L. Weller R.A.W.
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File
Solid Waste

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 15 1980

MEMORANDUM FOR: Bernard J. Snyder, Director
TMI Program Office

FROM: Robert E. Browning, Deputy Director
Division of Waste Management, NMSS

SUBJECT: MEETING BETWEEN BNL AND GPU REGARDING WASTE SOLIDIFICATION

Please find enclosed a copy of the Brookhaven National Laboratory (BNL) meeting notes covering a meeting between representatives of BNL, General Public Utilities, and Bechtel Corporation held on March 6, 1980. This meeting concerned the solidification of resins and evaporator bottoms in cement.

Robert E. Browning
Robert E. Browning, Deputy Director
Division of Waste Management, NMSS

Enclosure: as stated

cc w/encl:
J. T. Collins ✓
R. Bangart

BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

DATE: 3/18/80

TO: D. G. Schweitzer

FROM: A. J. Weiss

SUBJECT: Summary of discussion with TMI representatives at BNL.

ATTENDEES:

W. Kato	BNL	Jack DeVine	GPU
A. Weiss	BNL	Arshad Navaz	GPU
P. Soo	BNL	Jim McIlvaine	Bechtel
P. Colombo	BNL	Richard Lyman	GPU
R. Neilson	BNL		
H. Manaktala	BNL		

While you were at Silver Spring on NRC business, a group from TMI, composed of representatives from GPU (General Public Utility) and Bechtel, visited BNL on March 6, 1980 to discuss solidification of dewatered resins and evaporator bottoms in cement. Many questions were asked by the TMI group which could not be answered by BNL because they involved speculations and recommendations. W. Kato informed the group that BNL would be able to answer questions relative to our experience with cement solidification, but that any conclusions drawn by TMI are their own and that BNL accepts no responsibility for them.

The area of major interest addressed the question whether cement is an acceptable solidification agent for evaporator bottoms and dewatered resins from the "Epicor II system."

NRC presently requires that TMI develop a system for solidifying the resins before shipping them for burial. TMI proceeded to process the decontaminated water while searching for a solidification system. They investigated three systems: cement, vinyl-ester styrene (Dow process), and bitumen, and chose cement. The bitumen process was not readily available and the Dow process had not been demonstrated on a large scale. A total of 200 55-gallon carbon steel containers, each having radiation levels of 500-1000 R/hr, are expected to be generated. TMI is building storage capacity for the solidified waste drums for an indefinite period of time before burial. At the present time the hot resins are being stored in the Epicor liners until solidification is accomplished.

Jim McIlvaine discussed problems that have been identified with cement solidification of resins viz, that the solidified waste form swells and cracks. The types of questions that were asked, for which answers were not available include:

(a) Do we know the failure mechanism that causes swelling of the waste form?

(b) Why do resins, especially the cationic type, swell? Is it due to ionic charge or sorption?

(c) Can we predict how long after mixing and settling will it take for a solidified waste form to fall apart?

(d) What will be the consequences of addition of excess sodium hydroxide to the waste before solidification? Will the radioactivity be released from the resin and not incorporated in the solid matrix?

(e) What is the state-of-the-art of Canada's experience with cement/resin?

(f) Should TMI use the sodium or ammonium form of EDTA with regard to solidification?

(g) How much of a problem will they encounter from radiolysis of the EDTA waste?

(h) What method could be used to speed up solidification of evaporator bottoms?

TMI and their contractor are not conducting experiments along these lines because of finances.

J. DeVine asked if technical help is available from BNL. W. Kato responded that if solutions were required within three months it would be better to get help from a consultant. If it is recognized as a national problem, BNL could do the work under sponsorship of DOE or NRC. J. DeVine indicated that if resin waste cannot be solidified in cement, TMI's options were to consider asphalt, vinyl-ester styrene, or to convince NRC to release them from the commitment to solidify the resin beads. TMI was hoping to have the cleanup completed within one year.

The meeting was adjourned with the expectation that TMI would approach NRC for assistance.

AJW:gfs
cc: H.J.C. Kouts
W. Y. Kato
P. Soo

BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

T. Johnson
(for your info)
Sp

DATE: 3/19/80

TO: D. G. Schweitzer

FROM: A. J. Weiss AJW

SUBJECT: SUPPLEMENTAL MEMO - Meeting with representatives of TMI at BNL.

This memorandum is a supplement to the memorandum dated 3/18/80 to D. G. Schweitzer from A. J. Weiss.

While you were at Silver Spring on NRC business, a group from TMI visited BNL on March 6, 1980 to discuss solidification of dewatered resins in cement. The data that we have reported as part of the NRC research program "Properties of Radioactive Wastes and Waste Containers" concerning solidification and leaching of various power reactor wastes has identified us as experts in this area.

The TMI group asked questions concerning our experience with the solidification and leaching of dewatered mixed-bed resins, and asked us to predict what consequences would be expected if various parameters of the waste and binder were varied.

After the accident at TMI, the NRC required that GPU solidify the resin waste that will be produced from decontaminating the water in the Containment Building. GPU agreed to this and investigated three systems that are currently available for this purpose, viz, cement, vinyl-ester styrene, and bitumen. They had decided to use the cement system since the technology was immediately available. The Dow system had not been demonstrated for large scale, and the bitumen system is marketed by a German firm and would not be available for one to two years. Since that time, experience has shown that there are some difficulties associated with solidification of ion-exchange beads in cement, and that as a result of swelling, the waste form doesn't have the same integrity as other cement solidified waste forms.

My personal interpretation of TMI's objectives is that they want to establish that there are no readily available methods for proper solidification of the cation and mixed bed ion exchangers, and that NRC should allow them to dispose of the waste as dewatered resins (nonsolidified). They tried several times to get us to support this viewpoint. Dewatered resins satisfy shipping requirements of the Department of Transportation and are being buried at commercial sites. However, the total activity expected in these TMI resins (approximately 200 drums at 1000 curies per 55-gallon drum) represents more than two years combined activity normally disposed at a commercial site.

At the present time TMI has drums of contaminated resin waiting for solidification. The utility is constructing storage silos to accommodate all the solidified drums for an indefinite period of time in anticipation of disposal sites becoming available in the eastern U. S. When asked why they could not store all of the nonsolidified resins in the same drums in which they will be later solidified, the response was related to the economics of handling the drums twice.

I believe that it will be more expensive in the long term to rectify the error of allowing burial without solidification or of choosing the wrong solidification procedure. Since the capacity for storage of the waste will be available at TMI, it should be stored there until the proper disposal technique is available or until it is shown that there are no alternatives.

The Dow Corporation has successfully solidified dewatered resins and claims that their process would handle the TMI waste. We should do confirmatory testing of the Dow and bitumen processes within the scope of our research program, before NRC (pressured by TMI) allows cement solidification or no solidification before burial.

AJW:gfs

cc: H.J.C. Kouts
P. Soo
W. Kato

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Solid Waste

John Collins

Their component test did not meet 0.5% remaining water requirement (see clipped pages). Nevertheless, they have proceeded with liner dewatering test. ~~Cap~~ Cap-Gun is performing these tests at site and we will followup (Tim Johnson is reviewing this report also). This report is a progress report on dewatering test and intended for keeping us informed.

Jay L—

O R Bellamy ~~O J Lee~~ For review & comments

RRB 5/8/80 comments indicated

METROPOLITAN EDISON COMPANY Subsidiary of General Public Utilities Corporation

Subject Spent Resin Liner Dewatering Study

TMI-II-R-6655

Location TMI/U-2 Site Ops

Date April 30th, 1980

To G. K. Hovey

Phase II of the Spent Resin Liner Dewatering Study is continuing as projected. The objective of the Phase II Program involves reducing the free standing water content of a Spent Resin Liner to 0.5% by volume or 1.0 gallon, which ever is less. This criteria must be achieved to bury spent resin liners from January to July 1st, 1981. This testing program is predominantly in support of the EPICOR II Radwaste System but has generic application to TMI Unit II Spent Filter Liners, SDS, TMI Unit I and Oyster Creek. (Note: The Phase I TMI Dewatering Study was required to allow the Oyster Creek Torus Water Cleanup Project to commence in March 1980.) The period of applicability has some dependence on the activity deposited in a resin liner, however for TMI Unit II concerns it is mainly limited to July 1st, 1981. After this date liners must be solidified to be buried.

