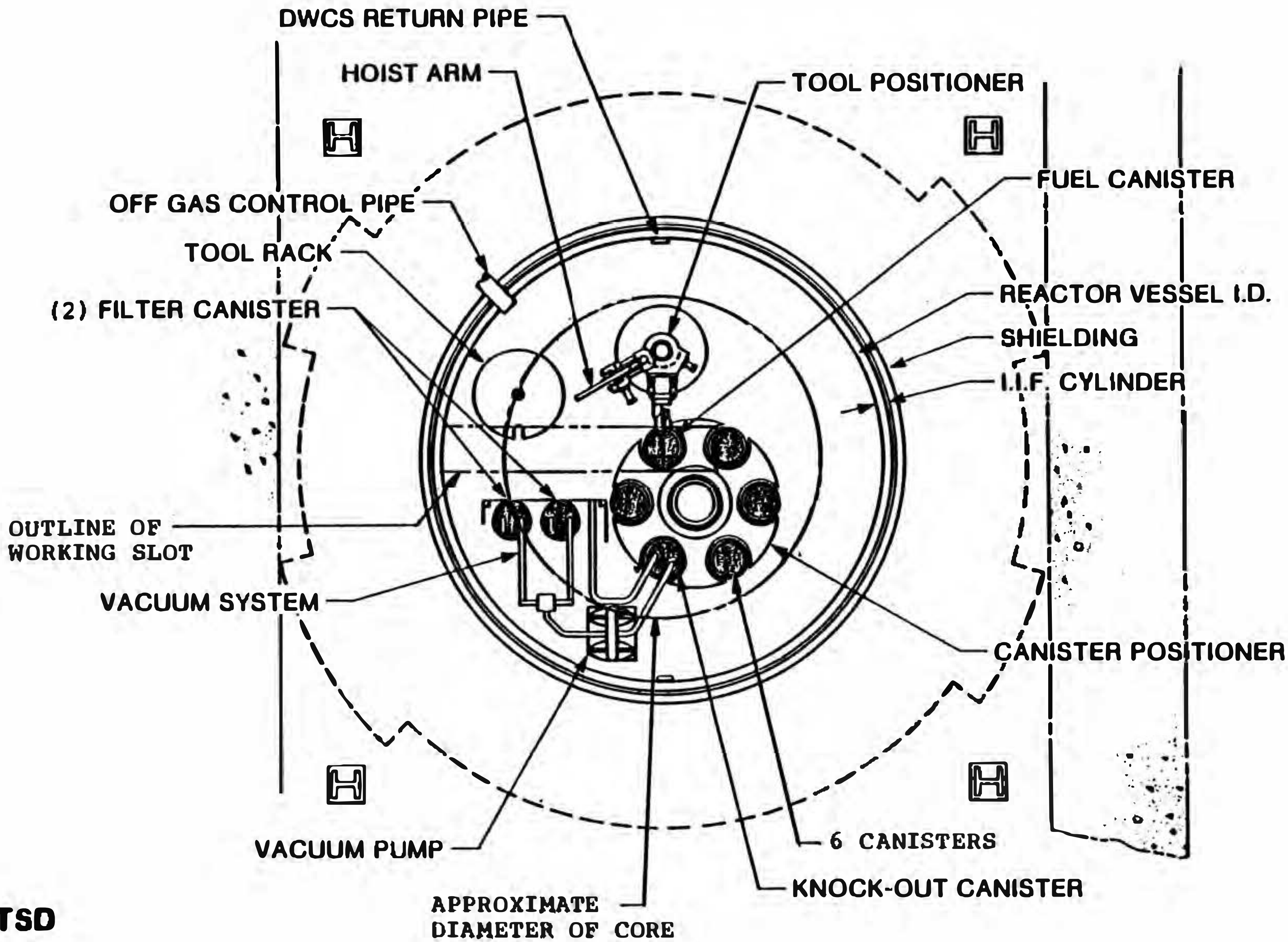
DEFUELING SYSTEM PLAN VIEW



WTSD

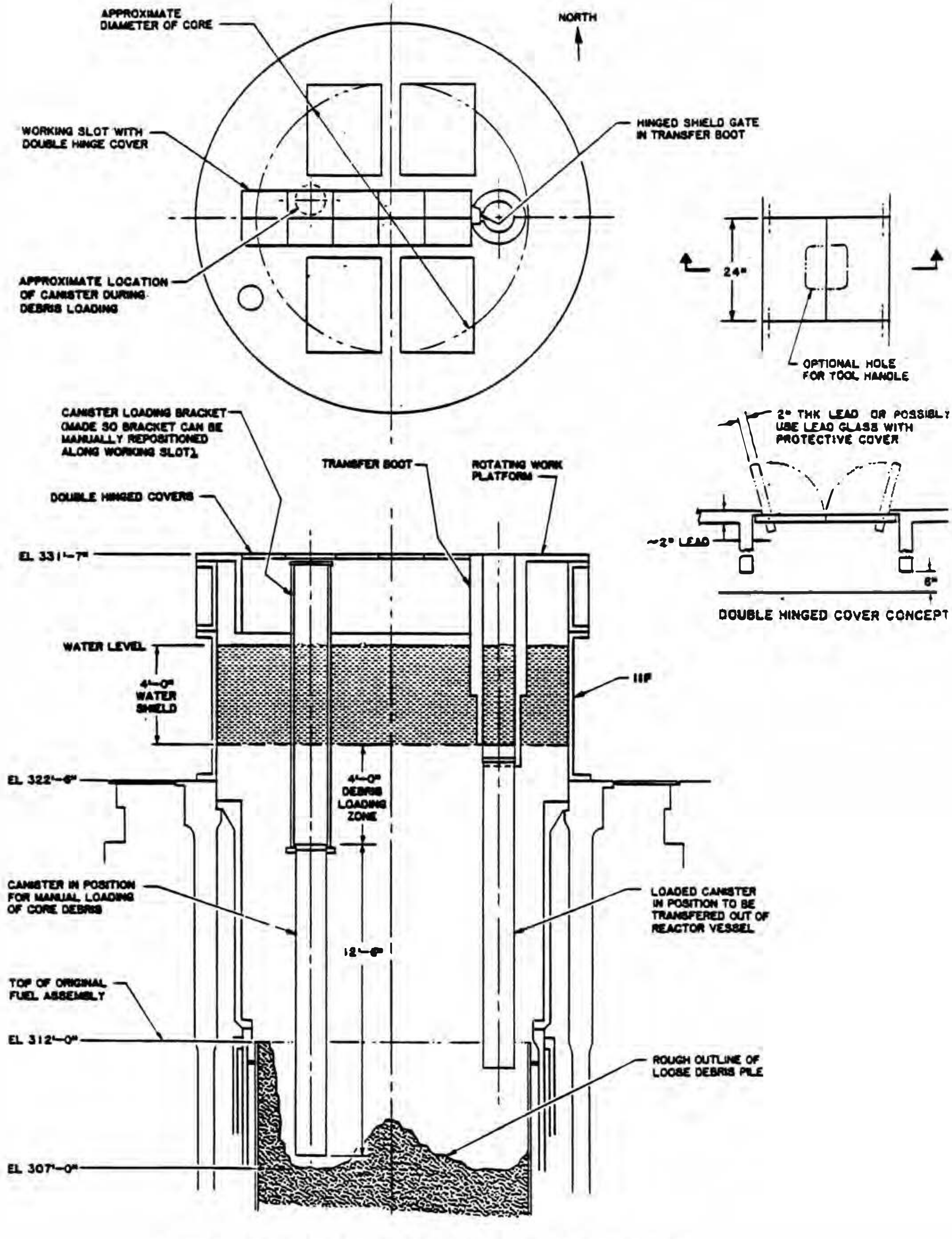
FIGURE 2

DEFUELING SYSTEM ARRANGEMENT



WTSD

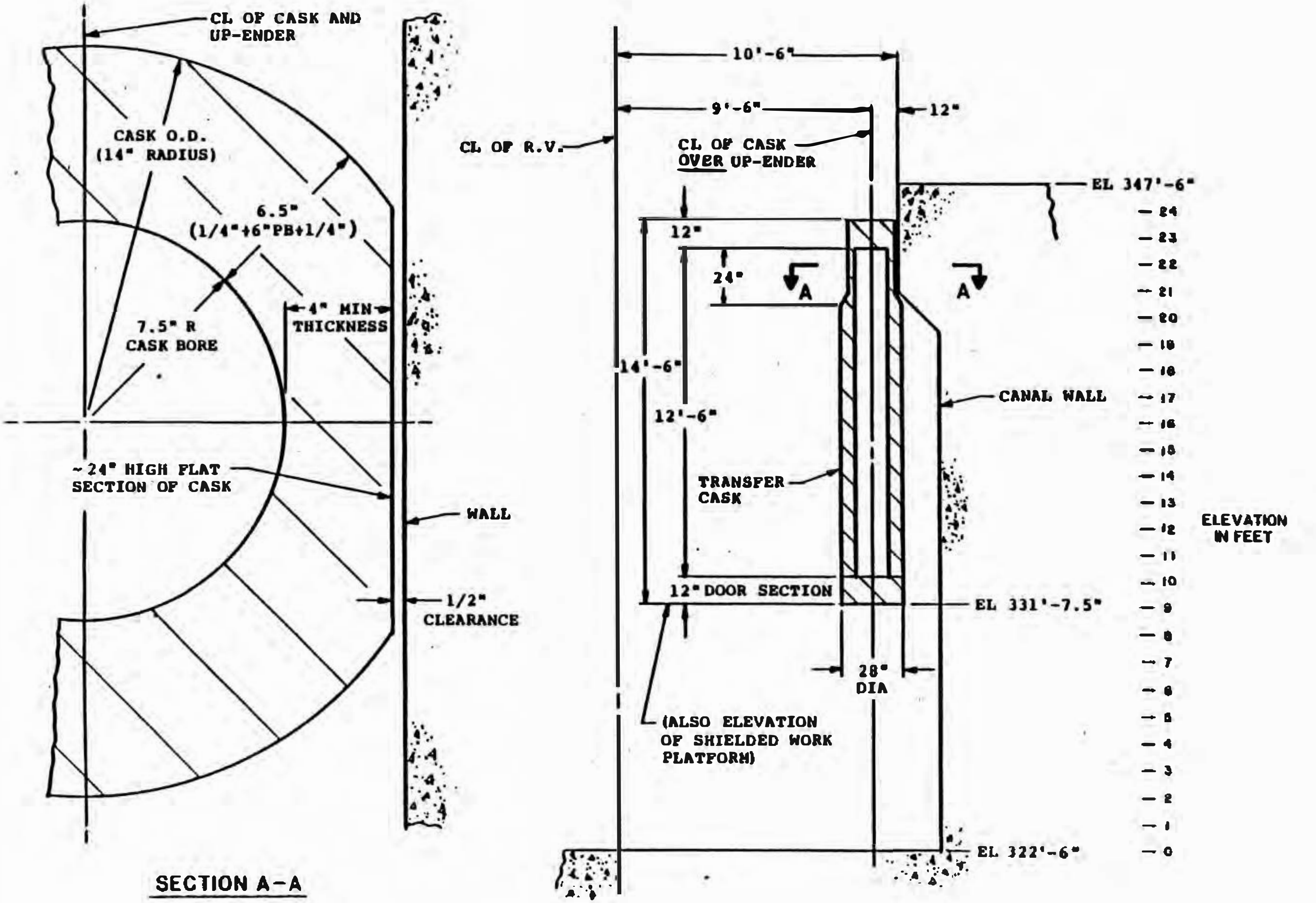
FIGURE 3



WORKING SLOT & COVER CONCEPT FOR ROTATING WORK PLATFORM AT ELEVATION USED BY (W)

MPR ASSOCIATES
F-74-01-29
8-31-84

FIGURE 4



TRANSFER CASK IN UP-ENDER POSITION

MPR ASSOCIATES
F-74-01-30
9/4/84

General Criteria to Help Ensure That TMI-2 Has A Practical Manual Defueling System

1. The radiation levels in the working slot shall be such that manual defueling operations can take place without excess exposure. As such, the following specific requirements shall be met:

   A. The shielding deck thickness of the rotating work platform shall be sized for protecting against only the activity in the water (e.g., 1 μci/cc).

   B. The minimum depth of water above fuel debris canisters and other highly contaminated components shall be established to provide the necessary shielding. (The shielding in the rotating platform shall not be used in setting this minimum water depth to handle radioactive components; otherwise radiation levels in the open working slot will be too high for manual defueling.)

   C. The shield doors over the working slot shall be configured so that only a minimum opening is needed for use of manual tools. Keeping the opening small will minimize exposure to the tool operator as a result of just the water activity (i.e., 1 μci/cc). For example, a large opening in the working slot can result in high radiation levels to the operator as a result of just the activity in the water.

2. The shield design and features of the work platform and its transfer boots and the transfer cask shall be such that the rotating work platform area <u>is not an exclusion area</u> during canister transfer operations.

