R0264

EG&G Idaho, Inc.
PO Box 88, Middletown, PA 17057

F.C. 74-01

June 12, 1986

Distribution

TRANSMITTAL OF THIRTEENTH TAAG REPORT - WAF-61-86

Dear Sirs:

Enclosed herewith is the thirteenth report of the Technical Assistance and Advisory Group (TAAG). This report covers the TAAG activities during the period from September 1, 1985 to January 31, 1986.

Very truly yours,

W. A. Franz, Manager
Technical Integration Office

mrr

Enclosure:
As Stated

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

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THIRTEENTH REPORT

of the

TECHNICAL ASSISTANCE AND ADVISORY GROUP (TAAG)

Three Mile Island Unit 2 (TMI-2)

For the Period September 1, 1985 to January 31, 1986

<u>TAAG MEMBERS</u>

W. H. Hamilton, Chairman
R. Brodsky
N. M. Cole
E. A. Evans
W. R. Cobean, Jr./C. W. Hess
D. O. Campbell/E. Collins
E. F. Sise, Jr.
E. J. Wagner

<u>Sponsoring Organizations</u>

U.S. Department of Energy
U.S. Nuclear Regulatory Commission
Carolina Power and Light
Newport News Shipbuilding
Electric Power Research Institute

CONTENTS

SECTION 1.0

INTRODUCTION

In a letter dated October 21, 1985, Mr. F. R. Standerfer, Director, Three Mile Island Unit 2 (TMI-2), requested that during the period through January 1986, the Technical Assistance and Advisory Group (TAAG) address the following items:

1. Keep current on defueling operations and provide technical comments as the work progresses.

2. Examine the canister transfer shield drawings and make suggestions which could lead to greater reliability during defueling.

3. Review and comment on the developing end point criteria and the definition of the systems and plant status for interim monitored storage.

4. Review the core boring program and comment on its integration into the defueling operations.

5. Provide consultation in answering specific issues with respect to overall plant Phase III end points.

6. Continue to review data from radiation source identification and fuel locations.

7. Review plans for additional data gathering regarding core and vessel conditions in the lower regions.

1.1 SCOPE AND APPROACH

During this report period, TAAG met three times to consider the items in the charter above. The meetings were held October 2 and 3, 1985; December 9 and 10, 1985; and January 28 and 29, 1986. This report presents the most current TAAG-generated information in seven work areas and in the charter letter referred to above. One section of the report addresses each of the work items. Additional recommendations that were made orally at the time of the meetings are included in this report.

SECTION 2.0

DEFUELING PLANS AND PROGRESS

TAAG heard presentations at each of the meetings during this report period regarding the preparations for defueling and the initial defueling operations.

In October, a representative from MPR Associates visited Eastport International and the Naval Civil Engineering Laboratory to observe underwater cutting tools powered by water-driven hydraulic motors. The report of that trip and recommended actions are attached hereto.

Later in October, following an observation tour of the GPUN defueling training facility, suggested tools for cutting fuel rods and other core members were forwarded to GPUN for action. The letter of October 18 is attached hereto.

At the December TAAG meeting where it was observed that the defuelers were having difficulty with the long handled tools, it was recommended that GPUN start now to examine ways to lower the refueling platform so that work in the lower region of the vessel would proceed more expeditiously, not requiring even longer manual tools.

In January following observation of the defueling operations, it was recommended that GPUN reconsider use of radios and headphones when the operators are not using respirators and, further, that a limit be placed

on how many days in a row a defueler can work - in the interest of avoiding fatigue and resulting errors. Improved lighting was also suggested for the work platform.

The technical problem of maintaining water clarity during defueling was discussed continuously through this report period. Prior TAAG experience with scintered metal filters plugging quickly forewarned of the trouble actually experienced. Direct TAAG assistance was offered at the January meeting.

MPR ASSOCIATES, INC.

October 11, 1985

Mr. William Franz
EG & G, Idaho
TMI Site Office
Route 441, Bldg. 400
P.O. Box 88
Middletown, PA 17057

Subject: Underwater Cutting Tools Powered by Water Driven Hydraulic Motors

Dear Mr. Franz:

The purposes of letter are to forward a Trip Report concerning operation of underwater cutting tools powered by a seawater driven hydraulic motor and to recommend the next actions to be taken in evaluating these tools for potential use in defueling reactor vessels. Briefly, it appears that the water driven motors may have application to defueling of the lower core support assembly. The tool that has the most promise is a grinder/cut-off tool. We recommend that a grinder/cut-off tool and water motor be ordered now for testing. While awaiting delivery, some work should be done to identify requirements and capabilities for this tool. This work is outlined below in items (a) through (e).

Hydraulic motors driven by seawater (or fresh water) have been under development by the Navy and its contractors for approximately 10 years. A 3.5 horsepower motor design is available currently. It is not a "production" model; it has not been used in a "field" environment. The design has recently been adapted to provide a 5 Hp motor. The first such motor is currently being built and tested.

The 3.5 Hp motor has been incorporated into several tools intended for use underwater. These are a grinder/cut-off tool, a bandsaw, and a rock drill. The tool development followed the motor development and consequently is not very advanced. Of the 3 tool designs, the rock drill is the least well developed. The grinder/cut-off tool is relatively simple and nearest to being usable in a "production" environment. The tool uses no lubricants other than the water used by the motor.

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

The viscous drag load on the wheel rotating in water is significant. For the 7 inch diameter grinding wheel being used with the existing tool, viscous drag consumes about 2 Hp. A minimum of 1 to 1.5 Hp is needed for grinding. That is, the existing grinder requires essentially all the power available from the 3.5 Hp motor. Although higher speeds would permit faster metal removal, the speed was selected to be as low as possible to minimize drag loss while still permitting grinding/cutting. Larger diameter wheels and higher rotating speeds drastically increase the drag load.

We recommend that scoping calculations, a literature search and cutting tests be done while awaiting delivery of the 3.5 Hp water motor and grinder/cut-off tool. It appears that the following actions are needed:

a. Develop sketches to show the access to core support assembly components for which a cut-off tool may be useful.

b. Determine the approximate size envelope in which the tool must fit, and determine the cutting wheel diameter(s) needed based on the tool geometry and thickness of material to be cut. Estimate the amount of material to be cut.

c. Use the data contained in the enclosed Trip Report to calculate the power required to overcome viscous drag on the wheel size selected.

d. Perform tests and/or survey available literature to determine quantities important to cutting stainless steel plate underwater with a cutting wheel. Quantities of interest include grinder shaft speed and torque, wheel diameter, linear cutting speed, metal removal rate, force applied to the cutting tool, and abrasive wheel wear rate. Tests of these quantities would not require a deep water tank or a water motor.

e. Use the data collected to assess (1) the power required, (2) cutting rates and any limitations on thicknesses that can be cut, (3) the frequency of water motor rebuilding that might be expected (based on an estimate of 250 hours of operation between rebuilds and the estimated amount of material to be cut). Identify the motor size that would be needed to efficiently cut the geometries being considered. Assume that the existing design can be extrapolated to larger power capacities, up to a reasonable limit.

We have begun work on items (a) through (c). We recommend EG&G perform item (d); these test should be started immediately as they may indicate the need for a larger water motor. We could assist with this item if you wish. The lead time to design, fabricate, and test a water motor of the proper size may be long. Also, there are some technical risks associated with extrapolating the motor design; that is, it is likely that unforseen problems will develop during fabrication and testing of a new motor size.

Eastport International offered to provide cost estimates and delivery dates to sell and to lease a 3.5 Hp water motor, an electric motor driven pumping unit for use with the water motor, and a grinding wheel tool head (for use with the water motor). They indicated they would provide this information by October 18, 1985.

Please call me if you have any questions.

Sincerely,

Tom Friderichs

Tom Friderichs

Enclosure

cc: W.H. Hamilton, TAAG
M. Martin, EG&G, Idaho
H. Burton, EG&G, TMI-2
D. Lopez, EG&G, Idaho
W. Austin, GPUN
F. Ross, DOE
W. Bixby, DOE-TMI

MPR ASSOCIATES, INC.

Enclosure to
MPR Letter Dated
October 11, 1985

TRIP REPORT

Date: October 4, 1985

Places Visited: Eastport International, Inc., and the Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California

Persons Contacted: Mr. Jim Osborne, Eastport Int'l
Mr. Wayne Tausig, Eastport Int'l
Mr. Bruce Farber, NCEL
Mr. Tom Conley, NCEL

Persons Making Trip: Mr. Daryl Lopez, EG&G, Idaho
Mr. Tom Friderichs, MPR Associates

Subject: Underwater Cutting Tools Powered by Water Driven Hydraulic Motors

SUMMARY:

1. Hydraulic motors driven by seawater (or fresh water) have been under development by the Navy and its contractors for approximately 10 years. A 3.5 horsepower motor design is available currently. It is not a "production" model; it has not been used in a "field" environment. The design has recently been adapted to provide a 5 Hp motor. The first such motor is currently being built and tested. These motors are sliding vane type pump/motors in which Torlon (teflon/graphite composite) vanes slide radially in slots in an Inconel rotor. The outer tips of the vanes run against the eccentric bore of the motor case.