The attached Preliminary Report provides a discussion of one section of this Phase II Program. Although not complete, this document details the use and testing of a specialized moisture absorbant material. As the testing is completed this document will be updated A discussion of sections two and three will be available as testing is completed.

R. J. McGoey

R. J. McGoey
Manager, Process Support

RJM/jw

cc: J. Barton
R. Wilson
C. Negin
M. Crook
J. Devine
L. Lehman
M. Augenblick
File

INTER-OFFICE MEMORANDUM

PRELIMINARY

TMI UNIT II

SPENT RESIN LINER

DEWATERING STUDY

PHASE II

APRIL 28, 1980

PROCESS SUPPORT GROUP

R. J. McGoey
M. Crook (NUS)
R. Naylor (Cap-Gun)

TMI - UNIT II

"SCALED-DOWN RESIN LINER DEWATERING

and

MOISTURE ABSORBANT INJECTION STUDY"

TABLE OF CONTENTS

TMI - UNIT II

"SCALED-DOWN RESIN LINER DEWATERING and MOISTURE ABSORBANT INJECTION STUDY"

I. BACKGROUND

Because of the nuclear industries concern over free-standing water in containers destined for burial, Three Mile Island has been investigating the dewatering of "spent" resin liners used extensively for the clean-up effort now in progress. In this regard, a series of dewatering tests were conducted on an actual "6 x 6" liner to determine the amount of free-standing water that can be expected to remain in a completely dewatered liner. The results of these tests were detailed in the "Three Mile Island Unit II Resin Liner Dewatering Study", submitted November 30, 1979 to the NRC.

Since the above study indicated that despite exhaustive efforts to remove all free-standing water small amounts still exist, it was decided that further testing involving various means of capturing (absorbing) this water were necessary. However, utilizing a full-sized liner for more stringent analysis was deemed infeasable; thus, the concept of a scaled-down version provided the solution.

II. DISCUSSION

A. Objectives

It is the intent of this test program to: 1) document the ability of moisture absorbant material (pre-tested in the laboratory) to capture free-standing water in a resin liner and retain this water; 2) to determine the amount of moisture absorbant material required to completely absorb different quantities of water; 3) to analyze the effects of the material on resin (i.e., damaging resin beads and perhaps releasing of resin-bound radioisotopes), and the demineralizer vessel shell (possible corrosive attack.)

NOTE: At no time during any of the testing sequences will radioactive water be used. All water will be demin. water.

Since a separate program study is being developed to identify possible internal design changes to improve dewatering efficiency, this program will not be involved with such research. However, the test apparatus constructed for this study may be used in other areas of investigation.

B. Design Criteria

In order to achieve the objectives in Section A, the test liner overall configuration should satisfy three basic requirements; they are as follows:

1. The test liner should, within reason, closely approximate the physical and hydraulic characteristics of a full-sized liner. This includes both the vessel and its internals.
2. The test unit should allow viewing the internals

Continued -

during operation (transparent).

3. The entire test apparatus should be capable of easy disassebly for inspection. Primarily, this means having the ability to remove the resin bed and discharge laterals.

Within this framework, considerations such as vessel size, product availability, and other variables were carefully analyzed. For complete details on physical and dimensional characteristics of the test vessel, vessel internals, and the test system, refer to Table 1 and Figures 1 & 2 immediately following this section.

NOTE: Due to the fact that all test objectives and operations pertain to dewatering activities, no consideration was given to any vessel components except the vessel shell and the discharge lateral assembly.

(Proprietary Information)

TABLE 1

PROJECT DIMENSIONAL DATA

	Test Liner (2'x 2')	Full-Size Liner (6'x 6')
1. Diameter		
2. Wall Thickness		
3. Height		
4. Volume, Vessel		
5. Volume, Resin		
6. Volume, Water		
7. Volume, Disch. Laterals		
Total		
Piping		
Filter Elements		