3. The design of the rotating work platform and its transfer boots, the transfer cask, and the working slot covers shall be such that manual operation of defueling tools through the working slot can proceed at the same time canisters are being removed from the reactor vessel. This is to allow operations personnel to have the option of performing canister transfer operations in either parallel or in series with manual defueling operations.

MPR ASSOCIATES, INC.

July 23, 1984

William Hamilton, Sr.
P.O. Box 613
Ligonier, PA 15658

Subject: Comments on Development of the TMI-2 Defueling Concept

Dear Mr. Hamilton:

Per your request that we monitor for TAAG the detailed development of the TMI-2 defueling concept, we have reviewed some of the conceptual layouts being used to refine the defueling system. The concept being developed retains the water in the reactor vessel and uses a shielded work platform mounted off the reactor vessel flange. Our comments on the conceptual layouts are attached.

If you have any questions, please do not hesitate to call.

Sincerely,

Noman M. Cole, Jr.

Enclosure

cc: H. Burton, EG&G
J. DeVine, GPUN
P. Bradbury, Bechtel-TMI
B. Kanga, Bechtel-TMI
E. Kintner, GPUN

1050 CONNECTICUT AVENUE, N.W. WASHINGTON, D.C. 20036 202-659-2320

July 23, 1983

Comments on Conceptual Layouts of the TMI-2 Defueling Method Being Developed by Westinghouse

BACKGROUN :

The defueling concept sketches reviewed are entitled:

1. Early and Bulk Defueling System - J. Mino dated 6/15/84

2. Bulk Defueling System - Marchetti dated 6/15/84

This is a general overview of these conceptual layouts. While it is fully recognized that the concept is evolving and these sketches are conceptual in nature, our observations and comments at this stage may be of help in developing the final version of the TMI-2 defueling concept.

I. General Observations

A. Originally there were to be two different work platforms for use over the reactor vessel:

- One simple static-type work platform was to be particularly directed towards the use of manual long handled defueling tools.