2. Eastport indicated that 1 or possibly 2 motors of the 3.5 Hp design have been wear tested with fresh water for 250 hours. The wear mechanism which caused testing to be stopped was that the tips of the motor vanes wore. This reduced the radial (outward) force provided by the vane springs, allowing the vanes to oscillate radially in their rotor slots, resulting in "hammering" in the motor. Eastport indicated that refurbishment of the motor generally requires about 1 hour and involves replacement of the plastic parts (i.e. vanes and end plates). Reports covering the wear tests do not exist.

Eastport noted that the very early motor designs had wear lives of about 5 hours and that the current design is the product of much testing of materials and clearances. The long term goal for these motors is 1000 hours.

3. The motor has been incorporated into several tools intended for use underwater. These are a grinder/cut-off tool, a bandsaw, and a rock drill. The tool development followed the motor development and consequently is not as advanced. Of the 3 tool designs, the rock drill is the least well developed. The grinder is relatively simple and nearest to being usable in a "production" environment.

4. The grinder/cut-off tool appears to have possible applications in disassembling the lower core support assembly (CSA). The grinder/cut-off tool, illustrated in Figure 2, consists of a handle with a built in valve for controlling water flow, a water motor, and a tool head which connects to the motor output shaft. The water discharged by the water motor flows through the tool head to lubricate plastic gears; the tool uses no lubricants other than the water discharged by the motor. The water is discharged from the tool head to the area behind the grinding wheel to attempt to reduce the viscous drag load on the wheel.

The viscous drag load on the wheel rotating in water is significant. Eastport indicated for the 7 inch diameter grinding wheel being used with the existing tool, viscous drag consumes about 2 Hp. A minimum of 1 to 1.5 Hp is needed for grinding. That is, the existing grinder requires essentially all the power available from the 3.5 Hp motor. Although higher speeds would permit faster metal removal, the speed was selected to be as low as possible to minimize drag loss while still permitting grinding/cutting. Larger diameter wheels would drastically increase the drag load.

7. Scoping calculations and some underwater cutting tests (without a water motor) could be performed to assess the viability of this tool system. The purpose of the tests would be to determine cutting rates and power requirements for cutting stainless steel (of the type and thickness being considered) underwater with abrasive cut-off wheels. This information could be used to make decisions as to how far to proceed with development of this type of tooling and to estimate the capabilities of the system. The work needed is outlined below.

- Develop sketches to show the access to core support assembly components for which a cut-off tool may be useful.

- Determine the approximate size envelope in which the tool must fit, and determine the cutting wheel diameter(s) needed based on the tool geometry and thickness of material to be cut. Estimate the amount of material to be cut.

- Use the data provided by Eastport to calculate the power required to overcome viscous drag on the wheel size selected.

- Perform tests and/or survey available literature to determine quantities important to cutting stainless steel plate underwater with a cutting wheel. Quantities of interest include grinder shaft speed and torque, metal removal rate, force applied to the cutting tool, and abrasive wheel wear rate. Tests of these quantities would not require a deep water tank or a water motor.

- Use the data collected to assess (1) the power required, (2) cutting rates and any limitations on thicknesses that can be cut, (3) the frequency of water motor rebuilding that might be expected (based on Eastport's estimate of 250 hours of operation between rebuilds and the estimated amount of material to be cut). Identify the motor size that would be needed to efficiently cut the geometries being considered. Assume that the existing design can be extrapolated to larger power capacities, up to a reasonable limit.

DISCUSSION:

WATER DRIVEN HYDRAULIC MOTOR

Eastport indicated that 1 or possibly 2 motors of the 3.5 Hp design have been wear tested with fresh water for 250 hours. The water supply pressure was about 1200 psi and the flow rate was about 7 gpm during the test. The shaft speed was about 1600 rpm and the power output was about 3.5 Hp. Figure 1 shows motor performance curves found during short time duration bench tests for the motor; the point at which the wear test was performed is circled. The wear mechanism which caused testing to be stopped was that the tips of the motor vanes wore. This reduced the radial (outward) force provided by the vane springs, allowing the vanes to oscillate radially in their rotor slots, resulting in "hammering" in the motor. Eastport indicated that

refurbishment of the motor generally requires about 1 hour and involves replacement of the plastic parts (i.e. vanes and end.

HIGH PRESSURE WATER PUMP SUPPLYING MOTOR

The 3.5 Hp motor requires about 7 gpm at 1,200 psig when used with the grinder. A commercial piston type pump manufactured by an English company (Breden) is used. The pistons have "Bellow-fram" type liners which completely seal the water side from the piston driving mechanism. The Navy has two pumping units, each of which is mounted on pallets. One unit is powered by a diesel engine and the other by an electric motor. Each motor is about 20 Hp.

The diesel powered unit includes two water filters piped in parallel to allow filters to be cleaned without interrupting tool operation. The filter size is 10 microns. NCEL is planning to try 50 micron filters; they feel that the hydraulic motors are tolerant of particles in the supply water. The unit powered by an electric motor has only 1 filter since NCEL's experience has been that the filters do not require frequent cleaning.

Eastport has a pumping unit (driven by an electric motor) in a transportable test stand that also includes instrumentation to measure flow rates, pressures, and other quantities related to motor performance.

Based on observation of operation of the diesel powered unit, it appears that the pumping unit design is straightforward and ready for use in a production environment. The components would fit through the equipment hatch airlock at TMI-2.

UNDERWATER TOOLS USING WATER MOTOR

The grinder/cut-off tool appears to have possible applications in disassembling the lower core support assembly (CSA). It should be possible to design a cut-off tool based on the existing grinder. The grinder, illustrated in Figure 2, consists of a handle with a built in valve for controlling water flow, a water motor, and a tool head which connects to the motor output shaft. The tool head includes gearing which drives a shaft perpendicular to the motor shaft. The shaft speed is increased from about 1600 rpm at the motor to about 2800-3000 rpm at the grinding wheel shaft. The water discharged by the water motor flows through the gear box to lubricate the plastic gears; the tool uses no lubricants other than the water discharged by the motor. The water is discharged

from the gear box to the area behind the grinding wheel to attempt to reduce the viscous drag load on the wheel.

The viscous drag load on the wheel rotating in water is significant. Eastport indicated for the 7 inch diameter grinding wheel being used with the existing tool, viscous drag consumes about 2 Hp. A minimum of 1 to 1.5 Hp is needed for grinding. That is, the existing grinder requires essentially all the power available from the 3.5 Hp motor. Although higher speeds would permit faster metal removal, the speed was selected to be as low as possible to minimize drag loss while still permitting grinding/cutting.

Eastport indicated that the generally recommended range for cut-off speeds is 4,500 to 6,000 feet per minute. The grinder currently being tested by the Navy runs at the low end of this range. Eastport also checked with grinding wheel suppliers and determined that the supplier they have been working with recommends the same type of wheel for use underwater to cut both stainless and carbon steels. These wheels are available in 6, 7, 8, and 10 inch diameters (as well as larger diameters). As shown in Figure 3, the power consumed by the viscous drag force is strongly a function of the wheel diameter and speed. If a wheel diameter greater than 7 inches is needed, the 3.5 Hp motor may not provide enough power for cutting.

With the existing grinder/cut-off tool, the 7 inch diameter wheel protrudes about 1 5/8 inches from the end face of the tool (the end opposite the handle). That is, the maximum thickness that could be cut would be about 1 inch. Slightly greater wheel clearance may be achievable through changes in the tool head geometry. Larger diameter wheels would also provide more clearance.

TESTING OBSERVED

During the visit to NCEL, the Navy was training divers to use the grinder/cut-off tool and band saw, as well as the diesel engine driven pump which supplied the water motor. Planned testing of the rock drill was cancelled after the tool failed during initial testing. NCEL indicated that the preferred materials had not been readily available for some of the wear parts in the rock drill tool head and that the alternative materials galled and stopped the tool.

We watched (on video cameras and through viewports in the seawater tank) several different divers use the grinder/cut-off tool. The tool was used to cut through a piece of 1 inch diameter carbon steel reenforcing bar. The first diver required about 4 minutes to complete the cut, however much time was spent trying to find a comfortable way

to hold the tool and to apply sufficient force to it. The divers generally had a difficult time finding something to lean against in order to react the force they were applying to the tool.

We did not watch the divers operate the band saw. It was noted that the bandsaw is also in a prototype status. When the saw was initially tested above water a roll pin sheared (it was connecting a gear to a shaft). The pin was quickly replaced. The bandsaw design includes a carbon steel chain in the drive train; the chain is lubricated with oil or grease. It did not appear that the band saw would be useful in defueling the lower reactor area.