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LATERAL CONFIGURATION

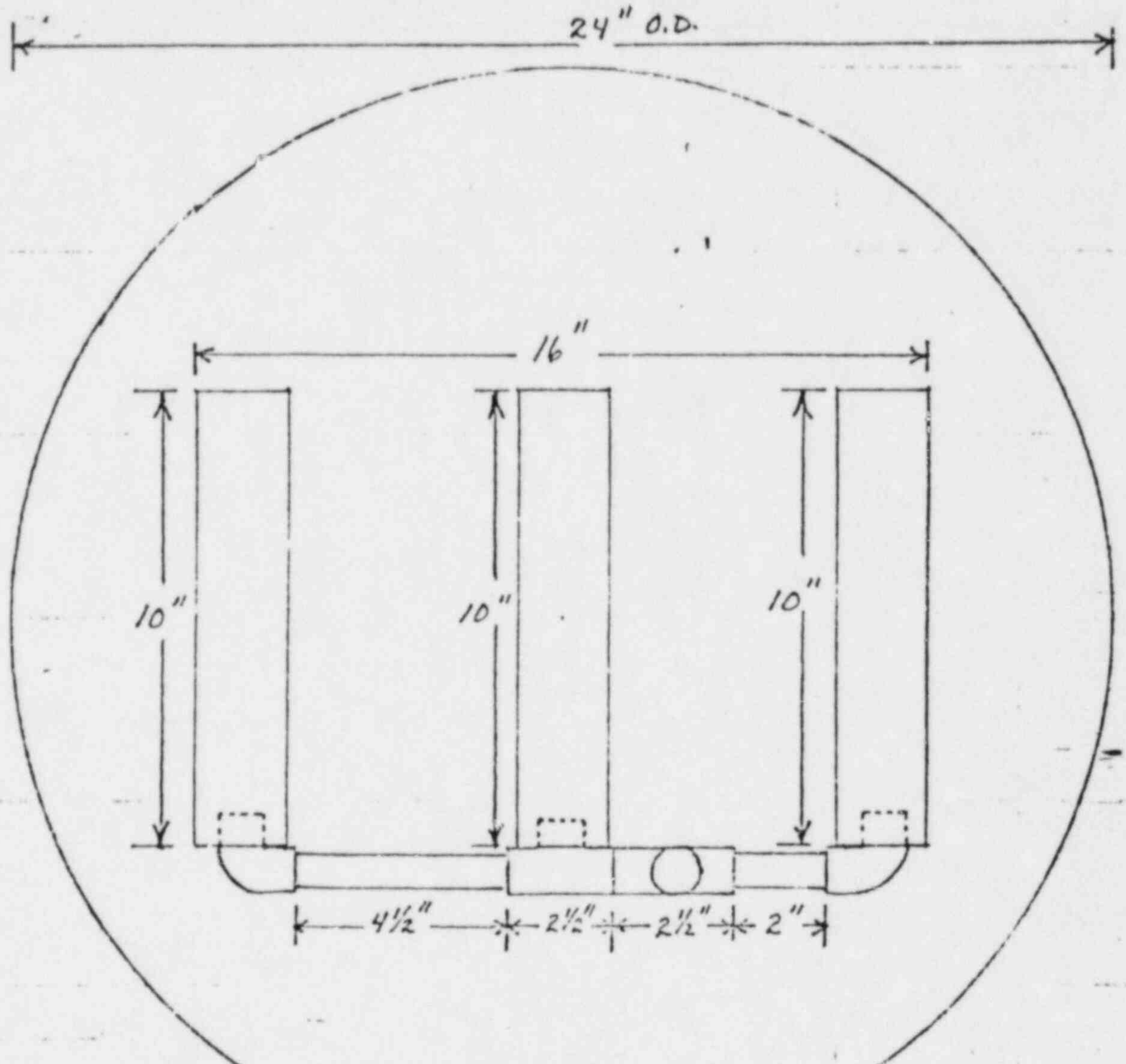

FIGURE 1

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TEST APPARATUS

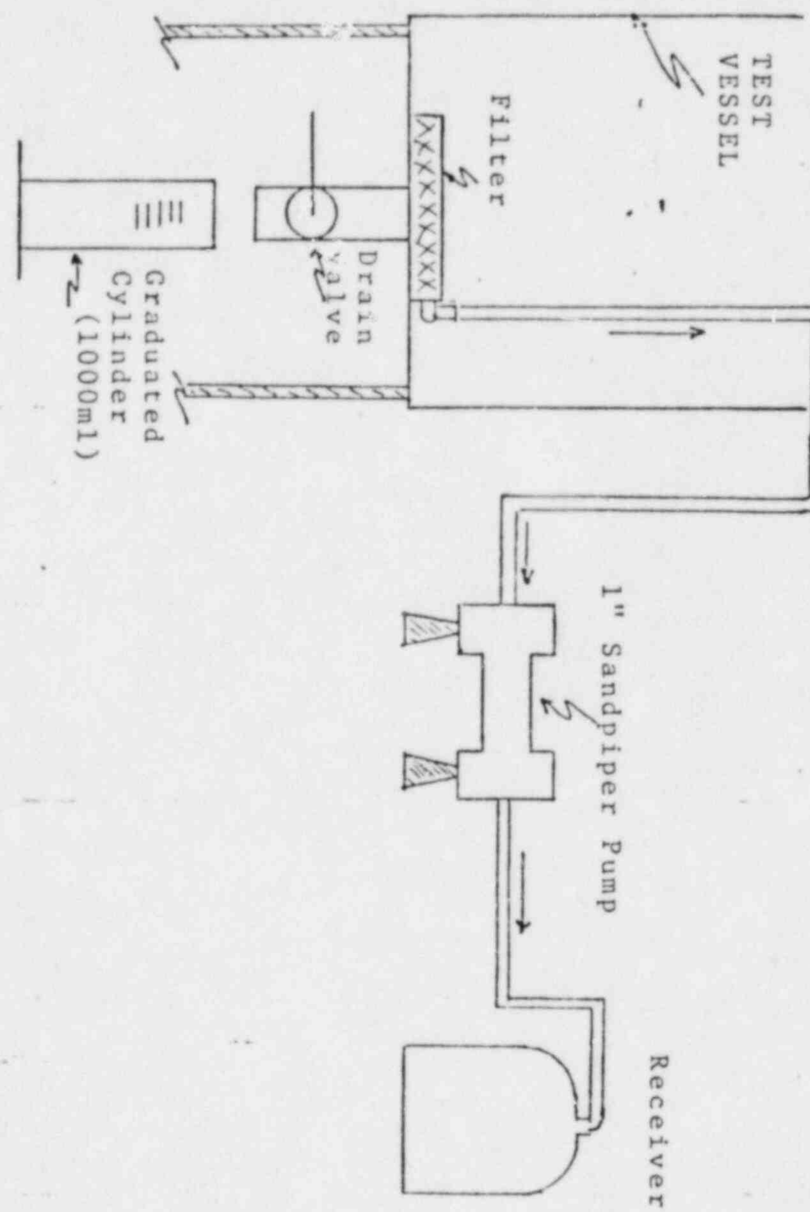


FIGURE 2

III. Test Liner Functional Tests - Preliminary

NOTE: Prior to the actual construction of the permanent test liner, several tests were necessary to corroborate calculations and to prove component/system design. To accomplish these tests a 2' diameter acrylic tube was selected to serve as the test vessel. Each of the succeeding tests sections describes, in detail, the objectives of the particular test conducted, and the final results. The actual test procedures are included as Attach(s) 1 - 4.

A. Component Tests

1. Resin Filter (2½" Dia.) Dewatering Test (Attach. 1)

a. Objectives

During the design phase, it became clear that small filter elements were not readily available with the same characteristics and construction as those contained in a full-size liner; it was, therefore, decided to utilize "Full-size Filter Elements", if possible. The main concern with this action was whether this element could remove all water from the smaller test liner. The objective of this test was to ensure that such an element could satisfactorily extract all water from a small vessel despite the fact that the water level will eventually decrease below the centerliner of the element's suction tube.

b. Results

Due to the capillary action of the wound filter

Continued -

material and the evaporative effect of air flowing past the filters fibers (once suction was lost), the filters completely removed all water from the container while the pump was in operation. Once the pump stopped, however, there was an apparent water seepage/drainage back into the resin portion of the vessel. This seepage is from free standing water draining from the interstitial free standing water space of the resin or from moisture retention in the filter elements. The Dewatering Procedure presently in use at TMI and demonstrated by the previous Dewatering Program accounts for such seepage by time sequenced pumping - draining cycles. In such a manner this accumulation is minimized. It is the objective of the Phase II Dewatering Program to minimize the amount of this water. This test showed the percentage of water remaining (to initial fill) was 0.65%. Although this does not reflect the full Dewatering Procedure aspects in operational use, the results show that the Resin Filter used for this test acts similarly as full size elements within acceptable tolerances.

2. Resin Filter (reduced dia.) Filter Test (Attach. 2).

   a. Objectives

   Although a 2½" diameter filter element could completely dewater a small vessel, the volumetric proportion of the full-size element permitted the use of only two such elements in the 2' x 2' test liner (consistent with scale proportions to a 6' x 6' liner). This was

Continued -

unacceptable because of the relatively large bottom surface area of a test liner. Thus, it was necessary to test the filtering capabilities of a filter with a portion of original material removed (allowing the use of more elements in the lateral design). The objective of this test was to determine if an original element (2½" dia. x 10" long) could be stripped of material to a diameter of 1-3/4" and still retain its filtering capabilities.

b. Results

The test indicated that no appreciable degradation of its filtering characteristics occurred as a result of a reduction in diameter. Using two coffee filters to filter 5 gallon of discharge water (after approx. 15 gallons were flushed through the test liner), the test showed no visible evidence of resin beads or fines.

3. Test Liner Dewatering Test - Preliminary - (Attach. 3)

a. Objectives

no you did not see previous page

Upon successful completion of the dewatering and filtering tests (Attach. 1 & 2), the interim design for the lateral configuration was formulated. The objective of this test was to determine if the design compares favorably in hydraulic performance to the current configuration in a 6' x 6' liner. The results of this test should identify a need for design changes in the test laterals prior to construction of the permanent test vessel.

b. Results

(Later)

Continued -

4. Moisture Absorbant Backflow Test (Attach. 4)

a. Objectives

Although the absorbant fluid slated for this test study has been laboratory tested, no real experience is available on its ability to flow through the filter elements used in the liners. This test will, first of all, verify that the fluid will extrude through the filter material satisfactorily. And, second, highlight any problem areas with getting the absorbant to flow out of several elements connected in parallel (If any problems arise with the test laterals - 3 in parallel - then problems may occur in the more complex configuration of a 6' x 6' liner).

b. Results

(Later)

IV. Test Liner Equivalency Verification Test (Transparent Liner)

Note: This test section will determine if the permanent test liner and system satisfies projected performance on a scale to the full-size liner. Each section describes, in detail, the objectives of the test and the final results. The actual test procedure is included as Attach. 5.

A. Loading/Dewatering Test (Attach. 5)

1. Objectives

The objectives of this test are to verify that the calculations used to arrive at the various volumetric and dimensional figures for the test liner are correct, and that the test liner performs as predicted as a scaled version of a 6' x 6' liner. The areas of concern are resin volume, water volume, and the dewatering characteristics of the entire system.