- A second rotating work platform was to be particularly directed toward the use of automated/remote tools; however, it was not to preclude the use of manual tools.

These general directions were set forth in Kintner's memorandum to Kanga dated June 11, 1984 (see items 5 & 6). However, since that time, the effort on the simple static work platform has dropped. The continuing effort design appears to be focused on a rotating work platform that is tailored for automated/remote tooling.

While we understand the original directive, we believe that things have changed in view of dropping the original static platform and we suggest a more balanced approach be taken in the design of the remaining single work platform. Specifically, the platform design should proceed in a manner so that TMI-2 can be effectively manually defueled with long handled tools without being dependent on the automated/remote tooling. In this regard, the concepts shown on the above Westinghouse drawings should be modified to be more useful in the event that a manual long handled tool defueling concept is used. We believe that we can still have a single work platform concept that strikes more of a balance to permit the effective use of the long handled tools while still being able to use the automated/remote tools, but not be totally dependent on them.

B. To provide a means of assuring that the rotating work platform concept finally selected can be effectively used with long handled defueling tools, we would suggest that Westinghouse be requested to develop three layout sketches. Specifically:

1. This first sketch would show how the work platform would be configured for vacuuming loose core debris with long handled tools and no automated/remote tools.

2. A second sketch would show how the proposed work platform would be used to defuel with just long handled defueling tools (i.e., no ROSA or any the other automated tools).

3. The third sketch would show how that same work platform concept could be used with the more automated/remote tools. The third sketch should also show how long handled tools can be used to solve problems that might develop with the automated tools and how the long handled tools still could be used for limited defueling operations in conjunction with automated tools.

II. General Comments

A. The arrangement layout of the carousel, the working slot and the rotatable mast on the work platform (as shown on the sketch identified MINO-6/15/84) results in the following:

1. Makes the structural design and contruction of the work platform more complex than necessary.

2. Makes for unnecessary crowded conditions when loading canisters into the transfer cask. For example, the carousel drive mechanisms, the transfer casks and the rotatable mast are all crowded into the center portion of the work platform. Positioning of the transfer cask in between the carousel drive mechanism and the rotatable mast will be tight and in an area where it will be easy to make mistakes that can damage defueling equipment.

3. Provides a limited size (i.e., small) working slot from which long handled defueling tools can be operated. (Note: This appears to be due to the fact that Westinghouse originally was to develop a work platform tailored around automated/remote equipment and, therefore, this design is not well-suited for long handled tool defueling - see Section I.A above on this issue.)

In view of the above, it is suggested that the work platform arrangement be modified along the following general guidelines:

1. Move the carousel off to one side so that the main structural beams on either side of the working slot can be extended the entire

diameter of the working platform. This will make for a much better and simpler structural design.

2. Make the working slot extend the full diameter of the working platform. (This makes the platform more effectively work for long handled defueling tools.)

3. Locate the transfer cask's transfer point toward the outer end of the working slot, (i.e., toward the ID of the reactor vessel and away from the center as presently positioned).

4. Position the rotatable mast as far from the carousel and the cask transfer position as reasonably practical, but still on the opposite side of the working slot from the carousel.

The separation afforded by the above arrangement should help avoid the crowding around the center area of the work platform and help avoid positioning problems when using the transfer cask. Also, it provides a better arrangement for use of long handled defueling tools. The longer working slot should allow more flexibility for operating the tools and better access to the core area while not encumbering the use of the automated/remote tools.

B. With the conceptual arrangement shown in the above Westinghouse sketches, the working lengths of tooling to reach the top of the lower grid plate are as follows:

- Working water depth: 29'6".
- The distance between the top of the working platform where workers will have to stand and the top of the lower grid plate is 34'.

This arrangement should not present problems with using long handled defueling tools effectively during the early phases of the defueling operations since the depth of the debris will be 5' to 8' less than the depths given above. However, as defueling gets to the lower grid plate region, the depths become as listed above. Working with long handled tools at these depths becomes very marginal and the operation will have to be mostly dependent on automated/remote tools. Further, damage in the region of the lower grid plate and below may be such that long handled tools may be the most effective way to deal with such a situation. Accordingly, it is recommended that the work platform and associated tooling be such that the IIF and support structures can be removed and the work platform can be lowered down directly onto the reactor vessel flange. This would allow the above listed working depths to be reduced by up to 7' (i.e., to the 22'6" and 27' lengths, respectively). This will help ensure that the defueling concept is not totally dependent on automated/remote tooling for the latter stages of debris and fuel removal. Specifically, this feature will help ensure that long handled tools can be used effectively in the final stages of defueling where we may run into some of the more difficult type operations. (A sketch should be prepared showing how the final work platform concept and its support services can be lowered down on the RV flange. This will help assure that the system really has the capability to be lowered.)

C. It is not clear from these layouts if the carousel is removable in the event that jamming should occur. It is suggested that Westinghouse be requested to show how the carousel, as well as any other "installed" type tooling, would be removed. In this regard, it may be that a smaller carousel might be more appropriate (e.g., be more easily removable, not impact the size of the working slot, etc.).

D. To evaluate defueling concepts and the tooling that is to be used, water depths for shielding should be set so tool-lifting heights can be judged and defined. Specifically, you want to ensure that during loading of canisters with various tools highly radioactive elements are not raised too close to the surface of the water. Basically, workers should be able to open doors in the working slot in the event that automated tool or canister loading operations encounter problems without also having to deal with a significant radiation problem. In essence, the design should not be dependent on shielding in the work platform to handle such situations because the shield door may very well have to be opened to obtain access to solve a problem.

E. Telescoping Tools - We note that there are some telescoping tools that use cables to hoist the retractable masts. It's been our experience that cables coming in and out of water can become a source of airborne activity under some conditions. With the TMI coolant being what it is, bringing cables in and out of water, as well as telescoping tools, may create airborne problems. Therefore, if these types of tools are to be used, they should be enclosed so that they do not create airborne problems.

F. Without a shielded boot extended down from the transfer cask loading position, long handled tool operations through the working slot will have to stop when loaded canisters are being removed. Also, lack of the shielded boot may cause radiation streams at the edge of the work platform when loaded canisters are being raised into the transfer cask. Accordingly, it may be prudent to have the ability to easily add such a transfer boot if radiation streaming or stopping of defueling operation during transfer operations does in fact become a problem.

Section 4.0

CAMERA INSPECTION OF THE LOWER VESSEL

MPR ASSOCIATES, INC.

December 14, 1984

William Hamilton, Sr.
P.O. Box 613
Ligonier, PA 15658

Subject: Inspection Into the Lower Plenum Area of the Reactor Vessel Prior to Final Removal of the Upper Plenum Assembly

Dear Mr. Hamilton:

At the last TAAG meeting Frank Ross of DOE asked if the inspection of the lower head of the reactor vessel could be made with the upper plenum assembly jacked up approximately 7" above its normal operating position (i.e., its present jacked up condition).

Per your request, we have examined the possibility of a TV camera insertion in two different general locations around the reactor vessel to make the lower plenum inspection. We first examined whether we could insert a camera down in the two holes of the core support assembly (CSA) that are on either side of both the Y and the W axes. We find that the TV camera can be inserted down one of the holes without much problem and a light down the other (see MPR Sketch SK-1074-01-533 which is attached). However, at either the Y or the W axis, it would require removal of one of the four upper plenum jacks. While I do not believe removal of one of the four jacks is either time consuming or a big physical problem, it would require some additional site paper work.