AT POINT ②

WITH 19.6:1

$$SPEED = \frac{(2065)(6.25\pi)}{(19.6)(12)} = 172.4 \text{ FPM}$$

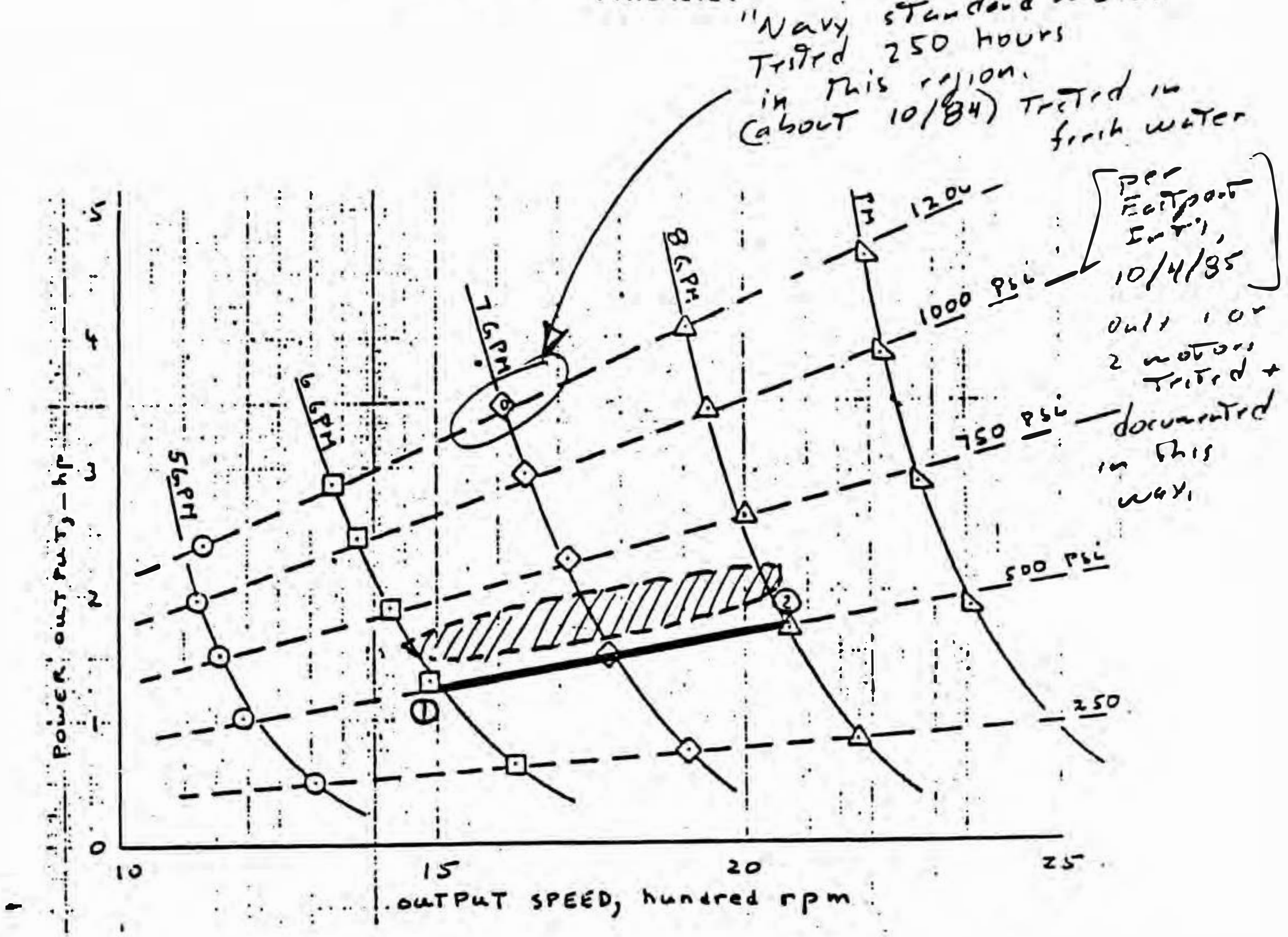


Figure provided by
Eastport International, Inc.
Pacific Marine Systems

PERFORMANCE CURVES FOR
NOMINAL 3.5 HORSEPOWER
WATER DRIVEN HYDRAULIC MOTOR

FIGURE 1

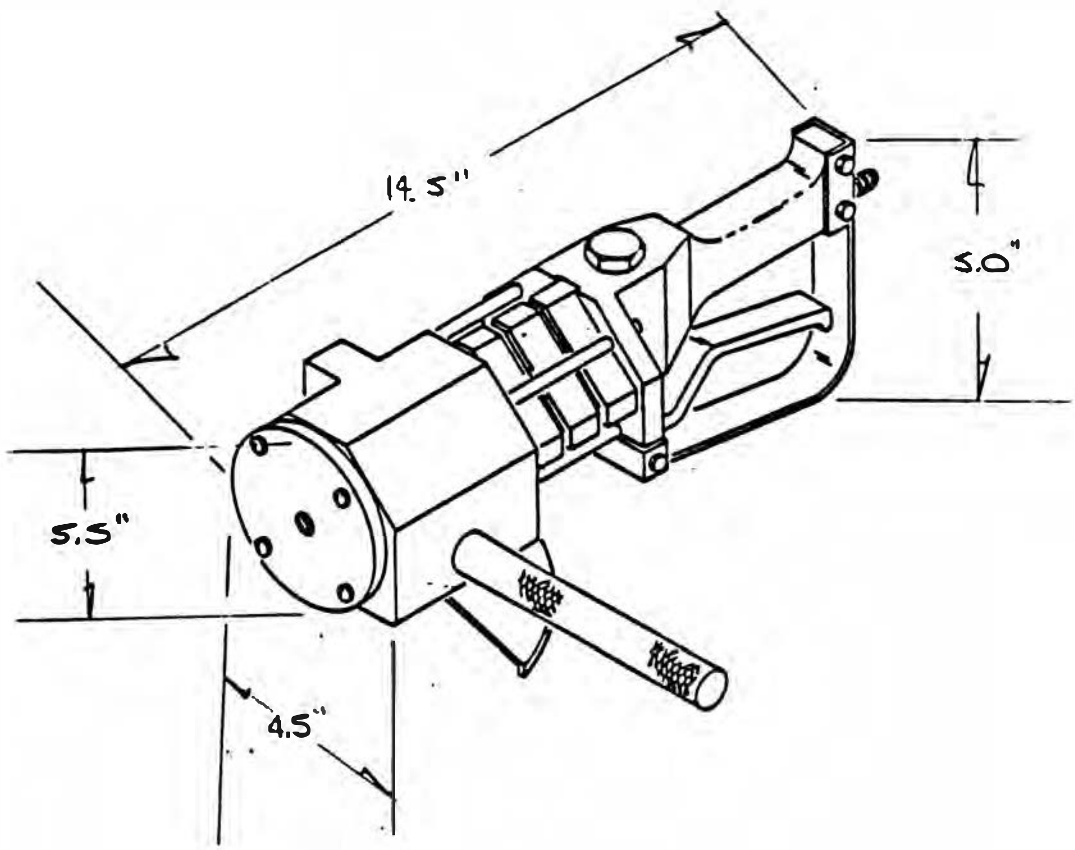


Figure provided by
Eastport International, Inc.
Pacific Marine Systems

SIZE ENVELOPE FOR EXISTING
ROTARY DISC TOOL (GRINDER/CUT-OFF TOOL)
USING WATER DRIVEN HYDRAULIC MOTOR

FIGURE 2

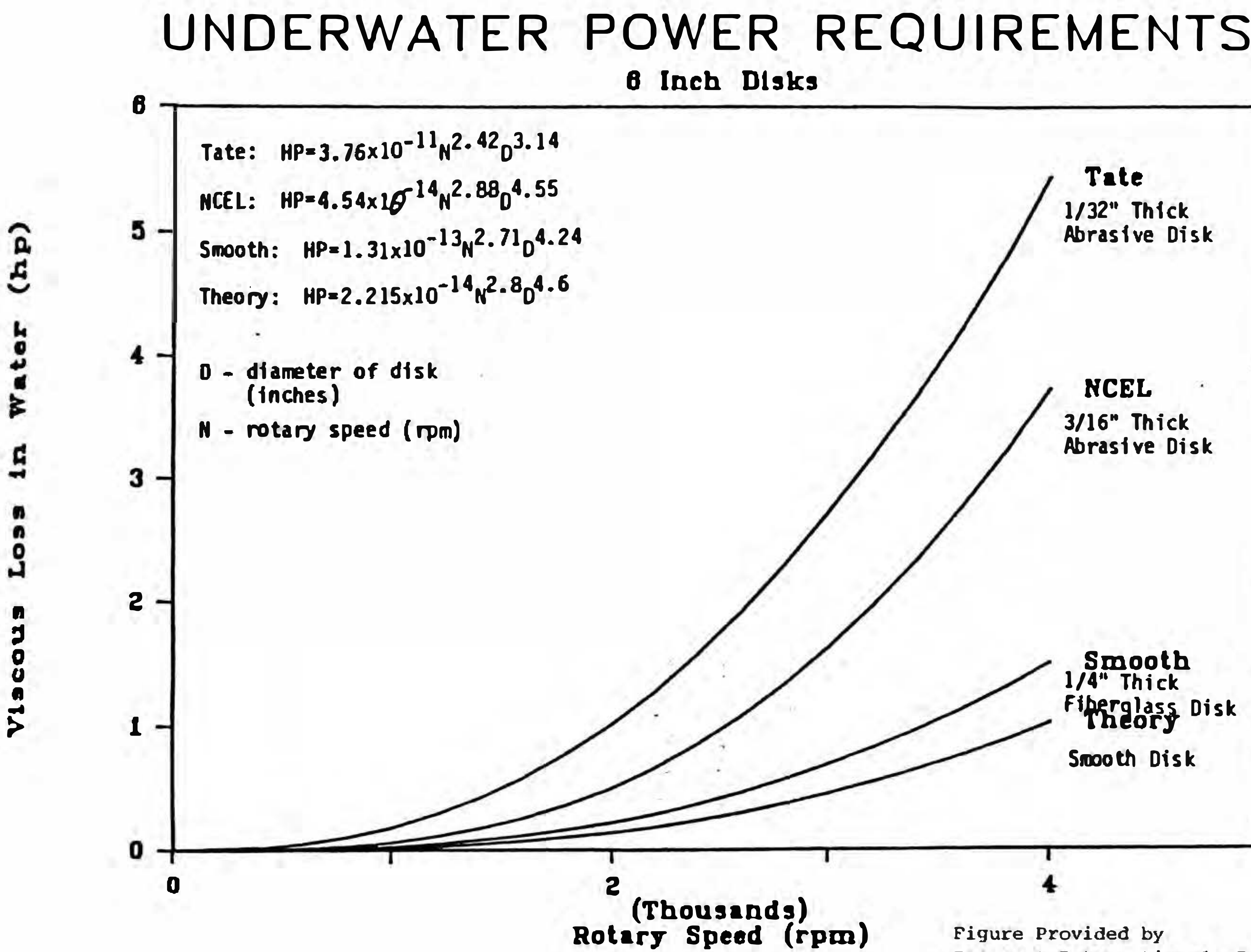


Figure Provided by
Eastport International, Inc.
Pacific Marine Division

POWER LOSS DUE TO VISCOUS DRAG
ON 6" DIAMETER DISC ROTATING IN WATER

FIGURE 3

MPR ASSOCIATES, INC.

October 18, 1985

Mr. Sandy Levin
TMI Nuclear Station
GPU Service Corporation
P. O. Box 480
Middletown, PA 17057

Subject: Remote Cutting Device

Dear Mr. Levin:

During the last TAAG meeting when we were touring the defueling training facility where the checking out of various long handle cut tools was in progress, you had indicated to me that you were experiencing trouble with the remote cutting tools supplied to cut tubing up to about .4 inches in diameter.

As you know, we designed and built a device for cutting up in-core instrument cables at TMI-1. Enclosed for your information are sketches and a description of the equipment we developed in 1977 and 1978 for removal and disposal of radial in-core detector cables at TMI-1. During the 1978 and 