

MASTER

Decontamination Demonstration Facility (D.D.F.) Modularization/ Mobility Study

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DECONTAMINATION DEMONSTRATION FACILITY (DDF)
MODULARIZATION/MOBILITY STUDY

I. INTRODUCTION

The component decontamination technology, developed under the DOE sponsored TRU Waste Decontamination Program, has significant potential benefits to Nuclear Utility Owners in four strategic areas:

- 1) Meeting ALARA Criteria for Maintenance/Operations
- 2) Management of wastes and waste forms
- 3) Accident Response
- 4) Decommissioning

The most significant step in transferring this technology directly to the nuclear industry is embodied in the TMI Decontamination Demonstration Facility (D.D.F.). Construction and operation of the D.D.F. will provide the Nuclear Industry solid data and experience on: 1) the potential dose reduction; 2) the effectiveness of the techniques under rigorous field and regulatory conditions; 3) cost-benefit information to make choices between recovery and disposal; and 4) the ability to decontaminate to change waste form.

The current status of application of this technology is small component decontamination provided by mobile facilities, utilizing a piece of the technology here and there. The D.D.F. provides an integration of state-of-the-art of component decontamination techniques, consolidated in one facility, taking advantage of the complementary features of electropolishing, freon cleaning and vibratory finishing.

Industry participation and presence in the TMI recovery program is expected to be quite large, and a successfully operating D.D.F. is expected to have a significant impact on the industry. The ultimate success of the demonstration at TMI will be to have other utilities utilize the design and experience to construct their own facilities.

A logical alternate to the proposed fixed facility at TMI is a completely mobile facility having the same capabilities, which could be moved to other sites after the demonstration is complete.

II. PURPOSE AND SCOPE

Financial considerations have caused the proposed construction schedule for the D.D.F. to slip. Initially it was planned that the facility would be constructed rapidly, and the early utilization would provide a data base for evaluating the potential for a mobile facility. The slippage combined with the rapid advances in the technology⁽¹⁾⁽²⁾ make it prudent to investigate the potential for modularity and mobility prior to committing significant resources to a fixed facility.

Battelle was requested by General Public Utilities (G.P.U.) to prepare a brief study which would address the following alternatives:

- Maximize modularity by rack and skid mounting components, but minimize the impact to the existing general facility arrangement.
- A completely modular, mobile facility useful for wide industry/ government application.

Based on the concepts developed, a discussion of the advantages of each alternate, and costs and schedule impacts are presented. A discussion of the state of development of each major component/system is presented to assist in defining the degree of risk associated with each alternative.

III. DISCUSSION AND RESULTS

The discussion and results are divided into four major categories, 1) a description of the existing design (baseline case), 2) a description of increased modularity with minimized impact to the current design, 3) a description of mobile facility, and 4) a comparison of the alternatives.

A. D.D.F. Existing Design

The discussion of the existing design is divided into three parts: the first section described the process, the second provides an overview of the development status, and the third sets forth the current cost and schedule.

1. Process Description

The process equipment for the D.D.F. is divided into two basic categories 1) the decontamination equipment and 2) the solution treatment equipment. The decontamination equipment provides an integrated array of state-of-the-art methodology for component decontamination and consists of: a disassembly box, electropolishing and rinse tanks, fixed and hand directed freon spray, in situ or spot electropolishing and rinsing, and vibratory finishing.

The solution treatment equipment is provided to treat secondary wastes and to insure all liquid wastes exit the facility as 55 gallon drums of concrete with no free water. Acids used in the electropolish operation will be purified by adsorption. Freon will be purified by distillation, and water used in the rinse and vibratory finisher will be evaporated to reduce the volume. Effluent from the adsorption unit and bottoms from the distillation unit will be solidified without volume reduction. The neutralized and concentrated liquids will be solidified by mixing with Portland cement. Solid wastes generated in the process equipment, such as filters, are to be encapsulated in cement, in 55 gallon drums.

The decontamination equipment is to be arranged in a L configuration, with the disassembly at the corner of the L, as shown in Figure 1. The decontamination equipment is designed to reduce activity hold up by employing good design practices. The arrangement also provides good contamination control and minimizes the potential for spills. The equipment can accommodate components up to 2,000 pounds in weight and of the size and at the process rates specified in Table I.

Movement of large components through the decontamination line will be achieved by a monorail with two independent hoists. Small components and tools can be sent to the vibratory finisher by means of a conveyor.