2. Results

(Later)

B. Summary

(Later)

continued -

V. Test Liner Dewatering/Moisture Absorbant Injection Tests.

(Later)

VI. Summary

(Later)

ATTACHMENT 1

RESIN FILTER (2½" Dia.) DEWATERING

TEST PROCEDURE

1.0 REFERENCES

1.1 Drawing of Filter Assembly, Figure 1

1.2 Drawing of Test Apparatus, Figure 2

2.0 LIMITS AND PRECAUTIONS

None

3.0 PREREQUISITES

3.1 Ensure that sufficient air and water supplies are available to the test stand area.

3.2 Ensure that the following equipment/materials are available for the test:

3.2.1 Two (2), 2½" Dia. x 5" long filter elements (consists of a 10" long full-size element cut in half).

3.2.2 One (1), 5 gallong plastic container (to serve as vessel).

3.2.3 One (1), 1" sandpiper pump.

3.2.4 Hoses and fittings for suction and discharge piping for pump.

3.2.5 Graduated container (1000ml).

4.0 PROCEDURE

______ 4.1 Construct filter assembly as shown in Figure 1.

______ 4.2 Place filter assembly into 5 gallon container ensuring that assembly sets flat on bottom of vessel. Hook up hoses and pump. See Figure 2.

______ 4.3 Using the 1000ml. container, fill the 5 gallon vessel with 12 liters of water.

continued -

______ 4.4 Start the pump and dewater the container until loss of suction; continue pumping for 20 minutes.

______ 4.5 Check to see that <u>all</u> water is removed from the vessel while pump is operating.

Yes__________ No__________

______ 4.6 Stop the pump; wait for 10 minutes.

______ 4.7 Remove the filter assembly from container.

______ 4.8 Pour the entire contents of vessel into 1000ml. graduated cylinder. Record amount.

78ml

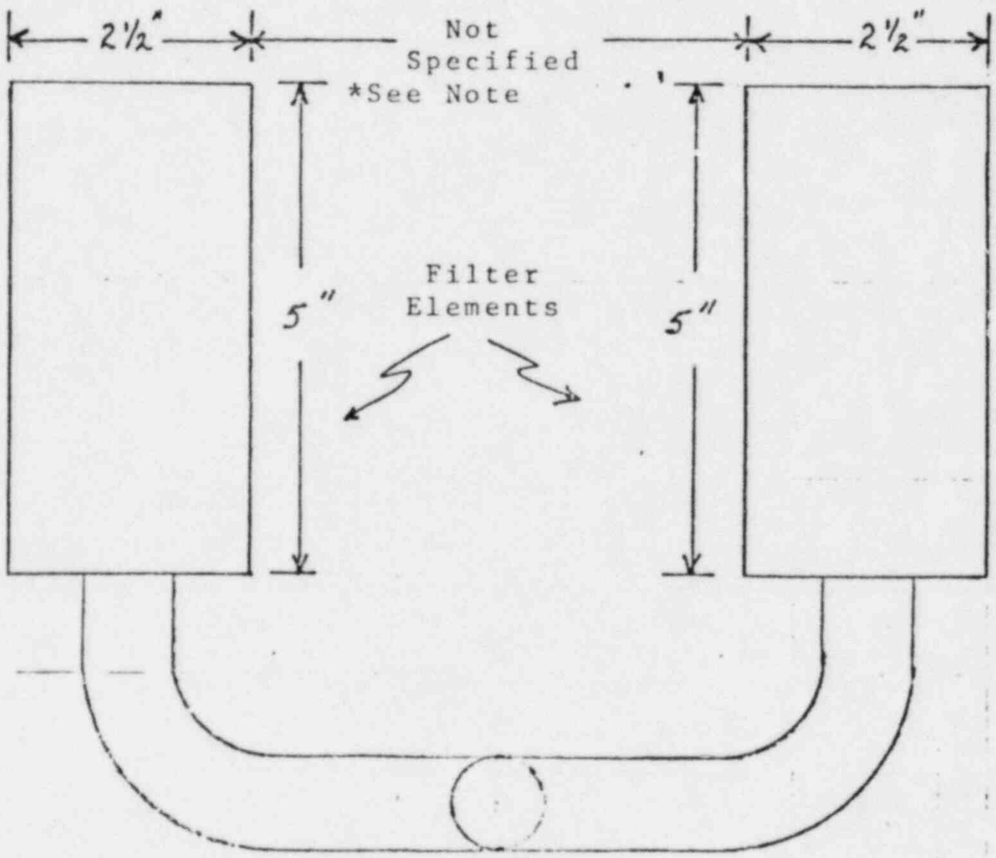
______ 4.9 Using the value obtained in step 4.8, calculate the percentage of total amount loaded in step 4.3.

$$\frac{78\text{ml (Step 4.8)}}{12{,}000\text{ (Step 4.3)}} \times 100 = .65\%$$

<u>End of procedure</u>

DEWATERING TEST FILTER

ASSEMBLY



NOTE: Use available "els" and "T's" to assemble the filters such that the unit will fit into the 5 gal. container (10½" dia.)

FIGURE 1

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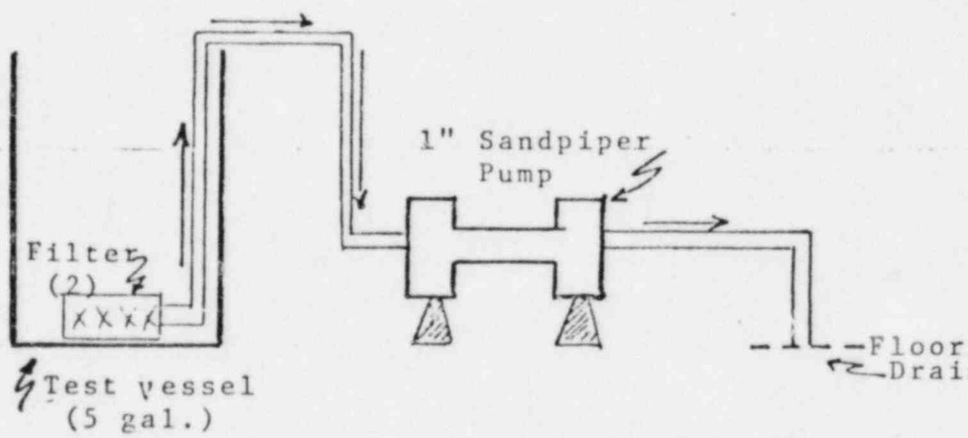
DEWATERING TEST APPARATUS



Other equipment (not shown): Graduated Cylinder (1000ml)

FIGURE 2

ATTACHMENT 2

RESIN FILTER (REDUCED DIAMETER) FILTERING

TEST PROCEDURE

1.0 REFERENCES

1.1 Drawing of Filter Assembly, Figure 1

1.2 Drawing of Test Apparatus, Figure 2

2.0 LIMITS AND PRECAUTIONS

None

3.0 PREREQUISITES

3.1 Ensure that sufficient air and water supplies are available to the test stand area.

3.2 Ensure that the following equipment/materials are available for the test:

3.2.1 One (1), 1-3/4" Dia. x 10" long filter element (consists of a 10" long, full-size element with sufficient filter material stripped off to reduce the diameter to 1-3/4".

3.2.2 One (1), 5 gallon plastic container (to serve as a test vessel).

3.2.3 Approximately 1Ft.^{3} of any type resin.

3.2.4 One (1), 1" samdpipe pump.

3.2.5 Two (2), clean 5 gallon plastic containers (to serve as discharge receivers).

3.2.6 Two (2), paper coffee maker filters.

3.2.7 One (1) funnel.

4.0 PROCEDURE

_______ 4.1 Assemble the filter assembly as shown in Figure 1.

Continued -

______ 4.2 Place filter assembly into test vessel as close to the bottom as possible. Hook up hoses and pump. See Figure 2.

______ 4.3 Load the test vessel with $1Ft^3$ of any resin.

______ 4.4 Fill the test vessel with water. Shake the vessel such that voids are filled with resin and water.

______ 4.5 Place discharge hose into floor drain and start the pump. Continuously fill the test vessel, while pumping, for 5 minutes. This will flush out the hose and pump cavities.