1979 TMI-1 refueling outages, a total of 51 highly irradiated in-core instrument cables were successfully removed and cut-up using this tool. Each in-core cable was removed and cut into links in about 1 hour or less. Each in-core cable was about 16 feet long and comprised of roughly 13 feet of .31 inch diameter tubing (see cross section in Figure 3) and 3 1/2 feet of .41 inch diameter tubing (spiral wound and vibration sleeve). Thus, the cutting of each cable involved about 19 cuts of the .31 diameter tubing and about 5 cuts of the .41 diameter spiral wound cable.

To date this cutting equipment using the TN type cutters has successfully made over 1000 cuts of the .3 inch diameter tubing and 270 cuts of the .4 inch spiral wound cable. All cuts were made without incident. During the development test it was observed if a short 1/4 inch long cut was made on these rods, the short end would snap up into the cutter assembly and become lodged. To prevent this type of problem, the operating procedures specifically requires that the minimum length of irradiated cable to be cut is two inches.

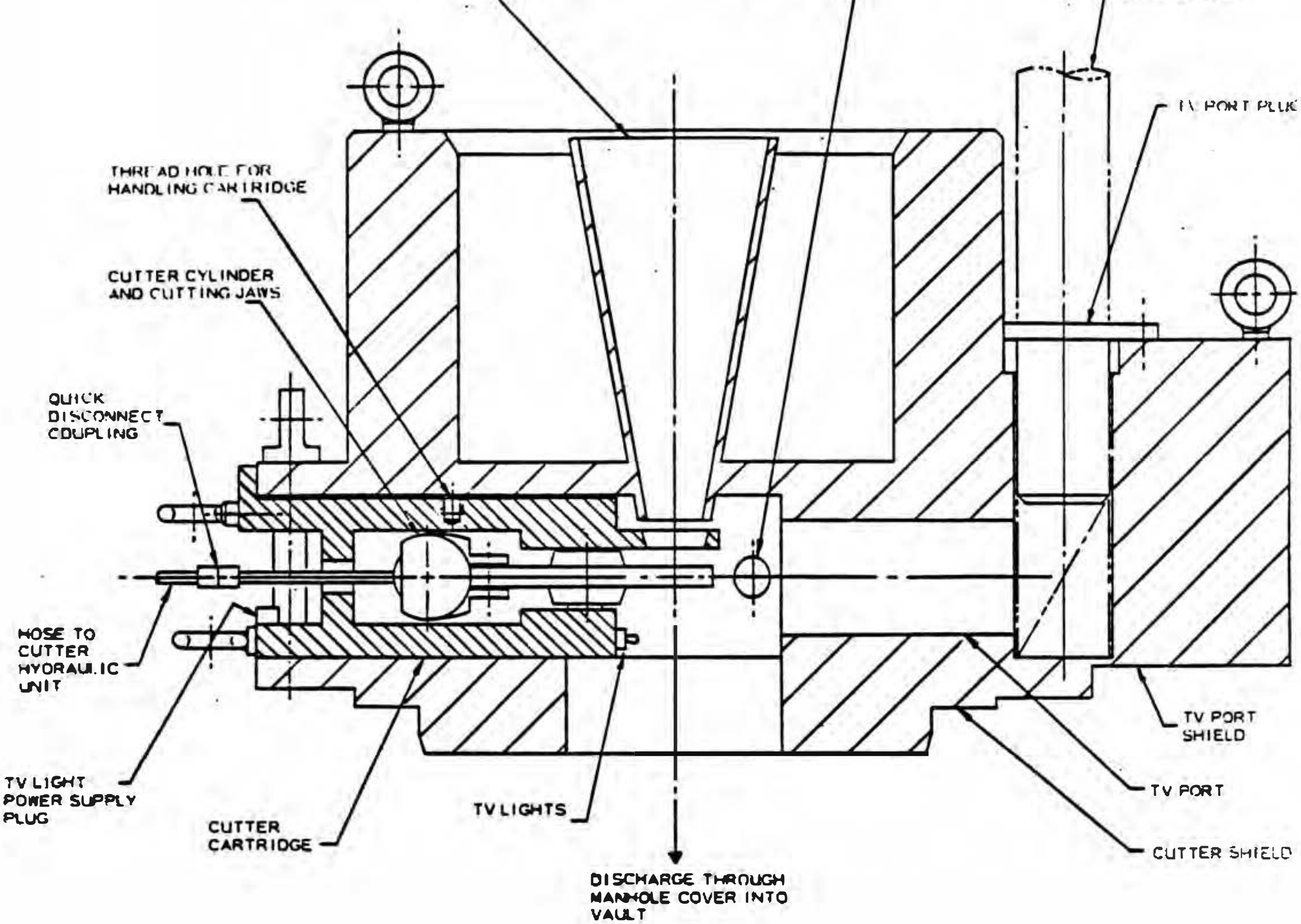
If this type of tool would be of help to you, I think we could modify the design relatively easily and quickly so that it could be adapted for underwater service for use at TMI-2.

If you have any further questions or want any further background on this, please do not hesitate to call.

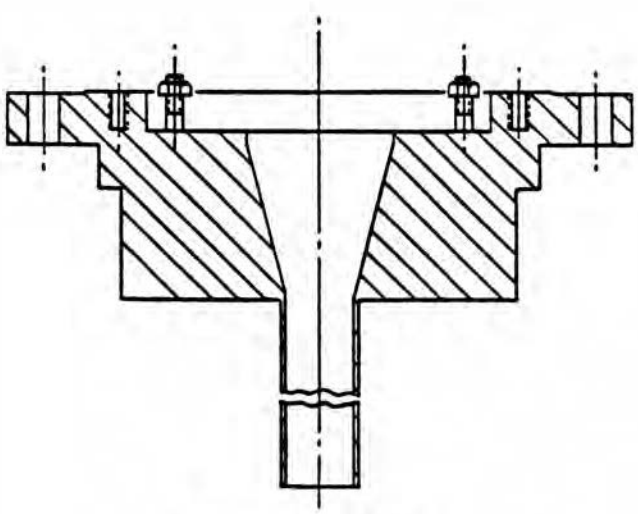
Sincerely,

Noman M. Cole, Jr.