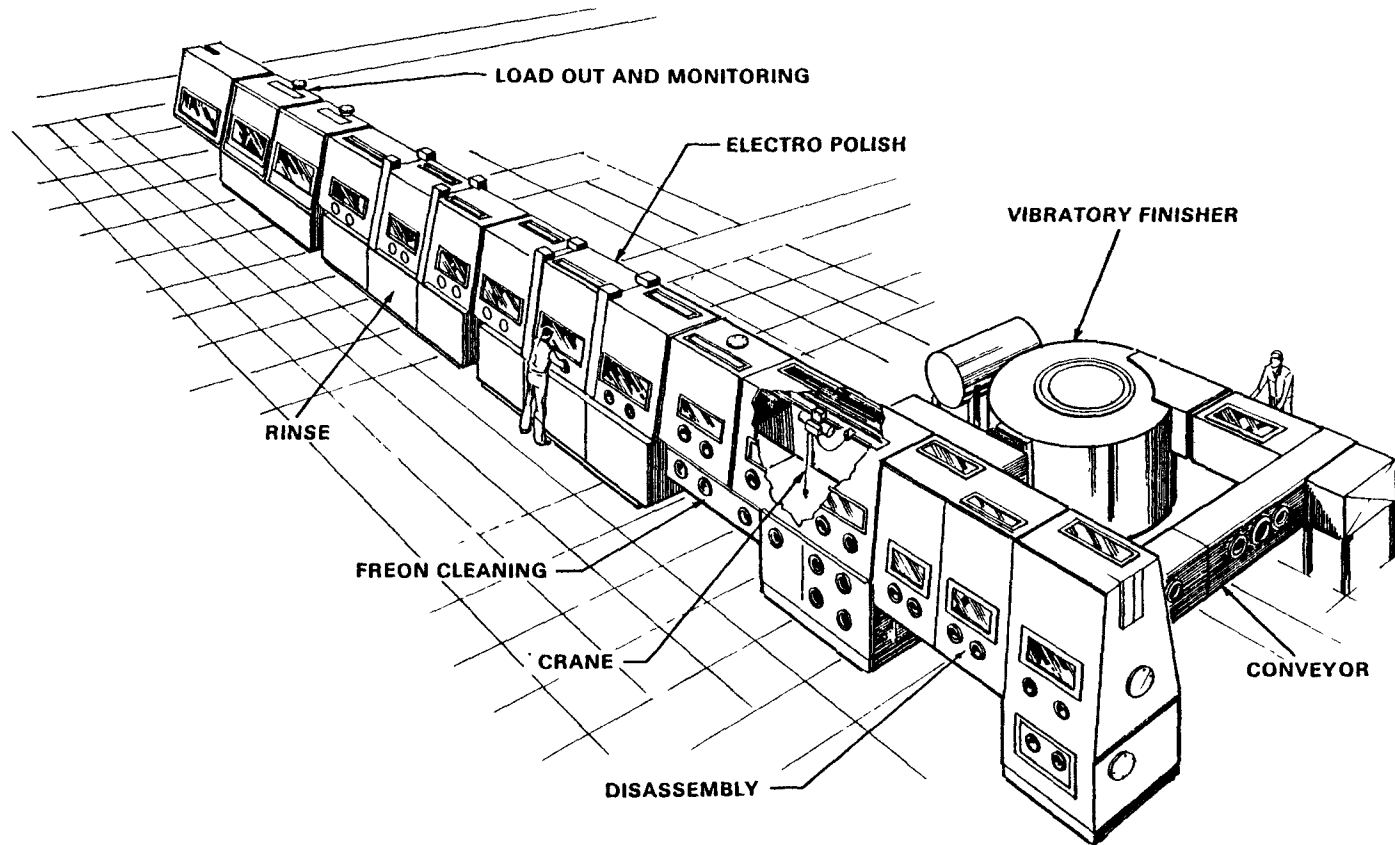
The decontamination processes are complementary and may be used in sequence, or individually depending on the component and requirements. Small components can be processed through the vibratory finisher for descaling or derusting prior to electropolishing. Tools that are scheduled for reuse during the clean up can be electropolished to precondition the surface before the initial use to facilitate subsequent decontaminations.

The equipment is designed to accommodate additional lead shielding in areas of potentially high radiation exposure such as the disassembly box, the electropolish box and the freon box. Lead glass windows can also be added to reduce operator exposure.

The spatial relationship of the decontamination equipment and the solution treatment equipment can be seen in Figure 2. The movement of solutions through the facility from use to purification to solidification is shown in Figure 3.

The acid purification system will consist of a 600 gallon fresh acid tank, a 600 gallon spent acid tank and an adsorption