A second option examined was the possibility of inserting a camera down some holes that were installed in the CSA flange during final field assembly at TMI-2. These holes are located approximately 27° north of the Z axis and 27° south of the X axis as you view the top of the reactor. Our evaluation of using these later two holes shows that the TV camera can also be inserted into lower reactor head region through them. (See MPR Sketch SK-1074-01-534 which is attached.) Two adjacent vent valve holes can be used to insert additional lighting. With regard to the

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insertion of the camera into these two holes, use of these holes will not require the removal of any of the jacks and therefore it should be a relatively simple matter of trying to lower the camera into this area of interest.

We have also made a rough full-size mock-up of the holes at each of these two locations and it further confirms that the TV cameras can be inserted. In overall conclusion, we see no technical reason why the inspection of the lower reactor head region cannot proceed prior to the final removal of the upper plenum assembly, presently scheduled for April or May 1985.

Sincerely,

Noman M. Cole, Jr.

cc: H. Burton
E. Kintner
F. Standerfer
J. Devine
TAAG Members

Section 5.0

CORE BORING

MPR ASSOCIATES, INC.

October 2, 1984

William Hamilton, Sr.
P.O. Box 613
Ligonier, PA 15658

Subject: Development of Core Boring Equipment for TMI-2

Dear Mr. Hamilton:

EG&G asked that I review, as part of TAAG, some of the development and testing work in progress on the core boring equipment which is to be used for obtaining core debris samples from TMI-2.

During the week of September 11, 1984, I visited the facilities in Idaho where EG&G was conducting core boring tests using a commercial drilling unit that is used in the mining and oil/gas well drilling industry. The drilling unit under test also has the ability to obtain a boring sample without requiring removal of the drill bit shaft. Basically, this unit allows the boring sample to be removed up through the center of the drill bit shaft, thus maintaining the configuration of the drilled hole.

With regard to this test, EG&G personnel have been concerned that as the drill bit cuts through the last portion of a TMI-2 lower end-fitting, the inside diameter of the drill bit will not cleanly cut the outside diameter of the plug being machined from the end-fitting. This plug that is cut out of the end-fitting is the bottom end of the core boring sample. With the current drill bits, a feather edge can be left on the outside diameter of the plug and this edge can extend out beyond the inside diameter of the drill bit. Thus, when attempts are made to draw the core sample up through the drill bit shaft, this feather edge on the plug acts as a wedge and prevents the core sample from being drawn up through the drill bit shaft. EG&G and the drilling company were in the process of testing a new configuration of drill bit which they hoped would solve the problem of the feather edge on the last portion of the plug cut out of an end-fitting. This was the test in progress at the time of my visit.

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The test involved drilling down through a bed of relative uniform loose debris, a 2 to 3 inch thick slab of concrete-type material and a simulated stubble of a fuel assembly which was comprised of fuel material simulated by glass rods, Inconel spacer grids (from the Loft Project) and a 304 stainless steel end-fitting (from the Loft Project). The drill operation test went quite well until the last phase of the operation, i.e., the sample core removal operation. Specifically, when an effort was made to withdraw the core bore sample, the feather edge on the bottom cut-out plug still caused the core sample to jam in the drill bit shaft and, thus, it could not be removed. Accordingly, it appears that additional effort will be needed to develop a drill bit configuration that does not leave an excessive feather edge on the last portion of the plug cut from the lower end-fitting.

My general observations and recommendations about the development and testing of the core boring equipment testing are as follows:

1. It should be understood that this core boring process is being developed on the bases of using a gap that normally exists between the underside of the lower end-fitting and the lower grid plate to provide a horizontal part-line to allow removal of the core sample. This gap is basically the inlet flow plenum area for the fuel assembly. Specifically, the boring machine does not have a device to cut horizontally to free the core sample from the body of the debris. For this reason, it is not planned to use this core boring device in core positions where the fuel assemblies have in-core instruments (e.g., it would be necessary to provide a horizontal cutter to part the in-core instrument to free the core sample for removal). As such, the boring device is dependent on the end-fitting being located where it is normally supposed to be, or if it is not, sufficiently brittle material to allow breaking the core sample free from the debris bed without having a horizontal part-line provided by an end-fitting.

2. There is considerable vibration imparted to the debris bed by the drilling operation. Accordingly, the drilling operation may act as a vibrator and cause loose/fine debris or brittle pieces to fall through to the bottom of the reactor vessel. If the lower plenum region already has debris, this may not make a significant difference. Consideration should be given to

having a TV camera in the lower plenum region (i.e., the bottom of the reactor vessel) to monitor conditions in this region during the drilling operation.

3. Even if a drill bit design is developed which has a high probability of success of eliminating the feather edge on the plug as it cuts through the lower end-fitting, it is recommended that the tooling and procedures be developed and tested to allow a drill bit shaft with a stuck core sample to be removed as a unit. This will be an involved operation and will require installation of a well casing in the event that such a problem develops. The drilling operations could easily run into such a problem at TMI-2 in spite of the effort to avoid it due to actual conditions in the core. Accordingly, the tool and procedures to remove a stuck core sample and drill bit shaft should be available at TMI-2 when the core boring operation is attempted.

4. Currently, the mock-ups being used to test the drilling equipment have a relatively uniform loose debris for the region covering the stubble of a fuel assembly. In the actual TMI-2 core, the loose debris region can contain upper-end fittings, BPRA spiders, BPRA retaining devices, etc. These objects all contain parts that have thick stainless steel sections and could be laying at odd angles. If such parts are loose within the debris bed, the drill bit could go part way through such an object and then jam in the object. At this point, both the object and the drill bit could spin together in the loose debris, thus stopping any further drilling action. Such objects could also deflect the drill shaft so that it is thrown off from its required drilling path and thus miss the end-fitting center (e.g., miss the area where the horizontal gap is located). Accordingly, to avoid or minimize such a problem, it may be prudent to delay core boring until after the vacuuming of the loose core debris from TMI-2 has occurred. Then such objects can be seen and can be removed from the drilling path by long handled manual tools. Also, it would be prudent to develop tooling to remove objects (e.g., BPRA retainer) that may become stuck to the end of the drill bit.

5. In regard to the issues of taking samples of the core debris, it is recommended that EG&G personnel also develop manual sampling tools and techniques so that as defueling occurs, debris samples of special interest can be taken at various elevation in core debris. Such debris can be retained in numbered sample containers and these can then be installed in a fuel canister for eventual shipment to Idaho.

The above items were orally discussed with the EG&G personnel working on this task and they seem to have a full appreciation of the issues and indicated they are working to resolve the above problem areas.

If you have any questions, don't hestiate to call.