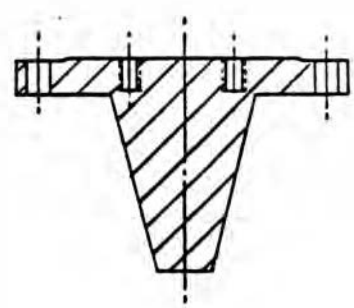
cc: W. H. Hamilton
F. Standerfer
E. Kintner
H. Burton



CUTTER SHIELD ASSEMBLY

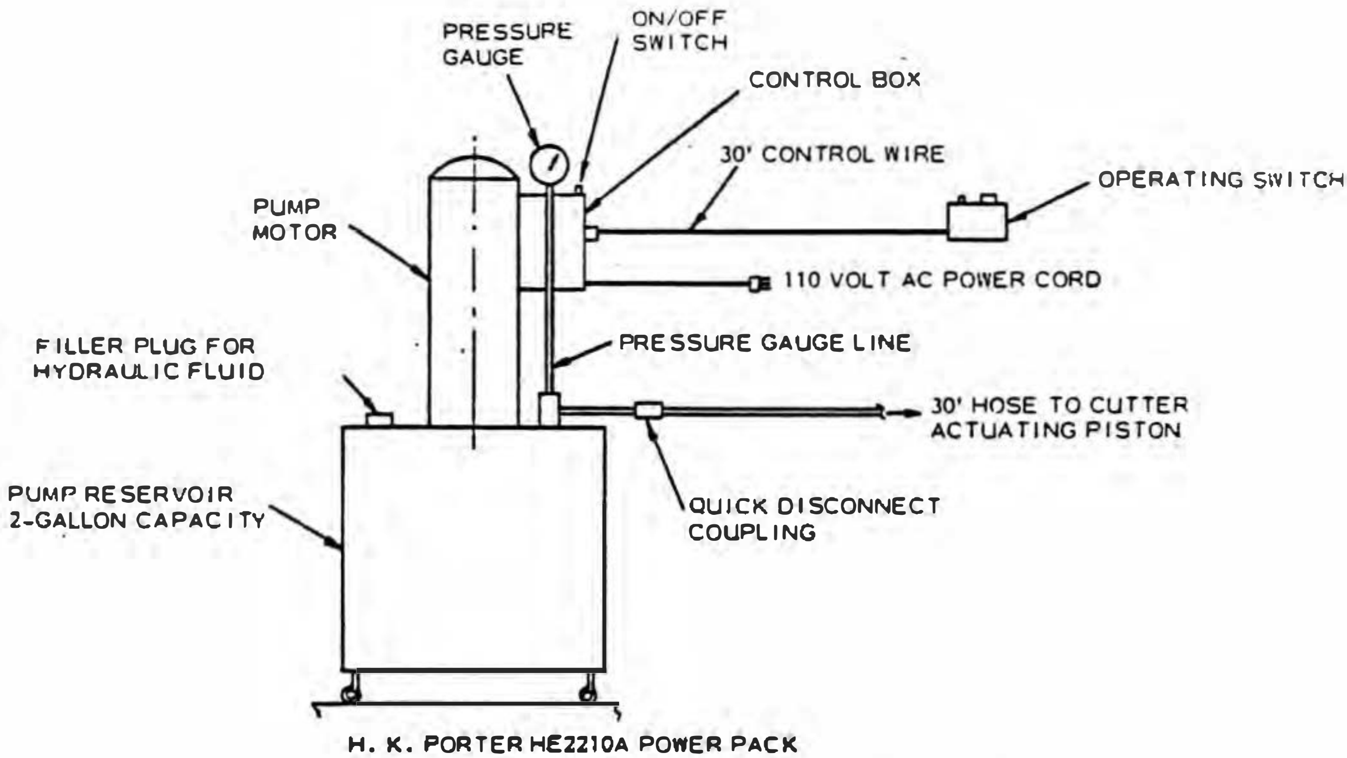


MODIFIED MANHOLE COVER

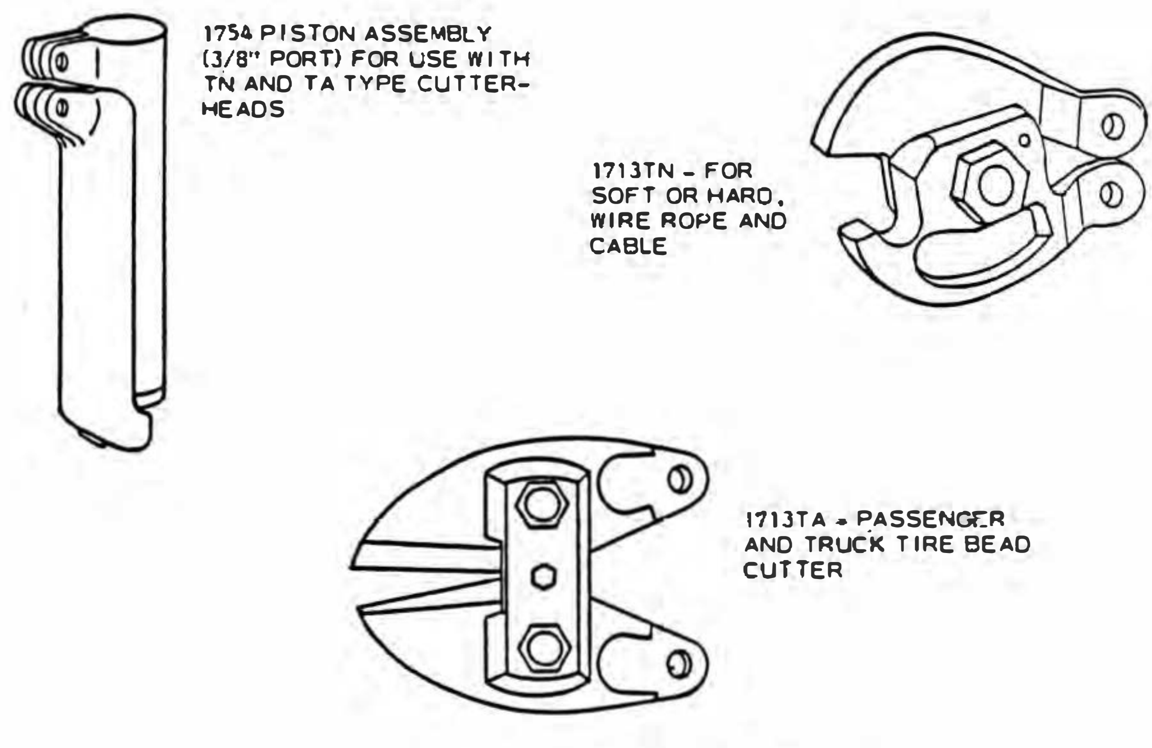


PLUG

FIGURE 1



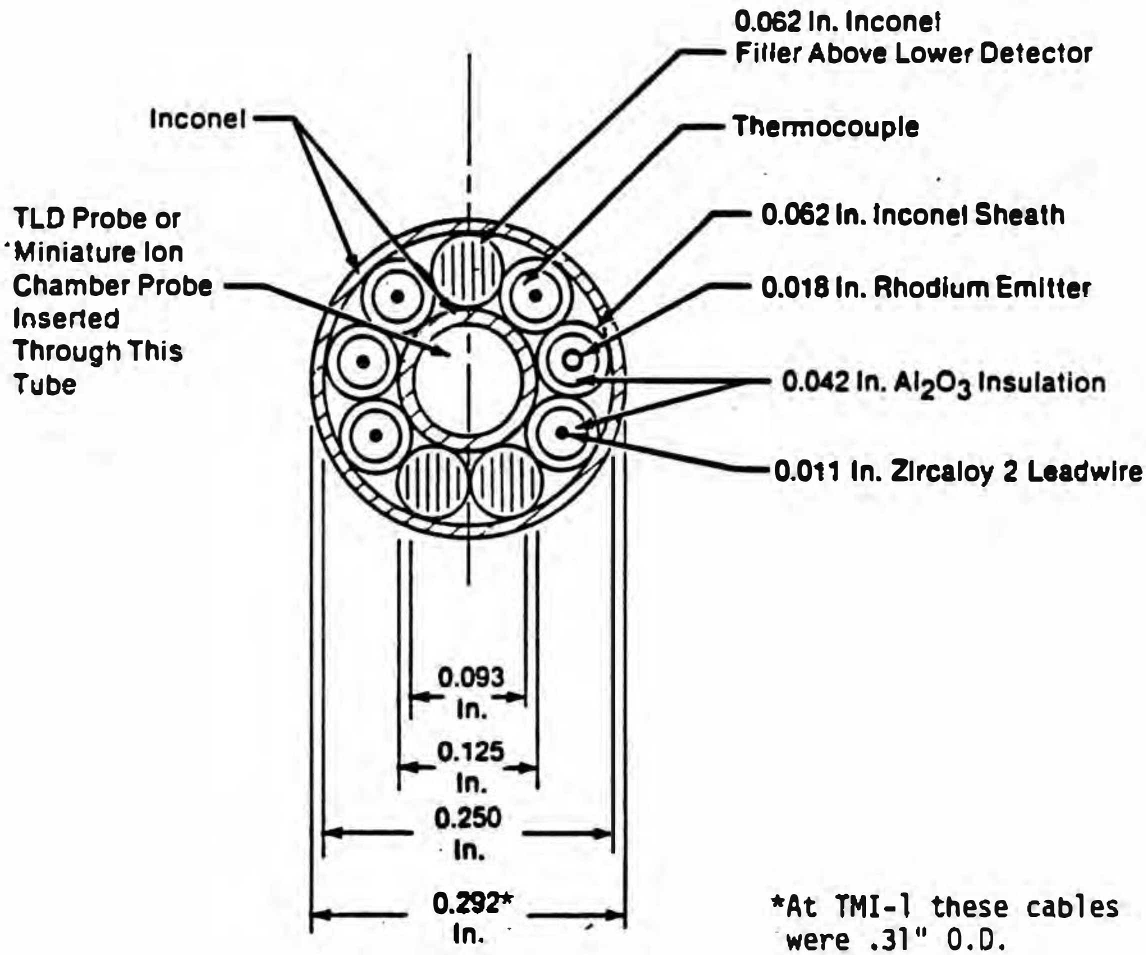
H. K. PORTER HYDRAULIC PUMP ASSEMBLY



H. K. PORTER PISTON ASSEMBLY AND CUTTER HEADS

FIGURE 2

IN-CORE DETECTOR — CROSS SECTION



*At TMI-1 these cables were .31" O.D.