DECONTAMINATION LINE

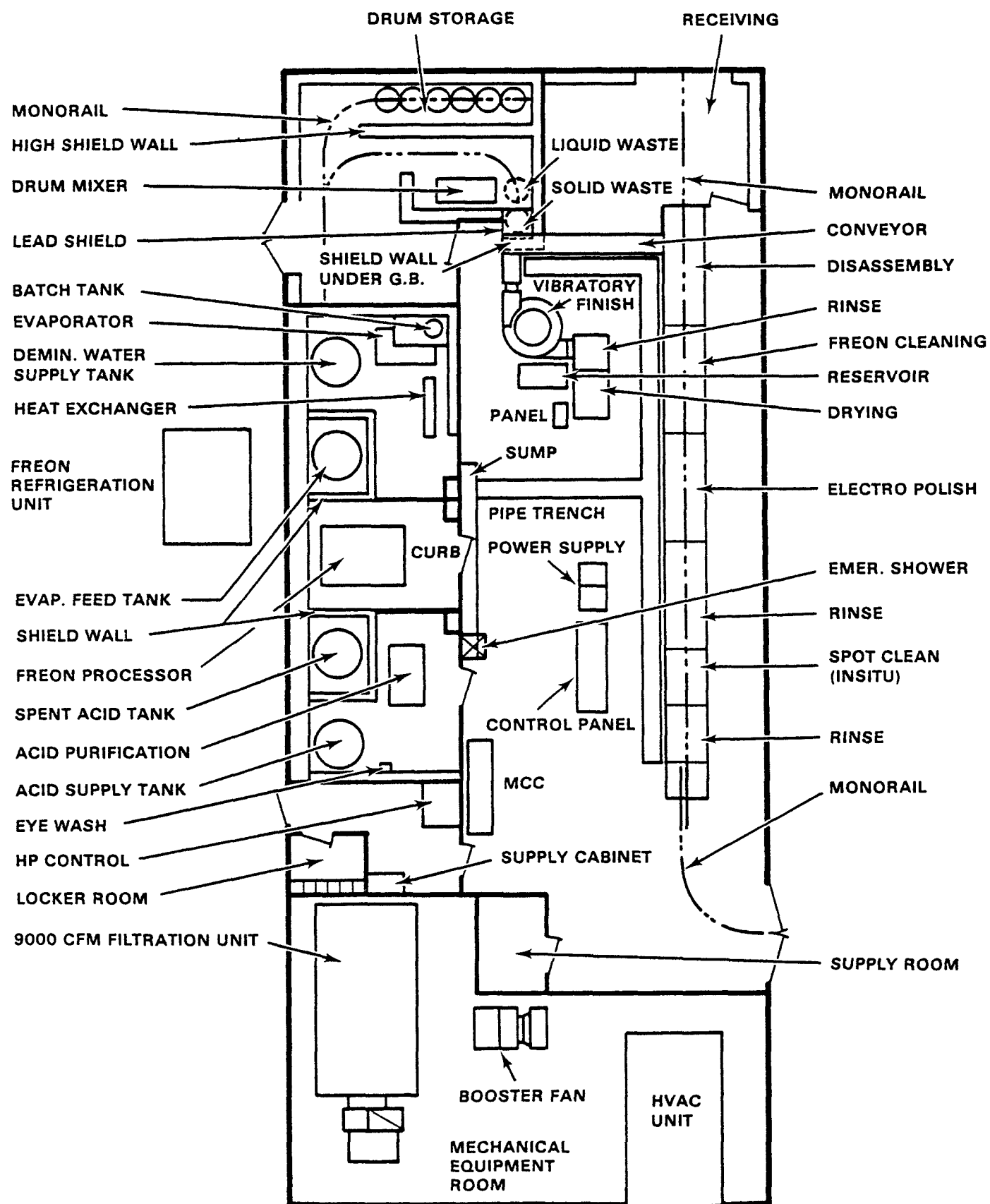


DECONTAMINATION LINE
FIGURE 1

TABLE I
DECONTAMINATION EQUIPMENT SIZES & PROCESS RATES

Decontamination Method	Maximum Size	Process Rate
Freon Cleaning	3'x3'x3' or 2'x2'x7'	50ft ² /hr
Electropolishing	3'x3'x3'	50ft ² /hr
Vibratory Finishing	18"x6"x2"	300lb/hr

GENERAL ARRANGEMENT DECON. DEMONSTRATION FACILITY



GENERAL ARRANGEMENT DECON. DEMONSTRATION FACILITY

FIGURE 2

unit. The adsorption unit is expected to remove up to 80 percent of the non-volatile gross beta-gamma contamination. Acid purification will be on a batch basis as required, when either the radiation level or the metals concentration reach predetermined limits.

The freon distillation unit will be capable of operation on a continuous basis, and will be capable of purifying freon at the rate of 60 gallons per hour. The bottoms will be pumped to the batch tank for solidification.

The evaporator system will consist of a 600 gallon evaporator feed tank, a 600 gallon distilled water tank and a single effect evaporator unit. Distillate from the evaporator will be used as make up water, and the concentrate will be routed to the solidification system. The design goals for the evaporator process are to concentrate rinse and vibratory finish solution at rates up to 24 gallons per hour, by a factor of forty with a maximum decontamination factor of 1000 for non-volatile radioculides.

All of the solution treatment units above will be purchased from commercial sources. The equipment for the D.D.F. or a similar unit will be tested and evaluated by Battelle prior to shipment to Three Mile Island.