Sincerely,

Noman M. Cole, Jr.

cc: H. Burton, EG&G
M. Peters, EG&G
E. Kintner, GPUN
F. Standerfer, GPUN
J. DeVine, GPUN
TAAG Members

12-6-84 [handwritten initials]

CORE BORING PROJECT STATUS

0	FINAL DESIGN OF INDEXING SYSTEM APPROVED	OCT 84
0	DESIGN OF INTERFACE PLATFORM SUBMITTED TO GPU/BECHTEL FOR FABRICATION	NOV 84
0	FINAL DESIGN REVIEW OF CORE BORING HARDWARE	JAN 85
0	UPPER PLENUM INDEXING MEASUREMENT ACTIVITY	JAN-FEB 85
0	DEMONSTRATION TEST OF SYSTEM IN IDAHO	MAR 85
0	DELIVERY OF CORE BORING HARDWARE	JUNE 85
0	TRAINING ON MOCKUP AT TMI	SEPT 85
0	ACQUIRE SAMPLES AFTER VACUUM DEFUELING	OCT-NOV 85
0	SHIP SAMPLES TO INEL	MAR 86

TAAG COMMENTS ON CONCEPTUAL DESIGN

1. DESIGN ASSUMES END FITTING LOCATION HAS NOT CHANGED.

   0 ONCE LIQUIFIED MATERIAL SHOULD BE SUFFICIENTLY BRITTLE, IF PRESENT
   0 DRILL UNIT INSTRUMENTATION WILL PROVIDE FEEDBACK ON POSITION AND MATERIAL HARDNESS

2. VIBRATION CAUSED BY DRILLING OPERATION MAY RELOCATE LOOSE DEBRIS

   0 VIBRATION MINIMIZED BY SUPPORTING STRUCTURES BELOW WORK PLATFORM
   0 OTHER DEFUELING CAMERAS MAY BE AVAILABLE FOR ADDITIONAL VIDEO MONITORING

3. LOWER END FITTING PLUG MAY PREVENT REMOVAL OF CORE SAMPLE AFTER DRILLING

   0 PROBLEM PRECLUDED BY CASING THE DRILL PIPE AND REMOVING COMPLETE DRILL PIPE ASSEMBLY TO RETRIEVE SAMPLE

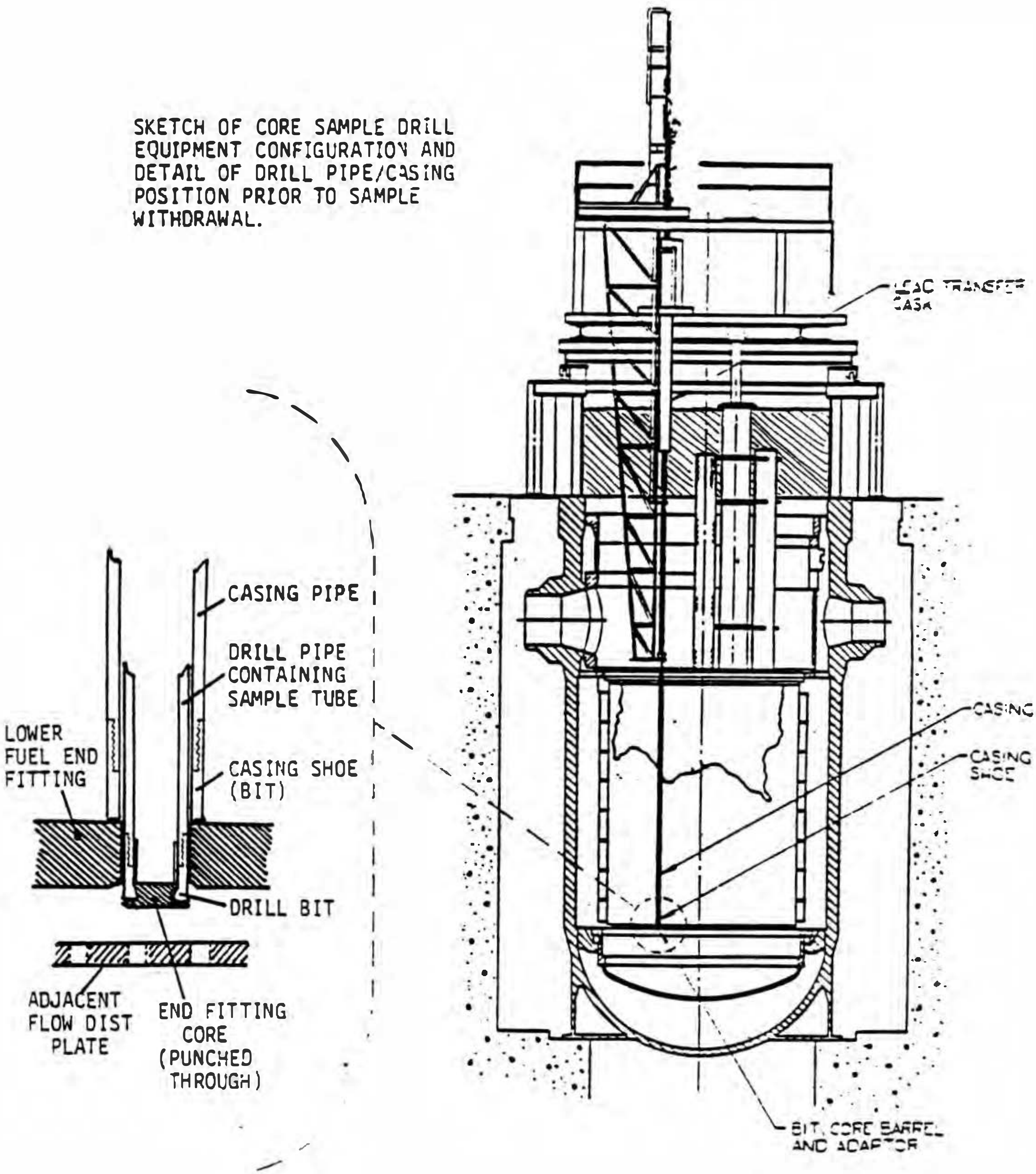
TAAG COMMENTS ON CONCEPTUAL DESIGN (CONTD)

4. THERE ARE POTENTIAL PROBLEMS WITH DRILLING INTO UNSEEN OBJECTS WITHIN THE LOOSE DEBRIS

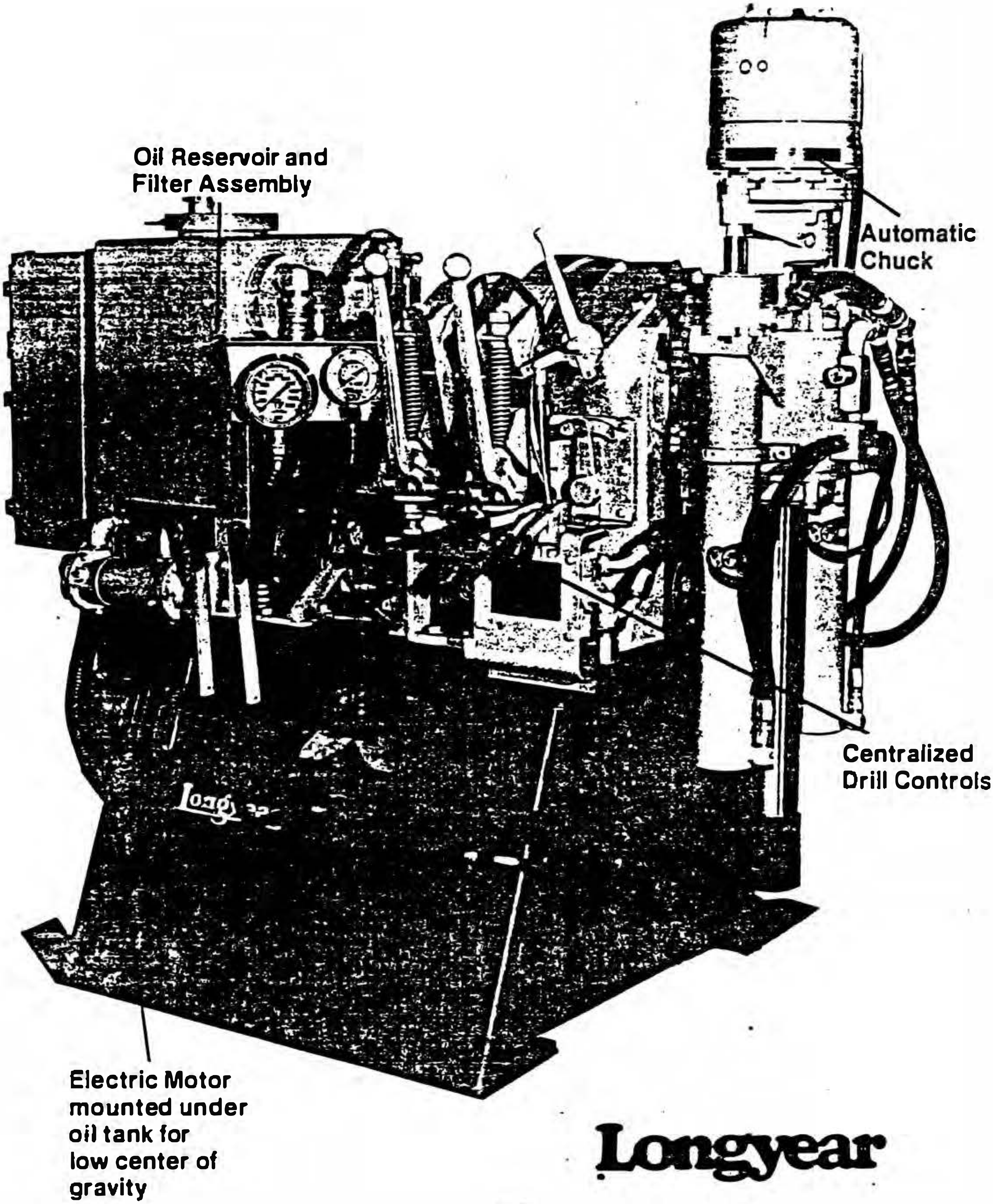
   0 CORE BORING WILL TAKE PLACE AFTER VACUUM DEFUELING
   0 LONG HANDLED TOOLS CAN MOVE ASIDE ANY OBJECT BEFORE DRILLING