FIGURE 3

SECTION 3.0

CANISTER TRANSFER SHIELD

At the suggestion of TAAG following a walk-through of the training facilities and equipment for TMI-2 defueling, a review was made of the design of the Canister Transfer Shield which had been delivered. Particular note was made of maintenance and repair steps to be taken to improve reliability of operation. The findings from this review, including recommended actions for GPUN, are recorded in the attached letter from MPR Associates, dated December 3, 1985. The review was conducted by Mr. Cole of MPR and Mr. Sise of Newport News but is forwarded to GPUN as a TAAG recommendation.

MPR ASSOCIATES, INC.

December 3, 1985

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

Subject: Canister Transfer Shield Review

Dear Mr. Hamilton:

We have conducted the requested review of the canister transfer shield based on the drawings forwarded by GPUN letters dated October 11, 1985, and October 29, 1985. This review covers the combined comments of MPR and Newport News members of TAAG. Since this is a review of a transfer shield that has already been manufactured and tested, the review focuses solely on what could be done at this time to improve reliability and/or permit easier handling of problems that could arise. Our review does not concern the overall concept, which was established some time ago. Our comments are as follows:

1. There are three areas of the transfer shield which could be particularly troublesome from a maintenance and operational viewpoint. The existing manufactured drawings of these three areas do not show assembled clearance, alignment required, etc., nor are they particularly helpful for maintenance and troubleshooting operational problems. The three specific areas are:

   a. The entire grapple support column (about 17 feet long in the reactor building transfer shield). The column contains the grapple pawls, pneumatic double-acting cylinder, air supply lines, limit switches and read out cabling, the free moving shuttle shield, etc.

   b. The canister keeper devices in the lower end of the transfer shields' body. These keeper devices are actuated by raising and lowering the approximately 9 foot long movable shielded sleeve. These keepers are to ensure that the canister will not drop out of the transfer shield if a canister should become disengaged from the grapple while moving back and forth between the reactor vessel and the up-enders.

c. Jack screw drive mechanism and the two jack screw shafts that raise and lower the 9 foot long movable shielded sleeve over a distance of about 6 feet. If either one of these jack screw shafts or either of the two drive trains get out of alignment, this could cause binding in one of the jackscrews and machining-type action of metal to occur and/or excessive drag on one side or the other of the movable shield.

Accordingly, it is suggested that assembly drawings be prepared of the above three areas that are tailored for maintenance and troubleshoot operational problems. Such maintenance drawings should show details of locking devices, the cam action such as for the canister keepers, alignment required for keepers, alignment and synchronizing sequence for the jack screw mechanism and drive train, assembled clearance between various critical parts in the grapple support assembly, clearance for the various pushrod-type devices, clearances between various stainless steel wear surfaces where galling problems can occur, etc. It would also be helpful if these maintenance and troubleshooting drawings were tailored for ease of use in containment.

2. Canister Grapple [Drawing 1154155, Rev. 5; part Number is in (# __)]

The pawls of the grapple are actuated by a plunger that is moved up and down to cause engagement and disengagement with the canisters. The plunger is moved up and down by a double acting pneumatic cylinder that is located about a foot above the pawls of the grapple. As such, the cylinder (#17), air lines (#20), and switches (#33) are underwater when engaging and disengaging the canister. The center shaft of the cylinder has a push/pull rod attached which goes all the way to the top of the transfer shield to permit manual actuation (through the cylinder) of the plunger to move the grapple pawls. Our comments on the grapple assembly are:

a. If problems are encountered with the grapple parts (e.g., the pneumatic cylinder, its connectors, limit switches), their underwater and unaccessible

location makes it difficult to recover. Since there is already a push/pull rod from the grapple plunger (i.e., down at the canister) all the way up to the top of the transfer shield, the actuating cylinder, air line, switches, etc. do not have to be underwater and unaccessible during canister handling.

We have had trouble occasionally with similar switches, cylinders, etc., and therefore try to locate them above water in an accessible location. This existing push/pull rod feature offers the possibility to re-locate these items in an accessible location if you find that the existing arrangement experiences problems.

b. The grapple drawing indicates that the center shaft of the actuating cylinder is attached to the plunger (#12) that actuates the grapple pawls by means of a roll pin (#18). We have experienced problems with roll pins and normally do not use them in critical applications. Roll pins tend to have high residual stresses and unusually high-strength materials which can be subjected to stress corrosion attack. If the plunger should become disengaged from the actuating shaft, it would be very difficult to disengage the grapple from the canister. It is suggested that you consider a more secure method of fastening the plunger to the actuating shaft (e.g., a weld locked solid pin).

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(1.) The item 11 lifting pawls (Dwg. 1154117E) and the item 12 plunger (Dwg. 1154121C) are specified as ASTM A-564 stainless steel heat

treated to condition H 1075. This corresponds to the heat treatment for type 630 material which is 17-4 stainless steel. From ARMCO Product Data Bulletin S-56b the threshold galling stress for 17-4 stainless steel in contact with 17-4 stainless steel or 304 stainless steel is 2000 psi (unlubricated condition). Also, the Corrosion and Wear Handbook for Water Cooled Reactor (TID-7006 of March 1957) indicated that pendulum slide test (which is comparible to the plunger's and the pawl's action) of 17-4 PH against 17-4 PH of the same Rockwell Hardness valve has very poor wear characteristics. Accordingly, you may want to consider new alternate material combinations for the plunger, the pawls, and the 304 stainless steel housing (on which the pawls pivot) in the event that wear and galling problems are encountered with the current design. Based on data in the Corrosion and Wear Handbook, there appears to be a very good probability that wear/galling could be encountered. This also further emphasizes the need for the study recommended in item #2.e. below to be able to deal with a grapple and converter that will not disengage.

(2.) The toleranced dimensions of the pawls and the inside diameter of the Pawl Housing Assembly (Dwg. 1154125E) should be evaluated to ensure that adequate clearance is provided for the plunger when the plunger is in the fully retracted position. This check of worst case tolerance conditions is necessary to ensure that high contact stresses between the pawls and plunger are avoided since galling of the plunger/pawls could result. The drawing of the Pawl Housing Assembly is needed to make such an evaluation and we do not have a drawing of the housing.

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areas at the bottom of cutouts in the pawl housing. The pawls in essence pivot on a 304 stainless steel surface of pawl housing. While the pawls are heat treated 17-4 PH, the pawl housing is apparently annealed 304 stainless steel. A harder surface is considered necessary at the radiused areas of the pawl housings. Uneven loading of the pawls and/or uneven wear of the pawl housing radii will result in the application of bending force(s) to the plunger where the pawls contact the plunger. If sufficient play exists in the system this could move the special washer over against the wall of the pawl housing. The special washer (Dwg. 115120C) apparently should not contact the inside diameter of the pawl housing when the plunger is retracted; the washer is relatively thin and could wear or bind in the pawl housing.

(4.) The spring (Dwg. 1154124C) expands and contracts in the bore of the plunger housing. Hard chrome plating of the plunger housing is recommended to reduce or eliminate binding and wear if problems are encountered with the existing arrangement.

e. It is suggested that a detailed study be developed (and procedures outlined) for determining how to recover from a case where the grapple does not disengage from a loaded fuel canister. This type problem may be very difficult to handle and some pre-planning would be helpful. This study would define the special platform, shields, tooling and techniques (e.g., raising the movable shields with the canister down in the deep-end of the pool) to be used to obtain release. Such a study may also identify some additional features for the grapple and/or transfer shield to facilitate recovering from this type of problem (e.g., providing access ports in pawls housing assembly (part #8) to gain access to the plunger and pawl area).

f. The release of the grapple pawls from the canister appears to require that the transfer shield weighing system sense that the canister weight is off the grapple, but still support the weight of the grapple assembly, before the release can occur. It may be difficult to properly sense this load transition when there is only a small relative vertical distance between the canister coming to rest before the grapple assembly's weight rests on top of the canister. We suggest you pay particular attention to this potential problem during the transfer shield test program and check-out at TMI-2.

g. The design and operational checks should be made to assure that there is there no chance that the free traveling lead-weighted shuttle shield could temporarily hang up (e.g., from grapple center shaft being off center about 1/4 inch) and then suddenly drop (e.g., up to about 14 feet) before being stopped at the bottom edge of the transfer shield. Our limited review with the available drawings indicate that this may be possible. We suggest you examine this possibility further, particularly for the case where the grapple is almost out of the body of the transfer shield and a free sliding shuttle shield can impact on the upper end of the section of the grapple housing the actuating cylinder. Operational testing should evaluate whether there is any tendency for the hang-up of the shuttle shield.