The waste effluents from the solution treatment equipment will be sent to the batch tank where requisite sampling and pH adjustments are performed. The volume of the batch tank will be sent to a prefilled drum of Portland cement and the cement will be mixed using a drum roller. Drum handling will be accomplished with a monorail system.

2. Process Equipment Development Status

The following is a brief discussion of the state of development of each subsystem. The information applies to the alternates as well as the baseline design.

The electropolish system has been demonstrated in the TRU Waste Decontamination Program as a reliable technique for component decontamination. Details of the experience with electropolishing can be found in the Nuclear Waste Management Quarterly Progress Report PNL-3000-1-6.^{3,4,5} There is sufficient experience with electropolishing that there is virtually certainty as to its viability in the D.D.F.

The vibratory finishing system has also been demonstrated in the TRU Waste Decontamination Program as a reliable technique for component decontamination. Details may be found in the same reference listed above. There is sufficient experience with the vibratory finisher that there is virtually certainty as to its viability in the D.D.F.⁶

The freon cleaning and freon processing will be discussed together, because without an integral purification system freon will recontaminate. Freon cleaning with high pressure spray represents a reasonable level of certainty because of the recent experience with the Health Physics Systems tool cleaning unit on test at Palisades.⁷ Tools contaminated to levels of 100,000-200,000 counts per minute have been cleaned down to levels of 100 to 200 counts/minute. Primary purification was accomplished by filtration with supplemental purification by distillation. The new field unit is reported to be superior to the original design evaluated by Battelle. The uncertainty in the system is focused in the area of the distillation rates of 60 gph. Discussions with the vendor indicated there are several viable solutions to increasing the distillation rate, and that a working unit for evaluation will be available within the next few months. In light of the suitability of the new commercial units and the choices of options for increasing the distillation rates the risk of proceeding with freon cleaning is considered acceptable.

A small version of the acid purification system is currently under evaluation at BNW. Preliminary data indicated the unit will perform satisfactorily. Additional testing is scheduled for the balance of GFY 81 to optimize the performance for the support of 231-Z building operations. These data will be applicable for the proposed use in the D.D.F. The area of uncertainty for the D.D.F. application is obtaining an adsorption column with sufficient capacity to permit rapid processing/purification of the spent acid. Calculations indicate that the electropolish tank can be used at the rate of 50 ft²/hr., for six, sixteen hours days before reaching the metal ion concentration limit. Therefore, it would appear desirable to accomplish the purification within a 24 hour period to have the use cycle coincide with one work week. This appears feasible, however, if unanticipated adversities are encountered, the purification cycle can be easily reduced to 150 to 300 gallons/day without adversely impacting operations. The risk of proceeding with the acid purification appears acceptable.

The evaporator unit that BNW uses to support operations in 231-Z building has several hundred hours of operation and all the experience is satisfactory. The unit purchased for the D.D.F. is nearly identical to the unit in 231-Z, except the D.D.F. unit has a single effect and the 231-Z unit has a double effect. The experience with the unit at 231-Z combined with a limited survey of industrial experience indicated a minimal risk associated with the evaporator unit.

Solidification of wastes involves operations in the batch tank such as mixing, neutralization, flushing and sampling; transferring the waste to a precharged drum containing Portland cement; and rolling the drum to assure mixing and solidification. A series of experiments has been conducted to determine

the optimum waste to cement ratio.¹ A drum roller unit similar to the unit proposed for the D.D.F. is being used to support normal operations for solidifying waste in the 231-Z building. Results from the tests and routine building operations indicate that the solidification-mixing area is very low risk.

Operation of the batch tank is the most critical element of the solidification process. The number of operations including mixing, solids removal, neutralization, sampling, etc., lead to complex operating procedures, and stringent equipment requirements. The risk associated with the design and operation is being minimized by the preparation and implementation of a Process Control Plan (PCP). A preliminary review of the operations indicates that the risk associated with this area is acceptable and will be reduced to a very low value by the P.C.P.

In summary, although the combination decontamination and solution treatment equipment represents the state-of-the-art, the technical risks are acceptable enough to proceed as planned.