5. PLANS SHOULD BE AVAILABLE TO OBTAIN LOOSE SAMPLES THROUGHOUT DEFUELING

   0 A SEPARATE TASK SAMPLE PACKAGE HAS BEEN SUBMITTED TO "PICK-AND-PLACE"
   0 CANDIDATE SAMPLES CAN BE IDENTIFIED BY VIDEO SURVEY AFTER PLENUM REMOVAL



SKETCH OF CORE SAMPLE DRILL EQUIPMENT CONFIGURATION AND DETAIL OF DRILL PIPE/CASING POSITION PRIOR TO SAMPLE WITHDRAWAL.


Oil Reservoir and
Filter Assembly
Automatic
Chuck
Centralized
Drill Controls
Electric Motor
mounted under
oil tank for
low center of
gravity
Longyear

Section 6.0

CORE SUPPORT ASSEMBLY

TAAG was asked to review the B&W study for the removal and storage of the core support assembly (CSA). Since that assignment was made, the focus of the study has shifted to in situ defueling and storage of the CSA; the premise being that the best place to clean and to store the CSA is in the reactor vessel. TAAG supports this conclusion, although for different reasons than those given by the B&W study.

The B&W study is based upon the assumption that the majority of the fuel debris in the CSA and in the lower head is vacuumable. If this assumption is not the case, much of the content of the B&W study is no longer valid. Therefore, characterizing the fuel debris in the lower reactor vessel should proceed on a priority basis. TAAG recommends that the fuel debris in the lower regions of the reactor vessel be characterized before any more work is done on the B&W study or its conclusion.

Aside from the issue of the characteristics of the fuel debris, four issues remain: 1) in situ CSA storage; 2) the need to defuel the CSA; 3) underwater cutting; and 4) defueling tooling.

1. In Situ CSA Storage

The concept of leaving the CSA in place seems appropriate at this point. If the fuel debris is vacuumable, then there is no need to remove the CSA to defuel it. If the fuel debris is a solidified mass or monolithic, the damage to the bottom of the CSA may preclude its removal. Thus defueling of the lower regions of the reactor vessel would logically be done through the CSA. The B&W study does not address the removal of fused or monolithic fuel and structural material from the CSA. It would seem prudent to add this contingency to the planning to verify that the conclusion of the study is not altered.

2. The Need to Defuel the CSA

The implicit assumption of the work to date is that the CSA must be defueled. TAAG believes that this assumption should be examined. The only reasons to defuel the CSA are: to eliminate criticality concerns, to reduce radiological hazard, or to permit CSA disposal in a low-level waste site. It is not likely that any of these concerns would force the early defueling of the CSA, especially the baffle plates behind the core former wall. TAAG recommends that a thorough inspection of the CSA be made with fiber optics and/or with small television cameras to ascertain the quantities of fuel present. If the quantities are small, TAAG recommends deferring the CSA defueling until the CSA disassembly/disposal effort. TAAG will propose a data acquisition approach in the next TAAG report that will reflect our thinking on this issue.

3. <u>Underwater Cutting</u>

The underwater cutting technique for the CSA defueling presented to TAAG has been plasma arc cutting. There is some concern over using plasma arc cutting tools near the fuel or fuel debris. By the time the CSA cuts are required, this may no longer be an issue, but it does not seem wise to tie this concept to plasma arc cutting at this point in the planning.

4. <u>Defueling Tooling</u>

If the fuel debris in the lower regions of the vessel is not vacuumable, then the planned defueling tools will not be long enough. Plans to lower the defueling work platform and/or to add extensions onto the defueling booms should be incorporated into the defueling tool design.

Section 7.0

EX-VESSEL DEFUELING

TAAG was asked to investigate methods to remove fuel from discrete locations in the reactor coolant system and to review the Technical Planning reports that address this problem. During the reporting period, two draft reports were reviewed by TAAG: Fuel Removal Strategy and Ex-vessel Fuel Removal. TAAG comments on these were forwarded to Technical Planning by letter dated December 1984. These comments are included in this report as an attachment.

The TAAG position on the technical planning to date is summarized by two concerns:

- o Planning is based on an assumed fuel distribution and characteristics, i.e., that the fuel is throughout the primary coolant system and that it is vacuumable.

- o The descriptions of the strategy and the methodology do not stress the importance of data acquisition.

The data acquisition effort must be intrinsic to the defueling program and should be formalized within defueling planning studies and reports. This will avoid expensive and time-consuming effort planning for conditions that may not exist.

Other than these two concerns, TAAG considers planning to date to be well done and useful. TAAG would appreciate the opportunity to continue with review of this matter as the reports are finalized.

TAAG COMMENTS ON FUEL REMOVAL STRATEGY AND EX-VESSEL FUEL REMOVAL

The following is the compilation of TAAG and EPRI comments on the draft fuel removal plan. These comments represent the TAAG response to the GPU Nuclear request for comments on these documents made during the December TAAG meeting.

FUEL REMOVAL STRATEGY TECHNICAL PLAN

- o The introduction should state the defueling will be based on the results of fuel location and characterization efforts. Locating and characterizing the fuel in the primary system is a prerequisite to detailed planning.

- o The strategy is based on assumed locations and characteristics of the fuel debris; i.e. that the fuel is distributed and vacuumable. These assumed conditions should be verified before statements such as the following are made:

  - (Pg. 7 Item #2) This entire paragraph looses force if the rubble is not vacuumable.

  - (Appendix A) The essential element of the argument is that the rubble is vacuumable. If it is fused or monolithic, there may be a significant delay in defueling which could argue for defueling other areas first.