______ 4.6 Stop the pump and place the discharge hose into a clean, 5 gallon receiver.

______ 4.7 Start the pump and continuously fill the test vessel until the receiver is full.

______ 4.8 Stop the pump. Ensure the test vessel is full of water.

______ 4.9 Place the discharge hose into the emply 5 gallon receiver.

______ 4.10 Start the pump. Alternating the two 5 gallon receivers, pump three (3) receiver volumes continuously through the test vessel. At the completion, ensure that one receiver is full.

______ 4.11 Stop the pump.

______ 4.12 Place the two paper coffee filters into the funnel then place the funnel into the neck of the empty receiver.

______ 4.13 Pour the full receiver into the funnel and drain <u>all</u> of the contents into the empty container.

______ 4.14 Inspect the filters for signs of resin beads of resin fines. Document the results below.

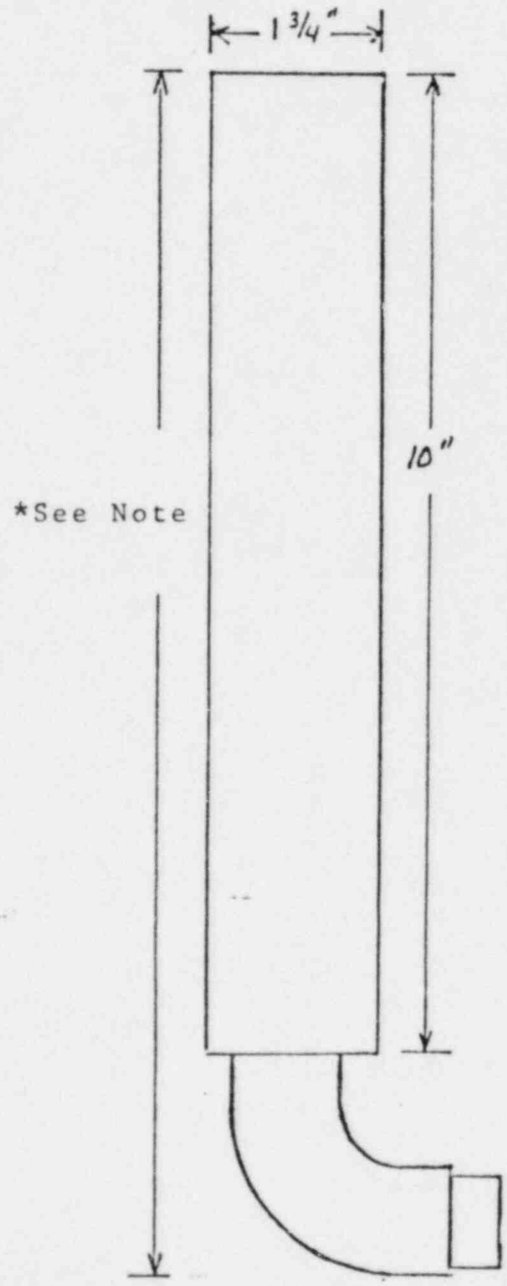
Resin Beads - Yes____ No____
Resin Fines - Yes____ No____

Remarks - There were no signs or evidence of any kind of resin particles. Only fine particles of dirt were found.

<u>End of procedure</u>

FILTERING TEST FILTER

ASSEMBLY



NOTE: Use available "els" to construct unit to fit into test vessel (10½" dia.)

FIGURE 1

NUS CORPORATION

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FILTERING TEST

TEST APPARATUS

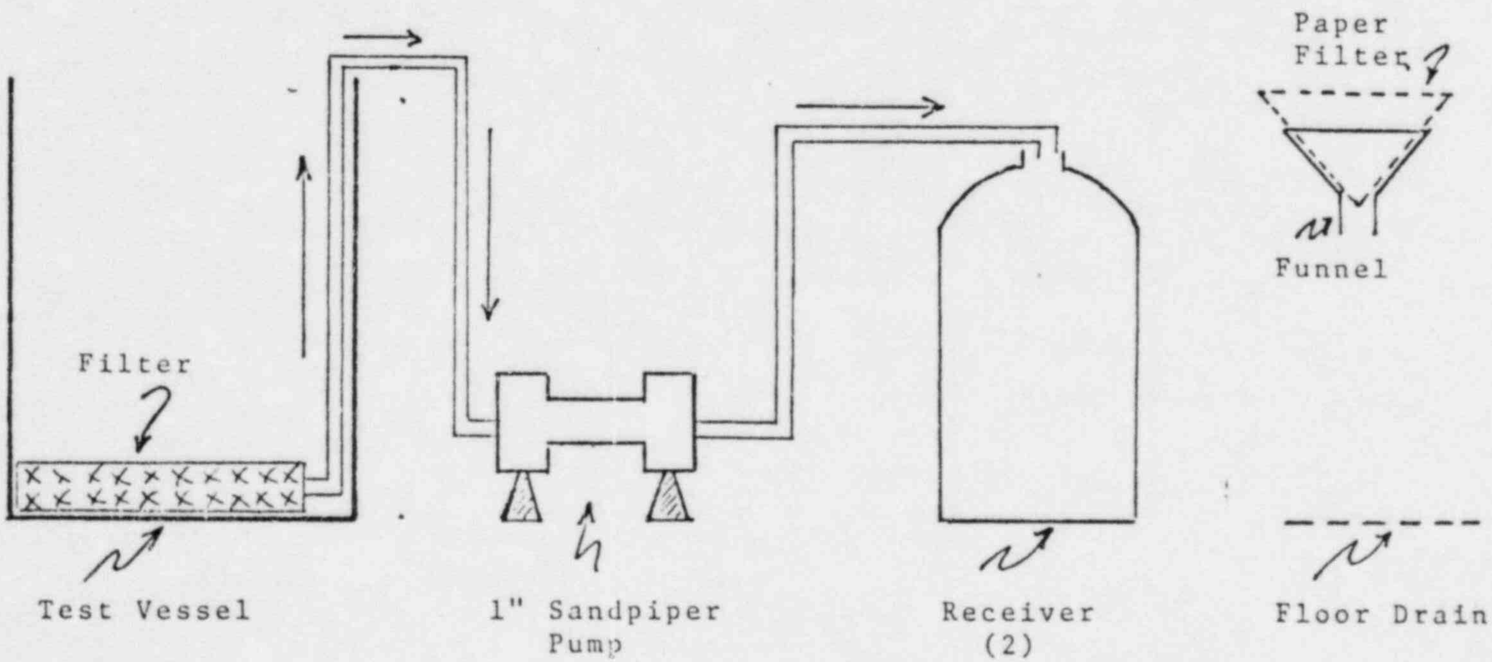

FIGURE 2

TABLE 1

VII. TEST LINER DIMENSIONAL DATA

A. Test Liner Dimensions

1. Diameter	=	23.5" I.D.
2. Height	=	24"
3. Volume	=	5.89Ft^3

B. Test Liner Internals Dimensions

1. Volume (Laterals)	=	.056FT^3
2. Volume H_2O (Total)	=	13.4 Gal.

TABLE 2

VII. TABLE OF ESTIMATED TEST DATA

Description	Estimated Value
1. Reşin Height (Before Compaction)	20.1 inc.
2. Resin Height (After Compaction)	19.5 in.
3. Water Height (After Resin Compaction)	20.0 in.
4. Amount Free Standing Water Remaining	.041 Gals. (7.44fl.ozs.) (155ml)
5. Percentage of Free Standing Water Left/ Total Free Stand Water	31%

ATTACHMENT 3

TEST LINER DEWATERING TEST PROCEDURE

(PRELIMINARY)

1.0 REFERENCES

1.1 Resin Filter (2½" Dia.) Dewatering Test Procedure, Attachment 1.

1.2 Resin Filter (Reduced Dia.) Filtering Test Procedure, Attachment 2.

1.3 Drawing of Filter Assembly, Figure 1.

1.4 Drawing of Test Apparatus, Figure 2.

1.5 Capolupo-Gundal Liner Dewatering Procedure, CG-1079-0086 Rev. 2.

1.6 Capolupo-Gundal Liner Loading Procedure, CG-0480-0229 Rev. 5.

2.0 LIMITS & PRECAUTIONS

None

3.0 PREREQUISITES

3.1 Ensure that sufficient air and water supplies are available to the test stand area.

3.2 Ensure that the following equipment/materials are available for the test:

3.2.1 Two 24" Dia. acrylic cylinders with bottom plates.

3.2.2 Three (3), 2½" Dia. x 10" long filter elements. These filters are to have filter stripped off to reduce the diameter to 1-3/4".