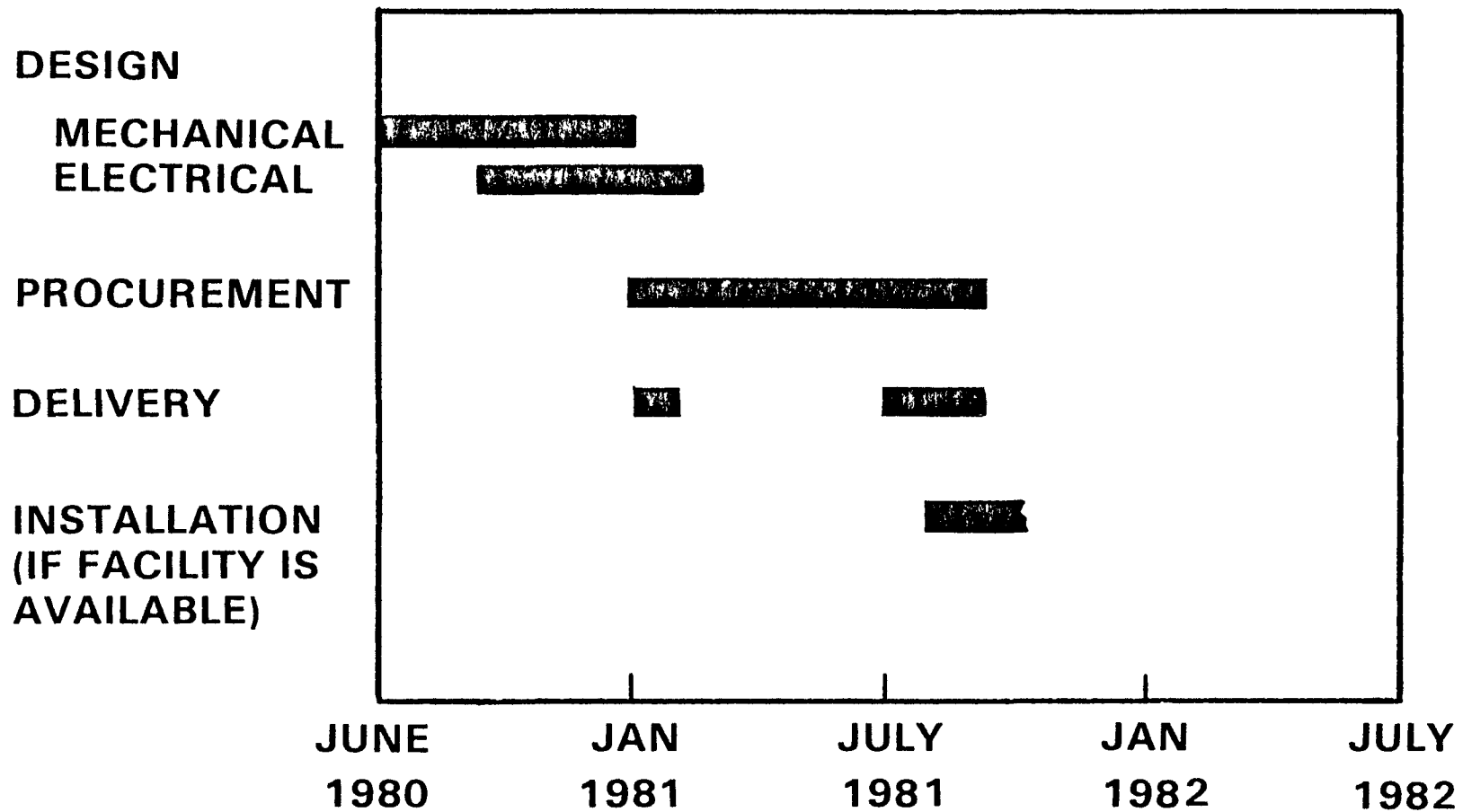
3. Cost and Schedule

The cost for the D.D.F. is presented in Table II. The facility related costs were developed by Bechtel, and the equipment related costs were developed by Battelle. Both numbers are current dollar costs and DO NOT contain escalation or contingency. This basis for presenting costs is consistent throughout the study. Escalation is not added because of the uncertainty associated with the schedules. If this uncertainty can be clarified an escalation of at least 1%/month to the centroid of the construction schedules is recommended. Contingency is not added because of the difference between the Bechtel-GPU and Battelle-DOE approach to assigning contingencies,

TABLE II
D.D.F. COST ESTIMATE

<u>ITEM</u>	<u>\$K</u>
BNW Manpower & Equipment Expenditure To 10/1/80	\$ 509
BNW Manpower To Complete (including evaluation and reporting)	403
Equipment	545
Facility Engineering and Construction	1,810
<hr/>	
TOTAL	\$3,267

D.D.F. EQUIPMENT SCHEDULE



D.D.F. EQUIPMENT SCHEDULE
FIGURE 4

would add confusion to and unnecessarily bias the cost numbers.

The schedule for the equipment is presented in Figure 4.

B. Alternate 1 - Increased Modularity with Minimum Design Impact

The discussion of Alternate 1 is divided into two parts; the first section describes the areas where modularity can be increased and the second describes the cost and schedule impacts.

1. Increased Modularity

The purpose of this alternate is to increase the modularity by rack and skid mounting equipment while minimizing the impact on the facility general arrangement.

There is relatively little that can be done to make the decontamination line more modular. However, there are some changes that could be made to minimize the interface with the facility. These changes are: 1) remove the sumps in the electropolishing, freon and rinse tanks, 2) redesign the electropolishing box to change the electrical feed from underfloor to overhead and 3) redesign the freon box to eliminate the need for a 8 inch depression in the floor on one side of the glove box. In light of the adverse impacts this would have on operations and the relatively low cost impact to the facility none of the changes are deemed desirable.