- o It is not clear that precluding the fuel removal from an area more than once will always enhance efficiency. First, it may take significant effort to absolutely assure that no fuel relocates into already cleaned areas. These efforts could detract from efficiency by requiring extra steps to seal holes or to otherwise block fuel movement. Second, this strategic approach may force defueling in a difficult area in order to avoid recontaminating an easier area. For instance, it may be possible to flush tramp fuel back into the reactor vessel where it can easily be removed rather than to deal with each ex-vessel location separately.

- o In Section 3.0, "Approach", list the basic assumptions as to the relative amounts of fuel in the various locations. Also, briefly address known constraints such as radiation levels at selected ex-vessel locations, limited accessibility, access prevented until water drained to certain levels, etc.

- o Page 6 - The strategy should acknowledge that sequence 6 through 9 may vary considerably depending upon how much fuel is really found at these locations.

- o Strategy should acknowledge that defueling of the lower vessel will likely require tools other than the vacuum, but that such tools (i.e., tools to deal with large slag pieces) cannot be built until visual access is obtained. This does not change the strategy, but it does mean, for example, that CSA defueling could proceed while these specialized tools are being built.

- The appendices are too wordy; they should be concisely written and moved up into the body of the report. (The one exception is Appendix B; it discusses the side issue of CSA access and should remain an appendix.) Appendix C both recommends vacuuming for the OTSG upper tube sheet and states that vacuuming is not feasible; correct this inconsistency. Appendix C, E and F overlap. This is another reason to integrate them into the text.

- Need some brief comments as to how the ex-vessel fuel will likely be handled, i.e., will it be put in defueling-type canisters? Perhaps these canisters will be much too big, maybe the fuel should be placed in "mini-canisters" capable of holding only a few tens of kgs.

EX-VESSEL FUEL REMOVAL

- Page 1 - State what constraints imposed by the DOE shipping contract.

- Once again, it should be acknowledged in the introduction that the document is based on assumed locations and characteristics of fuel debris. A statement should be added to stress that obtaining actual data could change the thrust and conclusions of the plan.

- Section 3 is a very useful description of the components likely to contain fuel. It would be more effective, however, if a simple drawing of each component was included. Much of the explanatory dimensional information could then be deleted from the text.

- Section 4 - Summarize briefly the mechanical and hydraulic defueling techniques at the end of the appropriate subsections.

- Section 4.2.1 of the ex-vessel fuel removal plan is too strongly worded in opposition to the use of the reactor coolant pumps. Specifically, the negative aspects of the approach discussed on pages 42 and 43 are unbalanced. For instance, repeated references to "time consuming", "expensive", and "additional...man-REM" exposures are value laden and unsubstantiated at this point in the planning. Also, concerns of fires, increasing contamination in the building, and operational interlocks are unwarranted since suitable procedures can readily address each.

- In Section 4.2.2, the third item may be unnecessary if the defueling endpoint criteria does not require the RCS to be totally free of fuel. What the defueling endpoint criteria will be are as yet uncertain. Accordingly, this concern is premature.

- Page 50 - Core flood tank lines are specifically called out here, but not in the above strategy document. Is this an oversight?

- Page 58 - Why are eutectic metals the only mechanical technique recommended for investigation? Surely pick-up tools, scrape/push/drag tools, strippable coatings and mechanical disassembly are at least as viable.

- In Section 6.0 of the ex-vessel fuel removal plan, the discussion of the endpoint cleanliness criteria misses the point that the criteria must also establish a safe endpoint which complies with appropriate regulations. This paragraph shall be reworded to include these considerations in addition to the issue of achievability.

- The final paragraph of Appendix A of the ex-vessel fuel removal plan is not persuasive. It would seem the burps in the RCS represented a relatively low velocity flow through the core void region with small transport capability.

Section 8.0

PHASE III RADIOLOGICAL ENDPOINT CONDITIONS

TAAG was requested to provide input to assist in determination of Phase III endpoints. This was accomplished by arranging presentations to site personnel by groups and companies that have experience with decommissioning nuclear facilities. One of the TAAG member organizations performed the preliminary engineering for the Shippingport Station Decommissioning Project. Members of the Decon Planning group met with the SSDP engineers for a presentation and working level discussion early in this reporting period. At the meeting, TAAG was given a rough draft of the TMI-2 Phase III Endpoint Criteria.

Comments on this draft were forwarded to the TMI-2 staff in a TAAG letter (TAAG-80-004), October 24, 1984.

Subsequent revisions to that draft have addressed most of the TAAG comments. TAAG is in general agreement with the goals and direction of the radiological endpoint criteria. However, there is one area of concern with the latest criteria; that is in the criteria for the reactor building basement.

Based on the most recent radiation survey data, it does not seem that the goal of less than 2 R/hr general area with 20 R/hr maximum hot spots is achievable without a major decontamination effort. Techniques that may be required to achieve these endpoint limits in the basement could have deleterious effects on the structural integrity of the reactor building. TAAG does not believe that the decontamination effort required to achieve those goals should be attempted during Phase III. Instead, these efforts should be deferred until Phase IV, when the ultimate disposition of TMI-2 will be known.

TAAG recommends that the reason for these low endpoint dose rate criteria (i.e., the need to send operators into the RB basement) be addressed by other means.

Robotics or new systems installed on other elevations may remove the need for general area dose rates in the basement significantly different than currently exist.

Section 9.0

PHASE III ENDPOINT CRITERIA

This section presents a method that could be used to establish the magnitude of fuel removal required to support long-term lay up or recommissioning of the TMI-2 power plant. The fact that trace quantities of fuel would remain even after a comprehensive cleanup program makes it necessary to establish how much fuel can be allowed to remain in specific locations.

The defueling endpoint establishes the maximum quantity of fuel that will be permitted to remain. It is important to recognize that establishing a limit does not preclude activities that would result in the removal of additional fuel. The endpoint criteria are established based on requirements relating to operational, safety, personnel exposure, or other considerations; not by factors relating to cost, defueling methods, etc. Hence it is possible that when defueling is completed, the amount of fuel remaining may be less than the endpoint limits.

The most limiting defueling requirement would be associated with a decision to restart the plant. In this case, the activation of free fuel would probably be the limiting factor in determining the amount of fuel that may be left in the primary system. The limits for other regions of the plant would also be expected to be lower because of the increased access requirements associated with plant operation, and hence the incentive to lower personnel exposure.

The following discussion does not assume plant restart. As a result, the defueling endpoint as presented represents an upper limit on the amount of fuel that may remain. If it is decided at a later date that plant restart is desired, the general concepts outlined in this discussion can be expanded to cover restart.

This discussion is not meant to be a recommendation for specific endpoint criteria, but instead outlines an approach that can be used to establish an endpoint. This discussion is based in part on a series of presentations given to TAAG during this period. These presentations were made by DOE and Burns and Roe personnel, and covered past and planned activities associated with the deactivation and/or decommissiong of several nuclear facilities including; West Valley, Hanford Production Reactors, Sodium Reactor Experiment, Bonus, Elk River, and Shippingport.

The experiences at these plants and engineering logic can be used to predict the conditions that will exist at TMI-2 at the end of Phase 3 of the Recovery Program. Unless a decision is made to restart the plant, it is anticipated that these conditions will remain in effect until the plant is disassembled. The following are the conditions that could be expected to exist at the end of Phase 3.

9.1 ASSUMPTIONS

- The plant will be under some form of NRC license, as it will not be practical until plant disassembly to reduce radiation levels and fuel concentrations to the extent that the facility will not require a license.

- A security system will exist which provides assurance that unauthorized personnel will not have access to the plant.