3.2.3 Drain assembly (to be installed on test liner).

3.2.4 PVC piping, "T's" and "EL's" to be used for the discharge laterals.

3.2.5 One (1) graduated cylinder (1000ml).

3.2.6 Approximately 5 - 10FT^3 of various types of resin.

Continued -

4.0 PROCEDURE

_____ 4.1 Test Liner Construction

_____ 4.1.1 Construct a test liner approximately a 2' x 2' cylinder using an acrylic cylinder.

_____ 4.1.2 Install drain assembly with valve onto the bottom of the test vessel, near the center.

_____ 4.1.3 Assemble the test liner discharge laterals per Figure 1.

_____ 4.1.4 Assemble the hoses, fittings, and pump per Figure 2.

4.2 Test Liner Resin/Water Loading

_____ 4.2.1 Check the drain valve closed, then fill the drain assembly until the water level is even with the vessel bottom.

_____ 4.2.2 Open the drain valve and drain the assembly into the 1000ml graduated cylinder. Record amount collected.

_____ ml

_____ 4.2.3 Load the test liner with $5.25FT^3$ of any resin. Measure the resin height. Record the height. (See enclosure 1)

_____ in.

_____ 4.2.4 Load the test liner with 13.4 gallons of water and then recirc. for 1 hour.

_____ 4.2.5 Measure the resin bed height. Record the height.

_____ in.

4.3 Test Liner Dewatering Test (Enclosure 2)

_____ 4.3.1 Start the pump. Upon loss of suction, continue to pump for one (1) hour.

_____ 4.3.2 Stop pump and wait for one (1) hour.

_____ 4.3.3 Restart the pump and continue to pump for one (1) hour after loss of suction

_____ 4.3.4 Stop the pump and wait for one (1) hour.

Continued

______ 4.3.5 Restart the pump and continue to pump for one (1) hour after loss of suction.

______ 4.3.6 Stop the pump and allow to settle for one (1) hour.

______ 4.3.7 Position the 1000ml graduated cylinder under the drain assembly; open the drain valve.

______ 4.3.8 Allow water to drain into flask for 1½ hours. Record amount drained.

______ ml

______ 4.3.9 Subtract value obtained in step 4.2.2 from value in step 4.3.8. Record results.

______ ml (Step 4.3.8)

\- ______ ml (Step 4.2.2)

= ______ ml (Amount of Free-stand water in liner.)

______ 4.3.10 Using the formula below, calculate the value obtained in step 4.3.9 into gallons.

$$\frac{\_\_\_\_\_\_ \text{ ml (Step 4.3.9)}}{1000 \text{ ml}} \times .26418 \text{ Gal./1} = \quad \text{Gallons}$$

______ 4.3.11 Determine the percentage of free-standing water remaining in the test liner (Step 4.3.10) as compared to the total amount of water (free-standing) prior to dewatering test.

$$\frac{\_\_\_\_\_\_ \text{ Gal. (Step 4.3.10)}}{18.5 \text{ Gal.}} \times 100 = \quad \%$$

End of Procedure

ENCLOSURE 1

CAPOLUPO & GUNDAL, INC. LINER DEWATERING PROCEEDURE
10/08/79 CG-1079-0086/ REV. 2

1.0 REFERENCES

1.1 Blueprint of typical pre-filter or demin vessel to be dewatered.

1.2 Applicable Epicor/Cap-Gun flow diagram.

1.3 Applicable S.O.P./O.P..

1.4 Blueprint of typical Cap-Gun pump.

2.0 LIMITS AND PRECAUTIONS

2.1 Continous on scene Health Physics coverage is required per shift Health Physics Supervisor.

2.2 Personnel performing work in accordance with this procedure shall utilize every means available to maintain their radiation exposure as low as reasonably achievable. (ALARA)

2.3 All applicable limits and precautions shall be adhered to per existing system operations procedure.

3.0 PRE-REQUISITES

3.1 Ensure there is adequate room in tank to receive liquid from vessel being dewatered.

3.2 The vessel to be dewatered must be vented.

3.3 The dewatering pump must be working properly as determined by Capolupo & Gundal, Inc. Foreman.

3.4 Vessel influent line to be blown out and detached from vessel per existing procedure. To ensure no new liquid will enter vessel.

4.0 PROCEDURE

______4.1 Start up vessel decant pump and continue to pump until loss of suction as determined by Cap-Gun foreman. Continue to pump for one (1) hour.

______4.2 Stop pump and let vessel settle for one (1) hour.

______4.3 Restart vessel decant pump and pump for one (1) hour.

______4.4 Stop vessel decant pump.

______4.5 Let vessel settle for a minimum of one (1) hour.

______4.6 Restart vessel decant pump for a minimim of one (1) hour.

______4.7 Vessel is now dewatered, continue to prepare for shipment per existing applicable procedure.

ENCLOSURE 2

CAPOLUPO & GUNDAL, INC.
142 ELM STREET • SALISBURY, MA 01950 • (617) 462-2997; 462-6543

April 24, 1980 CG-0480-0229

EXCERPT FROM THE
CAPOLUPO & GUNDAL, INC. LINER LOADING PROCEDURE

TIME	INIT.		
____	____	13.	Load prescribed resins into liner ensureing that each layer is carefully shoveled in and leveled, i.e. Resin mix calls for a total of 40 $ft.^3$ of three resin types - 20 $ft.^3$ of X, 10 $ft.^3$ of Y, and 10 $ft.^3$ of Z. Carefully shovel in the first layer (X) of resin and level. Thoroughly moisten the resin. After having moistened the previous layer shovel the next layer in carefully and level. Again, thoroughly moisten the resin. Continue this process until all the prescribed resins are loaded. This process eliminates nearly all air pockets in the resin bed.
____	____	14.	N/A
____	____	15.	Take liner(s) to "Flushing and Recirc Area." Perform open flush, closed recirc, and open flush in that order. Duration of flushes and recirc are per Capolupo & Gundal, Inc. Supervisor's directive in conjunction with Epicor, Inc. Purpose: Flushes; removes resin fines. Recirc; compacts resin bed and removes remaining air pockets.