Rack and skid mounting equipment in the solution treatment area has some potential in the acid purification and evaporator areas. The acid purification system and the spent and supply tanks could be mounted on a skid and internally piped so there would only be four piping connections to be made in the field. Local shielding (lead) around the spent acid tank would be required to reduce operator exposure during maintenance of the acid purification unit. A more logical alternate would be to skid mount the acid supply tank and the purification unit, leaving the spent acid tank behind concrete shielding.

In the evaporator area the most likely candidates for skid or rack mounting are the pumps and heat exchanger between the evaporator and the refrigeration unit.

2. Cost and Schedules Impacts

All of the major equipment items in the solution treatment area is larger than the doorways. It is assumed that the equipment will be set through a roof hatch or prior to erecting internal partitions. In either case the approach of rack or skid mounting is assumed to have no adverse impact on the facility cost or schedule. This is a reasonable assumption, if the equipment is available early in the facility construction.

Skid mounting the acid purification and supply tank will mean that 13 field welds will become shop welds. Some miscellaneous bracing or anchoring may also be saved, however this is doubtful. The dollar saving associated with welding and fitting appears to be quite small and would be greatly overshadowed by the cost of the skids. The impact to the project cost would be a net increase, approximately equal to the cost of the skid, and the extra shipping costs.

The same logic applies to rack or skid mounting the heat exchanger and pumps.

In summary there does not appear to be any cost effective potential for increasing the modularity while minimizing the impact on the current facility design.

C. A Modular, Mobile Facility

The description and discussion of a modular mobile facility is divided into four areas as follows: 1) key assumptions, 2) facility description, 3) equipment description and 4) cost and schedule impact.

1. Key Assumptions

The base line assumptions for a Mobile Decontamination Facility (M.D.F.) concept are 1) complete transportability, and 2) process

flexibility similar to the fixed D.D.F. Utilizing these two primary assumptions, subsets of assumptions and criteria were developed to establish the basis for the mobile facility concept and cost.

The limiting transport mode is a tractor/trailer on non-interstate highways. However, in addition to vehicle travel, the M.D.F. could and likely would be transported by rail or water (barge) or a combination of the three options.

In the limiting transport mode, the basis criteria are:

- The elevation of a module when mounted on a single drop trailer for secondary roads (State Highways), is limited to 12 feet, 6 inches.
- The length of a module that may be transported on a non-specialized trailer is limited to 45 feet.
- The width may not exceed 11 feet without requiring the use of escort vehicles for oversize loads.
- The loaded trailer may not exceed 70,000 pounds.
- The modules must be designed to meet the Department of Transportation requirements.

Using the height constraint of 12 feet, 6 inches the overall module height is 9 feet, with an interior height of 8 feet.

The inside of the module and the process equipment must be easily decontaminatable so the modules can be transported as Low Specific Activity (L.S.A.).

To assure acceptably low release, the HVAC supply and exhaust systems must be HEPA filtered.

2. Facility Description

The M.D.F. as presently conceptualized consist of a series of process modules and transition modules. The

process modules exterior dimensions are nominally 32 feet long, by 11 feet wide by 9 feet high. Although special modules up to 45 feet in length may be desirable in some cases. The transition modules are 11 feet square by 9 feet high. One potential arrangement is shown in Figure 5. These modules are very similar to the deck cargo containers used in the marine transportation industry.