- Trained personnel will inspect the plant periodically.

- Plant monitoring will be accomplished in such a way as to minimize personnel exposure.

- The containment boundary will be intact. However, it will be a low-pressure diffusion barrier and will have leakage paths.

- The location of fuel, both within and external to the primary system, has been identified and quantified with a known degree of accuracy.

- All pumps and other sources of hydraulic transport have been deactivated; physically disconnected from power sources.

- o The primary system boundary is intact; temporary covers are used to provide an enclosed system that is not pressure tight.

In summary, the plant will be;

1. Licensed
2. Monitored
3. Protected
4. Enclosed

Criticality considerations will be the basis used to determine the amount of fuel that must be removed.

Considering the protection provided by the above features and the fact that the fuel does not contain a significant inventory of fission products, it can be shown that even if a criticality accident were to occur it would not constitute a public hazard. Hence, it is not necessary to prove that a criticality event is impossible (a difficult proof), but rather it will be necessary to show that the likelihood of the event is sufficiently remote.

9.2 CRITICALITY CONSIDERATIONS

To ensure public and worker safety, precautions will be taken to minimize the likelihood of accidental criticality until the plant is disassembled and all fuel is removed. These precautions will be related to specific assumptions and plant conditions. Typical assumptions and conditions might include:

- No credit will be taken for the presence of soluble poisons.

- If the primary system is dry, it will be assumed that it, or other areas containing fuel, can be flooded.

- Because pumps will be disabled, it will be assumed that fuel will not be transferred between discrete plant volumes (i.e., fuel in a pump volute would not combine with fuel in a steam generator).

- Current measurement techniques can be used to determine whether a volume contains a significant fraction of a critical mass of fuel.

9.3 ENDPOINT CRITERIA

Considering all of the above, the endpoint criteria might be:

- No single unit volume of the plant can contain more than 45% of a critical mass (assume average enrichment, moderated by unborated water, optimum geometry, etc.) unless specific protection is provided; see below. A unit volume is any volume wherein it is credible to assume combination of all fuel in the volume. For example, the pressure vessel, a pump volute, the pressurizer, the section of pipe between the pump and the pressure vessel, building sump, and basement floor would each constitute unit volumes.

- In the event that a unit volume will contain more than 45% of a critical mass after defueling, action should be taken to provide additional shutdown margin through the addition of fixed poisons. Borated rachet rings or other insoluble poisons could be inserted into these volumes.

9.4 SUMMARY

As developed in this discussion, endpoint criteria can provide both safety and flexibility. This approach allows a defueling program which recognizes the difficulty of providing accurate material balances on one hand and the desirability of postponing "complete" defueling until the plant is disassembled.

Section 10.0

SOURCE IDENTIFICATION

TAAG continues to support the work of Mr. Paul Babel, Burns & Roe, to develop further requirements in the survey and analysis efforts relating to investigating and characterizing the sources of radiation in the containment building.

Section 11.0

DISPOSITION OF TAAG RECOMMENDATIONS FROM THE NINTH TAAG REPORT

RECOMMENDATION	DISPOSITION
If testing of Pall Trinity production filter elements supports the very favorable laboratory scale results, this type of filter should be incorporated into the DWCS design.	GPU concurs.
If the performance of Pall Trinity production filter elements is unacceptable, the use of sintered metal tubes as filter media should include knockout canisters upstream of these filters; this may reduce the frequency of back bumping the filters	Knockout canisters will be used regardless of the acceptability of the filters. GPU is in agreement with the TAAG recommendation.
Because the use of deep bed filters is a proven technology, efforts should be made to retain their use as a contingency in the event that unforeseen problems develop with the sintered metal filters.	Deep bed filters will create undisposable waste. It is GPU's intent to resolve whatever unforeseen problems may develop, if any, with the sintered metal filter.
The selection of "dry" defueling, and the attendant use of a shielded platform atop the Internals Indexing Fixture (IIF), have modified the original design criteria for the DWCS. The system should be re-evaluated in light of these modifications.	Such a reevaluation was conducted. The system has been modified with regard to size and use configuration of vessels. However, we have concluded that the savings that might result from redesign of the of the system as it might be optimized for the lesser water volume will not be orders of magnitude and is not worth the cost of interrupting progress on this critical path system.
The DWCS design should also reflect considerations of (1) means to prevent overloading of the filter canisters, and (2) protection to prevent sudden rupture of a sintered metal filter. The design should also accommodate the sudden rupture of a loaded filter.	1) The filter canisters cannot be physically overloaded; they are volume constrained and not weight constrained. 2) Protection to prevent sudden ruptures of sintered metal filters is accomplished by design features such as damped valve operations. The design does accommodate the sudden rupture of a loaded filter in that there is a post-filter installed which has a differential pressure instrument which would indicate severe loading of the post-filter.

RECOMMENDATION	DISPOSITION
Westinghouse should be asked to develop three layout sketches to demonstrate the work platform configuration for vacuuming, long handled tools alone, and automated/remote tools.	Layout sketches are included in WTSD-TME-051, "Task Descriptions for TMI-2 Defueling Tools." This document covers arrangements in much greater detail than the three layout sketches requested.
Modify the work platform arrangements to better suit defueling with long handled tools and to reduce crowding in the platform center.	The working slot is extended over the entire diameter of the working platform. This did not require moving the carousel off to one side. The carousel is still located towards the center of the work area. With respect to the location of the rotatable mast, the abovementioned Westinghouse document recommends removal of the rotatable mast from the design.
Provide for eventually lowering the work platform onto the reactor vessel flange. It is recommended that the specific requirements for a lowered platform be identified and considered in the design of the platform at its initial position.	The feasibility of lowering the work platform has been investigated and been determined to be feasible. TAAG considers this issue to be unresolved.
Westinghouse should be asked to illustrate the procedure for carousel removal.	This is scheduled to be included in the abovementioned document. It has not yet been written.
Enclose tool lifting cables to prevent airborne contamination problems.	There are no tool lifting cables.
Provide a contingency to add a shielded transfer boot extending down from the work platform. This should be done because radiation streaming may be a problem for work continuation while canisters are being removed.	GPU concurs.
TAAG recommends that the SER for plenum removal be issued as a single report and that maximum use be made of previously issued SERs.	The decision to conduct the safety evaluation report for plenum removal in several reports was judged to be the most expeditious way to get approval. The previously issued SERs referenced by TAAG were used in the safety evaluation.

RECOMMENDATION	DISPOSITION
TAAG has identified alternate methods of placing radiation instruments underneath the vessel and in the vicinity of the letdown coolers. The use of either of these paths should be considered in data acquisition planning	C. Oistenfeld
TAAG recommends that defueling can continue with leaks so long as the water level in the reactor vessel is maintained. It is noted that such operations are allowed at all commercial PWR power plants.	GPU concurs.
TAAG recommends that the containment equipment hatch be removed to perform a job or set of jobs and then be replaced. Large items should be staged outside the reactor building as much as possible to reduce the number of times and the duration of time that the equipment hatch is removed. Special measures should be taken to reduce the environmental risks associated with opening the equipment hatch, and these measures should be evoked only while the equipment hatch is open. A draft SER has been sent to GPUN under separate cover.	GPU concurs with the basic concept and, in fact, is pursuing this option.
An evaluation should be conducted of the feasibility of using conductivity meters to monitor boron concentration.	An evaluation was conducted and it was concluded that conductivity meters could be used to monitor boron concentrations. However, the approach will be to use the existing boronometer, which has been fixed, and manual sampling will be used as a backup in the event that it fails in the future.