3. It is also suggested that a study be made and procedures outlined for dealing with a canister stuck in the transfer shield, e.g., keeper latches are bent and will not sufficiently retract when the movable shielded sleeve is lowered. Special shields and platforms may be needed to deal with such a problem.

4. The operation manual in paragraph 7.7.2 (page 50), provides instructions for removal of the hoist. If the instructions are followed verbatim, and grapple is in up position, can the grapple section be dropped in an uncontrolled fashion? Specifically, the manual implies that full tightening of a screw by hand releases the

brake. When the brake is released in this manner, can the grapple section free-wheel downward or will the remaining gearing prevent such free-wheeling? Accordingly, it is suggested that this matter and the associated procedures in the manual be reviewed.

The above comments were orally discussed with Mr. W. Linton (Bechtel - TMI-2) on October 21, 22, and 31, 1985.

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

Sincerely,

Noman M. Cole, Jr.

cc: F. Standerfer
W. Linton
P. Bradbury
S. Levin
GPU-TMI
J. B. Colson
EG&G
TAAG

GPU Nuclear **Memorandum**

Subject: Actions Arising From December 3, 1985 Meeting to Discuss Cole/Sise Comments on Transfer Shields

Date: December 3, 1985

From: Task Leader, Defueling Operations, TMI-2 - P. Bradbury

Location: Three Mile Island Unit 2
4300S-85-0357

To: Manager, Recovery Programs, TMI-2 - W. H. Linton*

Following is a list of actions agreed to as a result of the Cole/Sise review.

A copy of the review itself is attached.

1. SO (Sieglitz) to identify specific needs for improved maintenance drawings to DE.

   DE to provide drawings as requested.

2. DE to prepare package for design mods. (Relates to Comments 2b, c, d). As part of this package, DE will check acceptability of abnormal loads on grapple positioner.

3. DE to recommend options for recovery from stuck canister situation. SE to develop into detailed plan.

4. DE to provide a study relating to shuttle shield drop (Comment 2.g) and make recommendation for further action.

5. DE to review instructions for removal of the hoist, with respect to the concerns raised in Comment 4.

6. SO to conduct γ scan of shield with full canister within the shield.

It is requested that all actions be completed by January 15, 1986 in order to close out all concerns on the transfer shield design.

P. Bradbury
Ext. 8975

PB:jrb

cc: See Page 2

Attachment: Canister Transfer Shield Review

* Meeting Attendees

cc: Director, TMI-2 - F. R. Standerfer
Site Operations Director, TMI-2 - S. Levin *
TAAG - N. M. Cole *
TAAG - E. F. Sise, Jr. *
Manager, Site Engineering, TMI-2 - R. E. Gallagher
Manager, Design Engineering, TMI-2 - R. L. Rider
Manager, Plant Maintenance, Site Ops., TMI-2 - R. E. Sieglitz *
Assistant Project Engineer - G. K. Boldt *
Fuel Handling SRO, TMI-2 - D. D. Hollmann *
Mechanical Engineer, TMI-2 - H. W. Kirkland *
Mechanical Engineer, TMI-2 - R. Preston *

* Meeting Attendees

Draft

MPR ASSOCIATES, INC.

December 3, 1985

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

Subject: Canister Transfer Shield Review

Dear Mr. Hamilton:

We have conducted the requested review of the canister transfer shield based on the drawings forwarded by GPUN letters dated October 11, 1985, and October 29, 1985. This review covers the combined comments of MPR and Newport News members of TAAG. Since this is a review of a transfer shield that has already been manufactured and tested, the review focuses solely on what could be done at this time to improve reliability and/or permit easier handling of problems that could arise. Our review does not concern the overall concept, which was established some time ago. Our comments are as follows:

1. There are three areas of the transfer shield which could be particularly troublesome from a maintenance and operational viewpoint. The existing manufactured drawings of these three areas do not show assembled clearance, alignment required, etc., nor are they particularly helpful for maintenance and troubleshooting operational problems. The three specific areas are:

    a. The entire grapple support column (about 17 feet long in the reactor building transfer shield). The column contains the grapple pawls, pneumatic double-acting cylinder, air supply lines, limit switches and read out cabling, the free moving shuttle shield, etc.

    b. The canister keeper devices in the lower end of the transfer shields' body. These keeper devices are actuated by raising and lowering the approximately 9 foot long movable shielded sleeve. These keepers are to ensure that the canister will not drop out of the transfer shield if a canister should become disengaged from the grapple while moving back and forth between the reactor vessel and the up-enders.

c. Jack screw drive mechanism and the two jack screw shafts that raise and lower the 9 foot long movable shielded sleeve over a distance of about 6 feet. If either one of these jack screw shafts or either of the two drive trains get out of alignment, this could cause binding in one of the jackscrews and machining-type action of metal to occur and/or excessive drag on one side or the other of the movable shield.

Accordingly, it is suggested that assembly drawings be prepared of the above three areas that are tailored for maintenance and troubleshoot operational problems. Such maintenance drawings should show details of locking devices, the cam action such as for the canister keepers, alignment required for keepers, alignment and synchronizing sequence for the jack screw mechanism and drive train, assembled clearance between various critical parts in the grapple support assembly, clearance for the various pushrod-type devices, clearances between various stainless steel wear surfaces where galling problems can occur, etc. It would also be helpful if these maintenance and troubleshooting drawings were tailored for ease of use in containment.

2. <u>Canister Grapple</u> [Drawing 1154155, Rev. 5; part Number is in (# __)]

The pawls of the grapple are actuated by a plunger that is moved up and down to cause engagement and disengagement with the canisters. The plunger is moved up and down by a double acting <u>pneumatic</u> cylinder that is located about a foot above the pawls of the grapple. As such, the cylinder (#17), air lines (#20), and switches (#33) are underwater when engaging and disengaging the canister. The center shaft of the cylinder has a push/pull rod attached which goes all the way to the top of the transfer shield to permit manual actuation (through the cylinder) of the plunger to move the grapple pawls. Our comments on the grapple assembly are:

a. If problems are encountered with the grapple parts (e.g., the pneumatic cylinder, its connectors, limit switches), their underwater and unaccessible

location makes it difficult to recover. Since there is already a push/pull rod from the grapple plunger (i.e., down at the canister) all the way up to the top of the transfer shield, the actuating cylinder, air line, switches, etc. do not have to be underwater and unaccessible during canister handling.

We have had trouble occasionally with similar switches, cylinders, etc. and therefore trying to locate them above water in an accessible location. This existing push/pull rod feature offers the possibility to re-locate these items in an accessible location if you find that the existing arrangement experiences problems.

b. The grapple drawing indicates that the center shaft of the actuating cylinder is attached to the plunger (#12) that actuates the grapple pawls by means of a roll pin (#18). We have experienced problems with roll pins and normally do not use them in critical applications. Roll pins tend to have high residual stresses and unusually high-strength materials which can be subjected to stress corrosion attack. If the plunger should become disengaged from the actuating shaft, it would be very difficult to disengage the grapple from the canister. It is suggested that you consider a more secure method of fastening the plunger to the actuating shaft (e.g., a weld locked solid pin).

c. To facilitate engagement of the grapple to a canister, it is suggested that the "outer" lead-in edges of the three fixed positioners (item 13) on the bottom of the grapple be given a more generous bevel to help guide the grapple into the canister.

d. Materials of grapple pawls, plunger, grapple housing:

(1.) The item 11 lifting pawls (Dwg. 1154117E) and the item 12 plunger (Dwg. 1154121C) are specified as ASTM A-564 stainless steel heat

treated to condition H 1075. This corresponds to the heat treatment for type 630 material which is 17-4 stainless steel. From ARMCO Product Data Bulletin S-56b the threshold galling stress for 17-4 stainless steel in contact with 17-4 stainless steel or 304 stainless steel is 2000 psi (unlubricated condition). Also, the Corrosion and Wear Handbook for Water Cooled Reactor (TID-7006 of March 1957) indicated that pendulum slide test (which is comparible to the plunger's and the pawl's action) of 17-4 PH against 17-4 PH of the same Rockwell Hardness valve has very poor wear characteristics. Accordingly, you may want to consider new alternate material combinations for the plunger, the pawls, and the 304 stainless steel housing (on which the pawls pivot) in the event that wear and galling problems are encountered with the current design. Based on data in the Corrosion and Wear Handbook, there appears to be a very good probability that wear/galling could be encountered. This also further emphasizes the need for the study recommended in item #2.e. below to be able to deal with a grapple and converter that will not disengage.