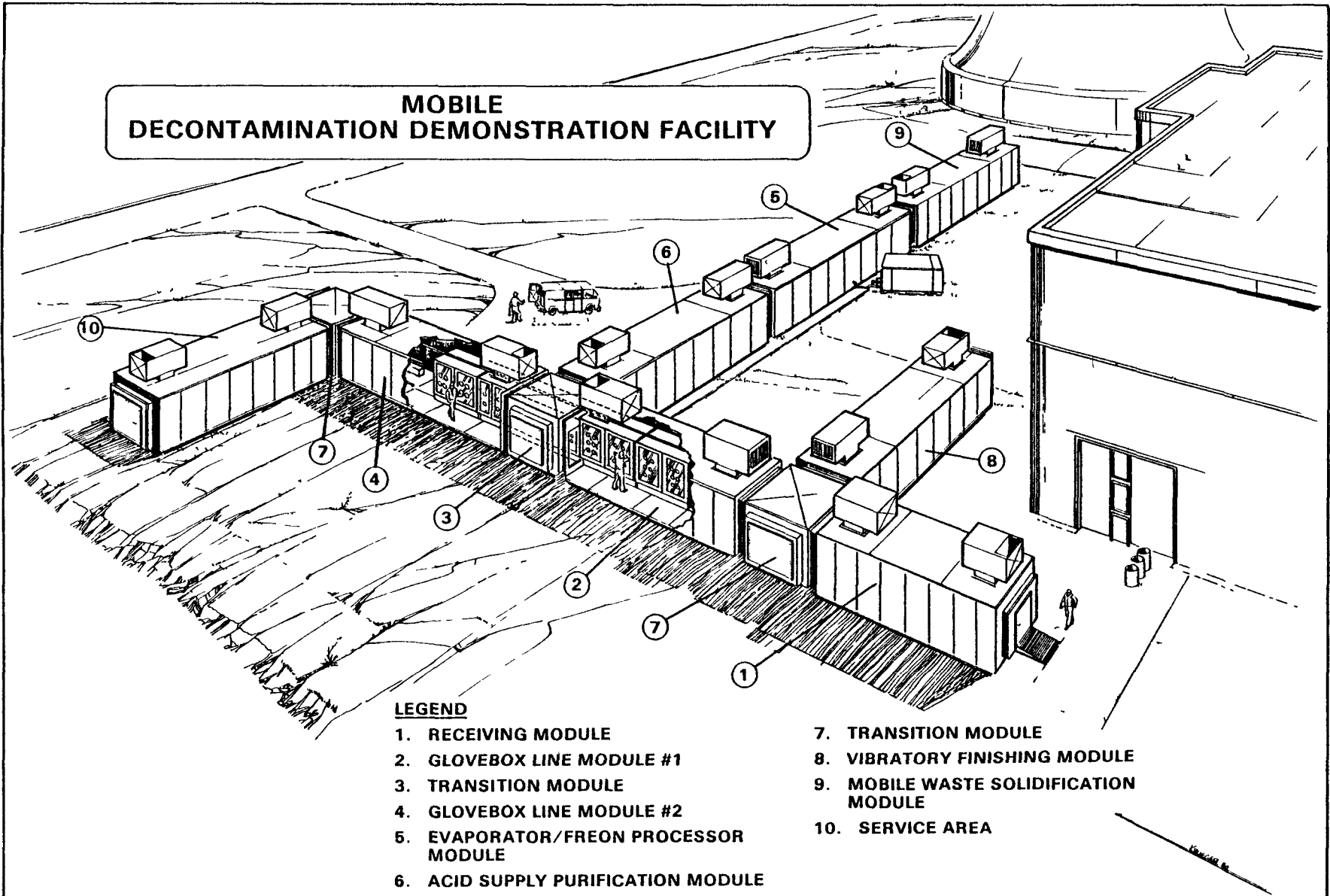
Personnel access into the M.D.F. is through a door or hatch opening at the ends of each module.

The transition modules are intended to be used as connecting modules enabling additional process modules to be attached either inline or at 90° angle. By designing the transition modules with flanged openings on each side, greater flexibility is achieved. An added benefit of the transition module concept is they can be used to provide a radiological buffer or control zone between various process modules.

The transportation scenerio envisioned would consist of shipping the modules to a site, assembling the modules, connecting supporting services, conducting the decontamination operations, module cleanup, disassembly and sealing all openings for shipment. All of these costs would be incurred by the user. Assuming an immediate need elsewhere, the next user's costs begin with shipping to the designated site and repeating the scenerio.

For ease of cleanup the interior of all modules would be constructed of 304 stainless steel using all (100%) welded seams. All corners would be coved for easy cleaning. All valves and process piping would be surface mounted on stand-offs for ease of cleaning. This facilitate clean up as a preparation for shipment as well as cleanup of inadvertent spills and/or leaks.

MOBILE DECONTAMINATION DEMONSTRATION FACILITY



LEGEND

- | | |
|--------------------------------------|---------------------------------------|
| 1. RECEIVING MODULE | 7. TRANSITION MODULE |
| 2. GLOVEBOX LINE MODULE #1 | 8. VIBRATORY FINISHING MODULE |
| 3. TRANSITION MODULE | 9. MOBILE WASTE SOLIDIFICATION MODULE |
| 4. GLOVEBOX LINE MODULE #2 | 10. SERVICE AREA |
| 5. EVAPORATOR/FREON PROCESSOR MODULE | |
| 6. ACID SUPPLY PURIFICATION MODULE | |

MOBILE DECONTAMINATION DEMONSTRATION FACILITY
FIGURE 5

The other material of construction would be carbon steel structural members and an aluminum or carbon steel exterior wall. The space between the exterior and interior walls, (about 3-inches) would be insulated. Plates would be bolted to the gasketed flanges of all wall and ceiling penetrations to completely seal the modules for storage or transport.

3. Equipment Description

All process equipment proposed for the D.D.F. would be incorporated into the M.D.F. however; some design changes in the gloveboxes would be required in order to meet the height constraints. Two conceptual floor plans are shown in Figure 6 and 7.

It can be seen from studying Figures 6 and 7 that a wide variety of equipment/layout configurations are achievable using the basic process and transitation module scheme. Based on the available area at different sites, it is quite conceivable that the configuration would change from site to site. This consideration makes the equipment arrangement in Figure 7 a more likely alternative. The main difference being that the decontamination line is wholly contained within one module.