CG/kjc

NUS CORPORATION

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DATE________

CLIENT________ FILE NO.________ BY________

SUBJECT________ Checked By________

LATERAL CONFIGURATION

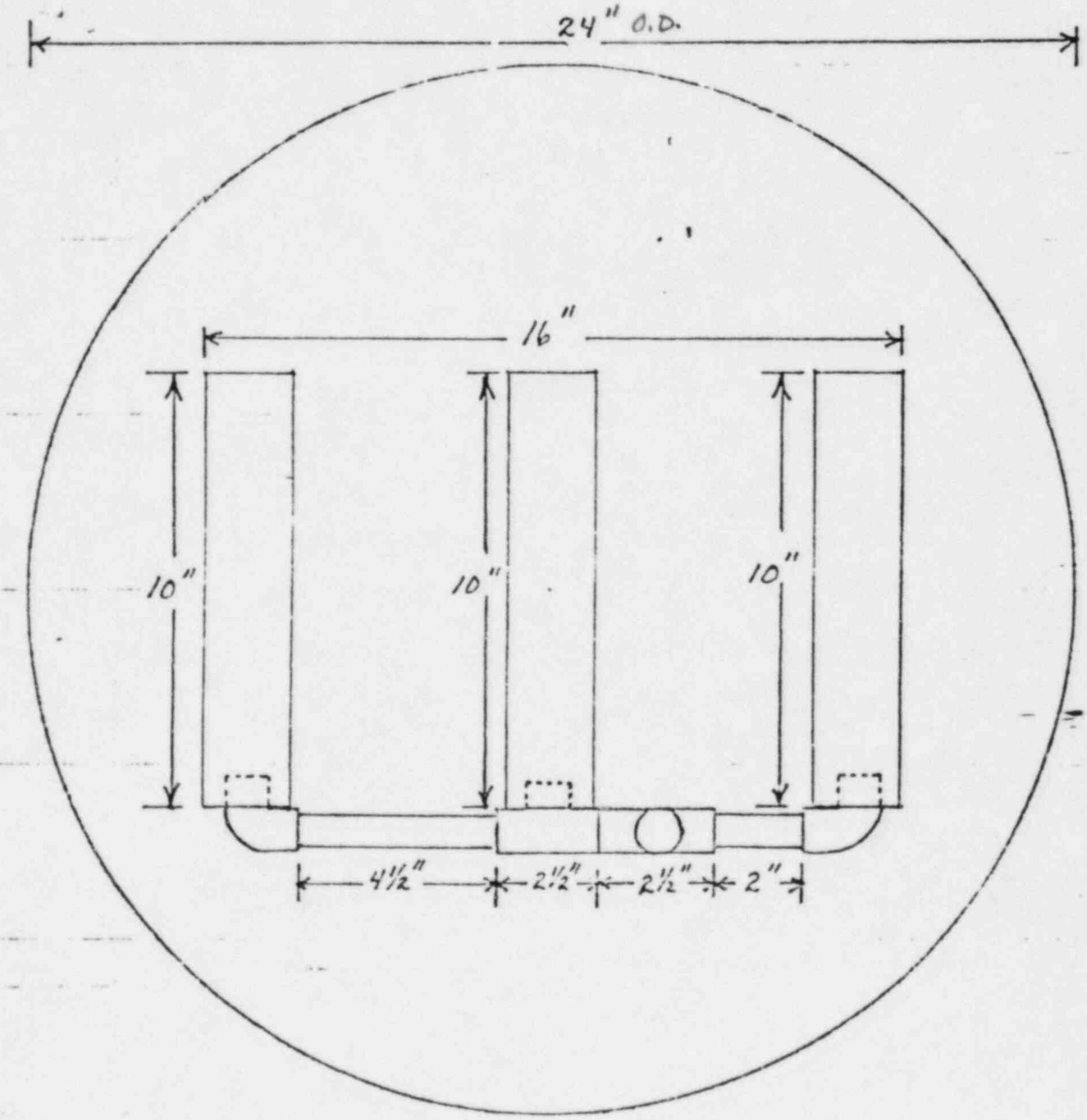

FIGURE 1

NUS CORPORATION

CLIENT ______ FILE NO. ______ BY ______ DATE ______

SUBJECT ______ Checked By ______ Page ___ of ___

TEST APPARATUS

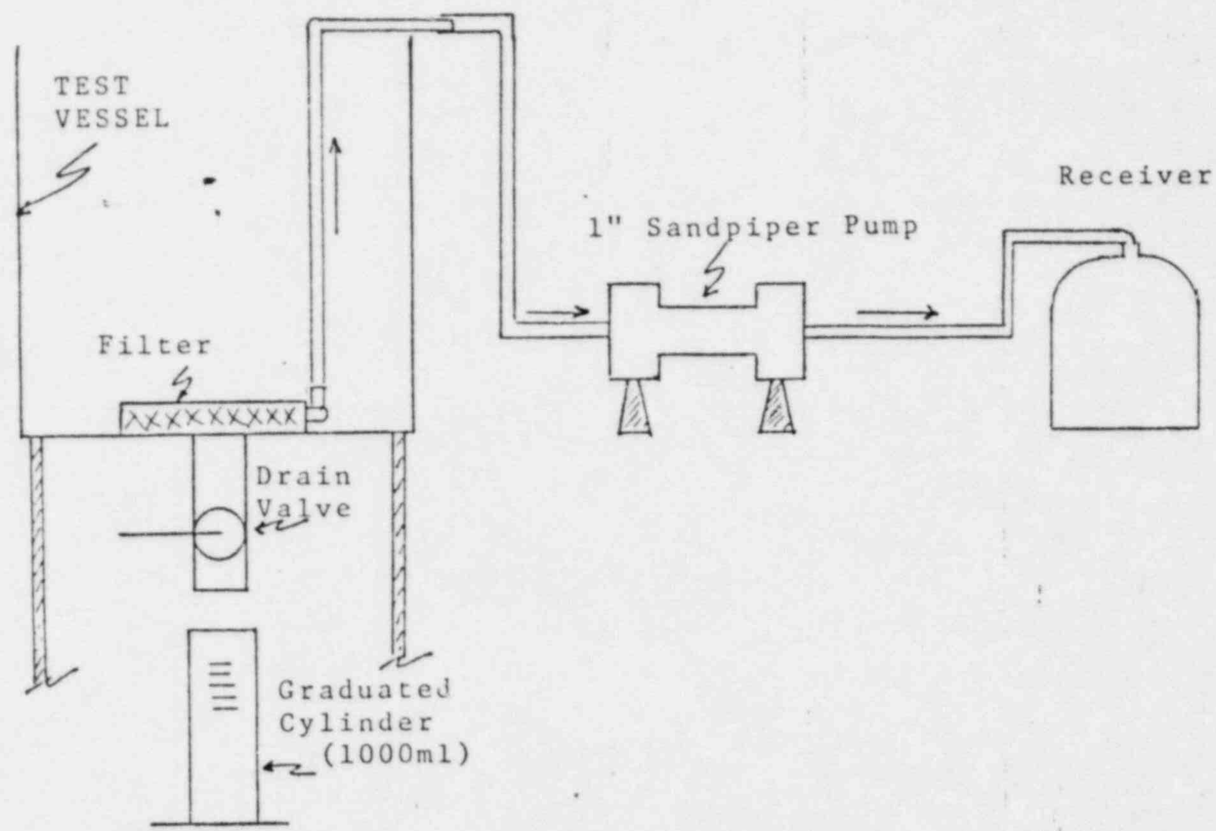

FIGURE 2

ATTACHMENT 4

MOISTURE ABSORBANT BACKFLOW TEST

PROCEDURE

1.0 REFERENCES

1.1 Test Liner Dewatering Test (Preliminary), Attachment 3.

1.2 Drawing of Filter Assembly, Figure 1.

1.3 Drawing of Test Apparatus, Figure 2.

1.4 Manufacturers Data, Moisture Absorbant Material (Later).

2.0 LIMITS AND PRECAUTIONS

2.1 Exercise caution while handling the absorbant material. Wear goggles and gloves.

2.2 If, after a reasonable amount of time, the absorbant material fails to flow into the test liner, stop the pump and investigate.

3.0 PREREQUISITES

3.1 Ensure that sufficient air is supplied to the test stand area.

3.2 Ensure that the following equipment/materials are available for the test:

3.2.1 One set of discharge laterals as per Figure 1.

3.2.2 The acrylic test liner, clean and empty.

3.2.3 Hoses and fittings for the suction and discharge piping.

3.2.4 One (1), 1" sandpiper pump.

3.2.5 Several gallons of moisture absorbant material (enough to fill all piping and flow into liner).

3.2.6 One (1), 2' x 2' acrylic cylinder or equivalent (to serve as a reservoir).

continued -

4.0 PROCEDURE

_______ 4.1 Construct the discharge lateral assembly (if not done previously) per Figure 1.

_______ 4.2 Hook up the hoses, fittings and pump per Figure 2. Drain out any water before assembly.

_______ 4.3 Fill the "Reservoir" with moisture absorbant fluid.

Caution: Be carefull of overpressurizing the hoses or fittings due to possible pluging by the fluid.