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areas at the bottom of cutouts in the pawl housing. The pawls in essence pivot on a 304 stainless steel surface of pawl housing. While the pawls are heat treated 17-4 PH, the pawl housing is apparently annealed 304 stainless steel. A harder surface is considered necessary at the radiused areas of the pawl housings. Uneven loading of the pawls and/or uneven wear of the pawl housing radii will result in the application of bending force(s) to the plunger where the pawls contact the plunger. If sufficient play exists in the system this could move the special washer over against the wall of the pawl housing. The special washer (Dwg. 115120C) apparently should not contact the inside diameter of the pawl housing when the plunger is retracted; the washer is relatively thin and could wear or bind in the pawl housing.

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brake. When the brake is released in this manner, can the grapple section free-wheel downward or will the remaining gearing prevent such free-wheeling? Accordingly, it is suggested that this matter and the associated procedures in the manual be reviewed.

The above comments were orally discussed with Mr. W. Linton (Bechtel - TMI-2) on October 21, 22, and 31, 1985.

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

Sincerely,

Noman M. Cole, Jr.

cc: F. Standerfer
W. Linton
P. Bradbury
S. Levin
GPU-TMI
J. B. Colson
EG&G
TAAG

SECTION 4.0

END POINT CRITERIA - IMS

The services of Mr. C. W. Hess from Burns and Roe were provided to GPUN (Mr. J. Devine, task leader) to assist in developing the end point criteria for the Interim Monitored Storage period.

SECTION 5.0

CORE BORING

Several questions were asked of TAAG regarding the planned program sponsored by DOE to bore cores from the damaged fuel and to ship these cores to INEL for evaluation. The questions and answers were recorded in the attached memo dated December 10, 1985.

WILLIAM H. HAMILTON

4601 BAYARD STREET, APT. 307
PITTSBURGH, PENNSYLVANIA 15213
TELEPHONE: 412-683-8826

December 10, 1985

Mr. Frank Standerfer
GPU Nuclear Corporation
P.O. Box 72
Middletown, PA 17033

Dear Frank:

Pursuant to your request that TAAG consider the core bore program for TMI-2, at our meeting on December 9-10, 1985 at TMI, TAAG heard the latest plans with regard to core boring and deliberated the matter at length. The questions we addressed and our responses are as follows:

QUESTION 1

Should the core bore program proceed?

RESPONSE

TAAG discussed with the project personnel (primarily EG&G) the readiness of the equipment, procedures, approvals and training for core boring. This included a tour of the core boring machine which is set up in the TMI turbine building. The status of the defueling and relationship of the core boring to defueling operations was reviewed. From these discussions, TAAG understands that:

1. The core samples are still needed by the DOE/TMI program.
2. The core boring itself and the availability of the core boring machine for other drilling is a potentially useful resource for

defueling operations. The cores may be of little use to defueling unless they are quickly examined. However, the access below the hard crust provided by the core holes will be useful to defueling to better define the condition of the core below the crust.

3. The boring machine has alternate bits to drill four inch diameter (non-cored) holes and extensions to reach to the bottom of the reactor vessel. These could be very useful for later bulk defueling. The drill bit (non-coring) is much faster and simpler to use than the coring tools. It was also noted that the machine cannot remove a core of loose rubble.

4. The development of the machine appears to have been a thorough effort and to have provided a machine with a high probability of success.

5. The necessary software, including safety analysis, operating procedures, and training are in final stages of completion.

6. The coring sequence and physical limits built into the boring machine have given due consideration to precluding loads on the in-core instrument nozzles of the lower head or the lower head itself. The greatest potential for inadvertent loading of the nozzles exists in the centrally located nozzles. The sequence of boring has been proposed to enable inspection from initial boring locations to determine the conditions under the central support plate before boring at that location .

TAAG concludes that the boring should proceed.

QUESTION 2

When should core bore be scheduled relative to the status of the core?

RESPONSE

TAAG concurs with present plans that core samples should be taken after the loose rubble has been removed from the core region by pick-and-place or by vacuuming techniques. If a hole is discovered under the rubble and rubble is discovered in or below the hole, then that rubble should also be vacuumed or picked out.

QUESTION 3

Where should samples be taken? In what sequence should the samples be taken? Should the core boring machine be used for bulk defueling?

RESPONSE

At the TAAG meeting a sequence of the core bores was presented. The first sample was taken from a peripheral position so that a T.V. camera could be inserted in the hole and obtain data looking under the reactor core toward the reactor vessel center.

Another approach would be to sample at the center of the reactor core initially since those are the highest priority samples. An additional consideration is having samples from all the regions of the reactor core.

In addition to the nine samples which are now planned to be drawn from the reactor core, provision has been made to take samples in the region below the reactor core. Further, provision has been made for drilling through the reactor core with a 4" flat surfaced diamond cutter. This drilling can be done either in the reactor core region or in the region below the reactor.

The question of sequencing the bores involves the possibilities of several core bores in the reactor core region or in the region below the reactor, or of drilling holes in the crust or in the lower vessel region -- four types of use of the boring machine. The sequencing of these four uses of the machine will be heavily dependent on the data acquisition work done between the present time and the time of the first bore. The sequencing of the bores will also be dependent on conditions in the vessel at the time of boring, such as water clarity. There is concern in TAAG that the core boring process will seriously reduce water clarity where it may require proceeding with drilling without waiting for T.V. examination of already drilled holes.

Sequencing will also be impacted by the findings from previously drilled holes.

Recognizing the day-to-day data which will affect the sequencing of core bores and drilling, it is the TAAG recommendation that flexibility

in sequencing be written into the procedures now, and that a task force or joint core boring and drilling group be established to meet daily as the core boring progresses to adjust the sequence of operations as current data is examined.

The above comments and recommendations are submitted for your use.

Sincerely,

William H. Hamilton
Chairman, TAAG

WHH/RLV/ad

cc: Dale Uhl, EG&G
David McGoff, DOE
Ray Schwartz, EPRI
William Travers, NRC

SECTION 6.0

END POINT ISSUES

TAAG continued through the period of this report to work with the GPUN Task Force (J. Devine, leader) in the development of the strategic plan for the clean-up of TMI-2. For example, at the January meeting TAAG suggested that, in the deactivation of systems, removal of fuses or breakers or closing of valves not be relied upon for assuring shut down. Rather cut or remove cables and pipes. But, generally, TAAG was highly impressed with the thought processes in the task force report and endorsed the proposals therein.

Regarding the decontamination of the basement, TAAG continued to propose that leaching of the cesium from the basement concrete be considered a viable option and that experimental work be done to confirm the leachability of concrete. A letter to GPUN to this effect was sent on January 2, 1986. It is attached hereto. This was the first letter in a series to be continued into the next report period.

In light of the TAAG persistence on this matter, GPUN agreed to reconsider basement reflood as an option for reducing basement radiation levels for the end of the IMS period.

The initial TAAG interest in this matter of leaching cesium from the basement concrete stemmed from some early work at Oak Ridge. This early work is reported in an informal memo from Dr. Campbell of Oak Ridge to Mr. Wagner of Carolina Power and Light. The memo is attached hereto.

Some specific suggestions were made regarding the experimental program: 1) obtain core bores from the walls close to the floor of the basement; 2) experiment with flooding the elevator pit or the entire basement to a shallow depth; 3) scan the outside of the D-ring structures.

1/6/86-cc: R. Vree

JAN 8 1986

P. O. Box 613
Ligonier, PA 17057

January 2, 1986

GPU/T-5084

Mr. Franklin R. Standerfer
Director, TMI-2
GPU Nuclear
P. O. Box 480
Middletown, PA 17057

TMI-2 TECHNICAL ASSISTANCE AND ADVISORY GROUP (TAAG)
REVIEW OF PHASE III END POINTS
CESIUM AND STRONTIUM IN THE REACTOR BUILDING BASEMENT

Dear Mr. Standerfer:

During the December 9 and 10 TAAG meeting, Jack DeVine and his task force presented their work on definition of Phase III end points and actions to achieve Interim Monitored Storage (IMS). The condition of the fission products in the reactor building basement weighs heavily upon a definition of end points and the course of action to achieve them. Fission products of interest are Cesium 137, which dominates the dose rates and Strontium 90, which dominates the off-site release limits.

The fundamental characteristics that are pivotal are the physical location and mobility of these two radionuclides associated with the concrete of the reactor building basement. The task force is basing its considerations on the idea that these fission products are on or near surfaces of the concrete, can be removed by washing or other shallow surface treatment, and the residual during IMS will be relatively immobile. Conclusive data on these characteristics are not available. TAAG noted that, should the fission products be deeper in the concrete or be more mobile than estimated, the effectiveness of the IMS actions could be impaired.

At the TAAG meeting, we agreed to review this subject and provide to you our TAAG comments. This letter summarizes this review and our comments. It presents 1) our understandings of the facts, 2) related preliminary Phase III end points, 3) TAAG concerns, 4) TAAG recommendations.

Facts

Information has been developed throughout the TMI-2 cleanup that relates to the effects of Cesium and Strontium in the basement. Much of this information was obtained as a by-product of cleanup activities or from other sources as opposed to a concerted data acquisition effort.