_______ 4.4 Start the pump and slowly begin pumping fluid into the test liner. As soon as fluid appears from any filter element, record the pump speed =_______SPM (strokes per minute).

_______ 4.5 Increase pump speed until fluid appears from all filter elements. Record the pump speed =_______SPM.

Fluid from all filters - Yes ____ No ____

Remarks -

Note: The data obtained from steps 4.4 and 4.5 will be evaluated to determine how the fluid will flow into the more complex lateral configuration of a 6' x 6' liner.

End of procedure

NUS CORPORATION

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DATE______

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SUBJECT______ Checked By______

LATERAL CONFIGURATION

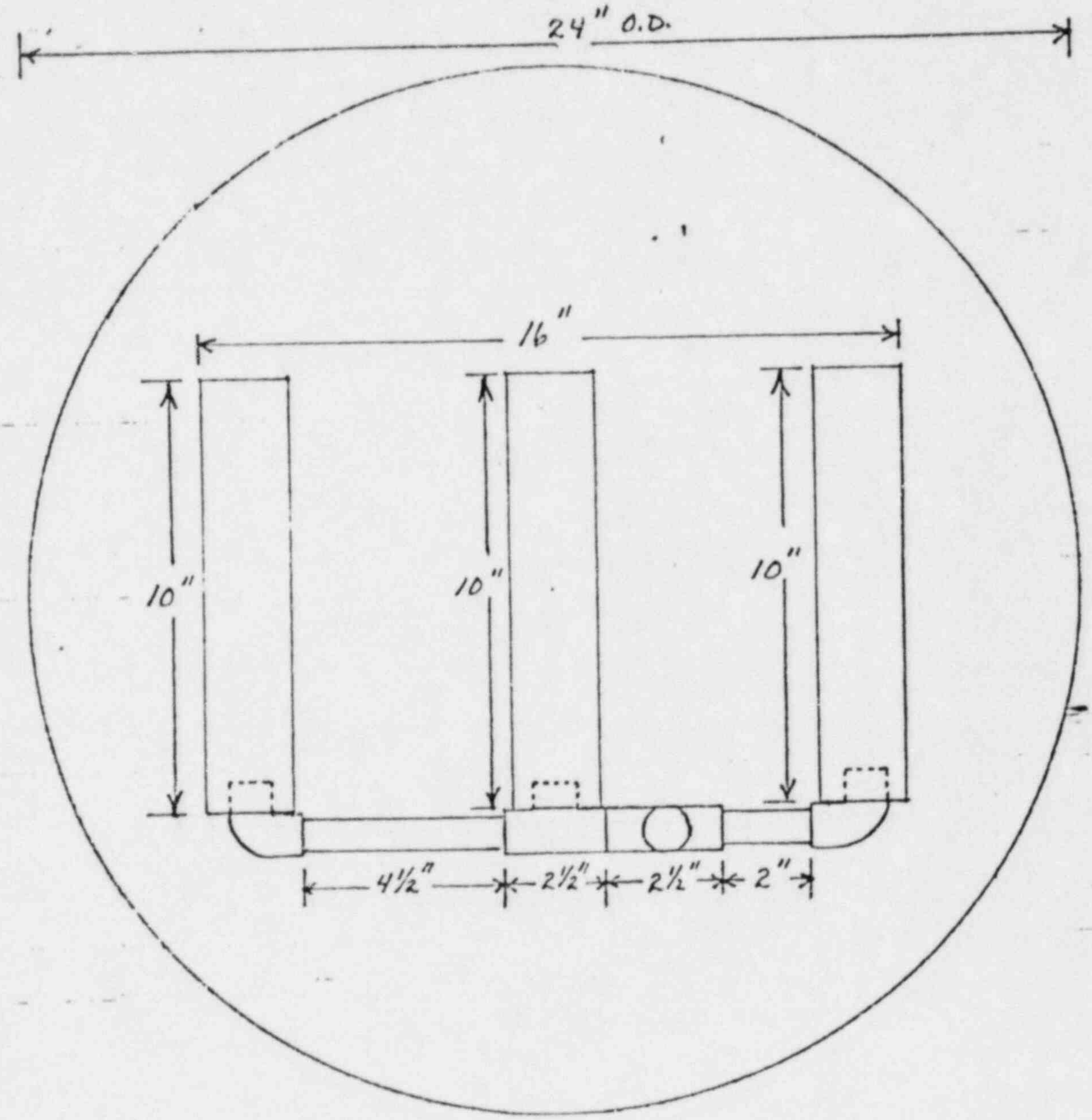

FIGURE 1

NUS CORPORATION

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CLIENT___ FILE NO.___ BY___

SUBJECT___ Checked By___

TEST APPARATUS

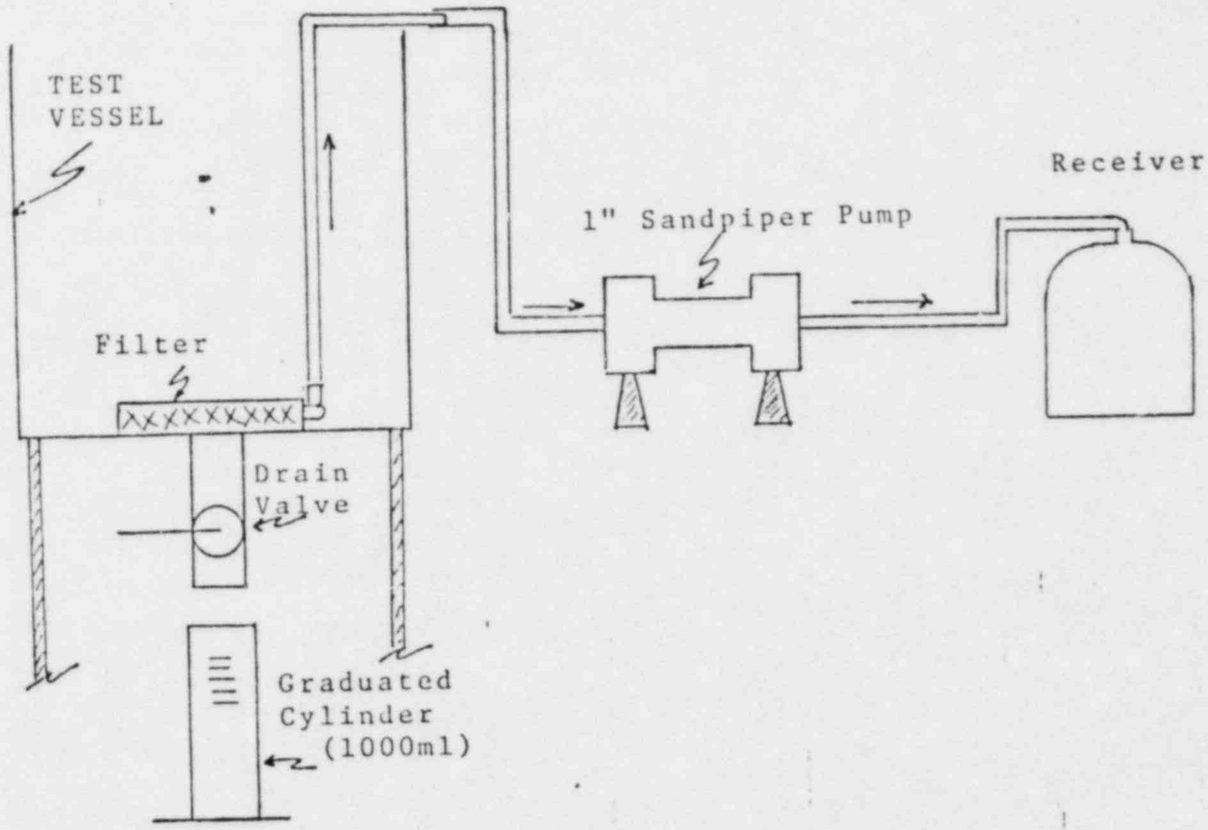

FIGURE 2