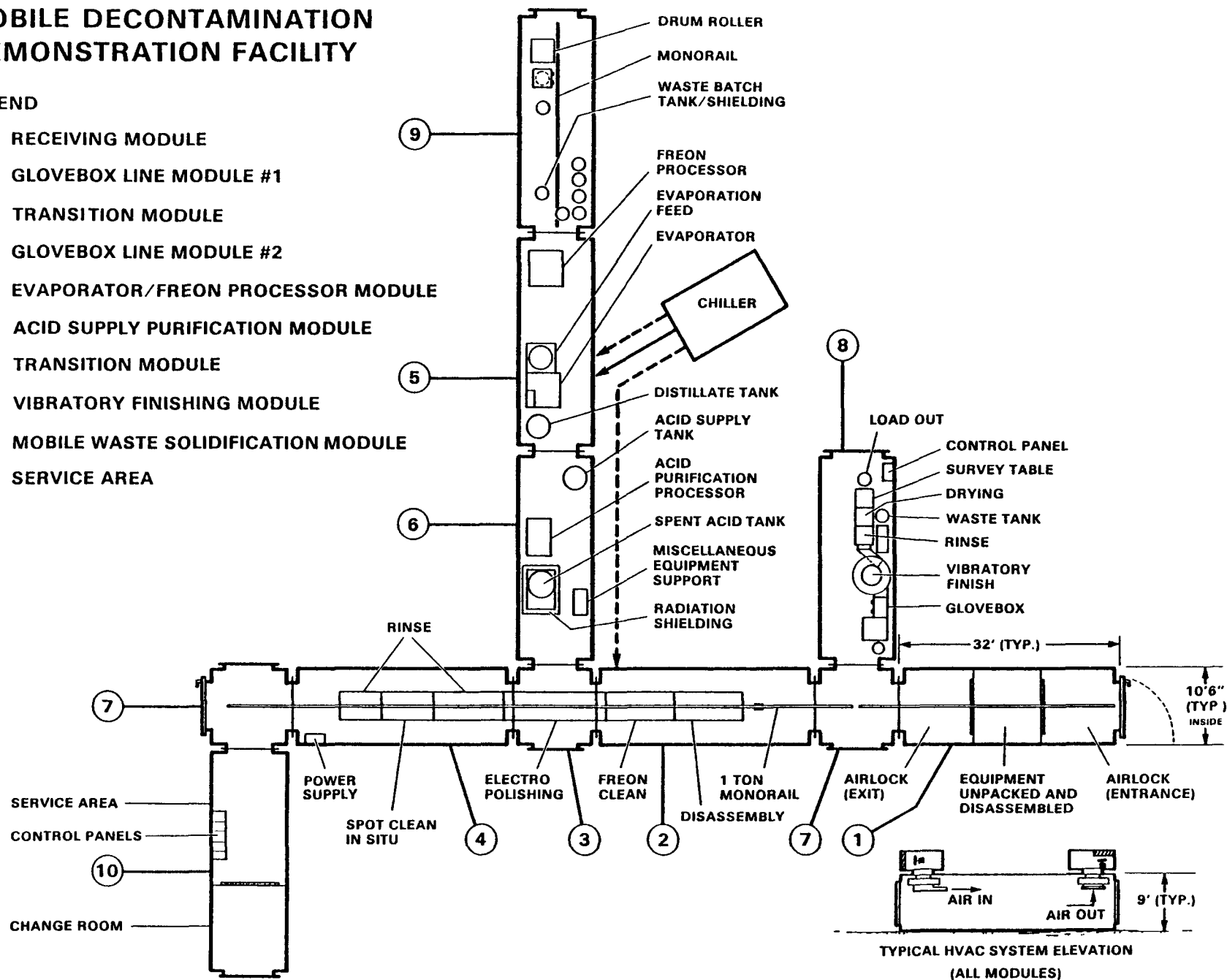
It would be desirable to have the power supply/transformer, equipment and control panels associated with each process system contained in the same module. This was the approach used for portable instrument systems used to acquire and evaluate data during nuclear weapons tests. The only exception in the M.D.F. would appear to be the decontamination line module. This approach significantly reduces the piping/electrical instrument interfaces between modules.

Where piping is required between modules, either flanged or welded jumper would be installed. Instrument and electrical connections between modules would be made using prewired pig-tails.

MOBILE DECONTAMINATION DEMONSTRATION FACILITY

LEGEND

- ① RECEIVING MODULE
- ② GLOVEBOX LINE MODULE #1
- ③ TRANSITION MODULE
- ④ GLOVEBOX LINE MODULE #2
- ⑤ EVAPORATOR/FREON PROCESSOR MODULE
- ⑥ ACID SUPPLY PURIFICATION MODULE
- ⑦ TRANSITION MODULE
- ⑧ VIBRATORY FINISHING MODULE
- ⑨ MOBILE WASTE SOLIDIFICATION MODULE
- ⑩ SERVICE AREA

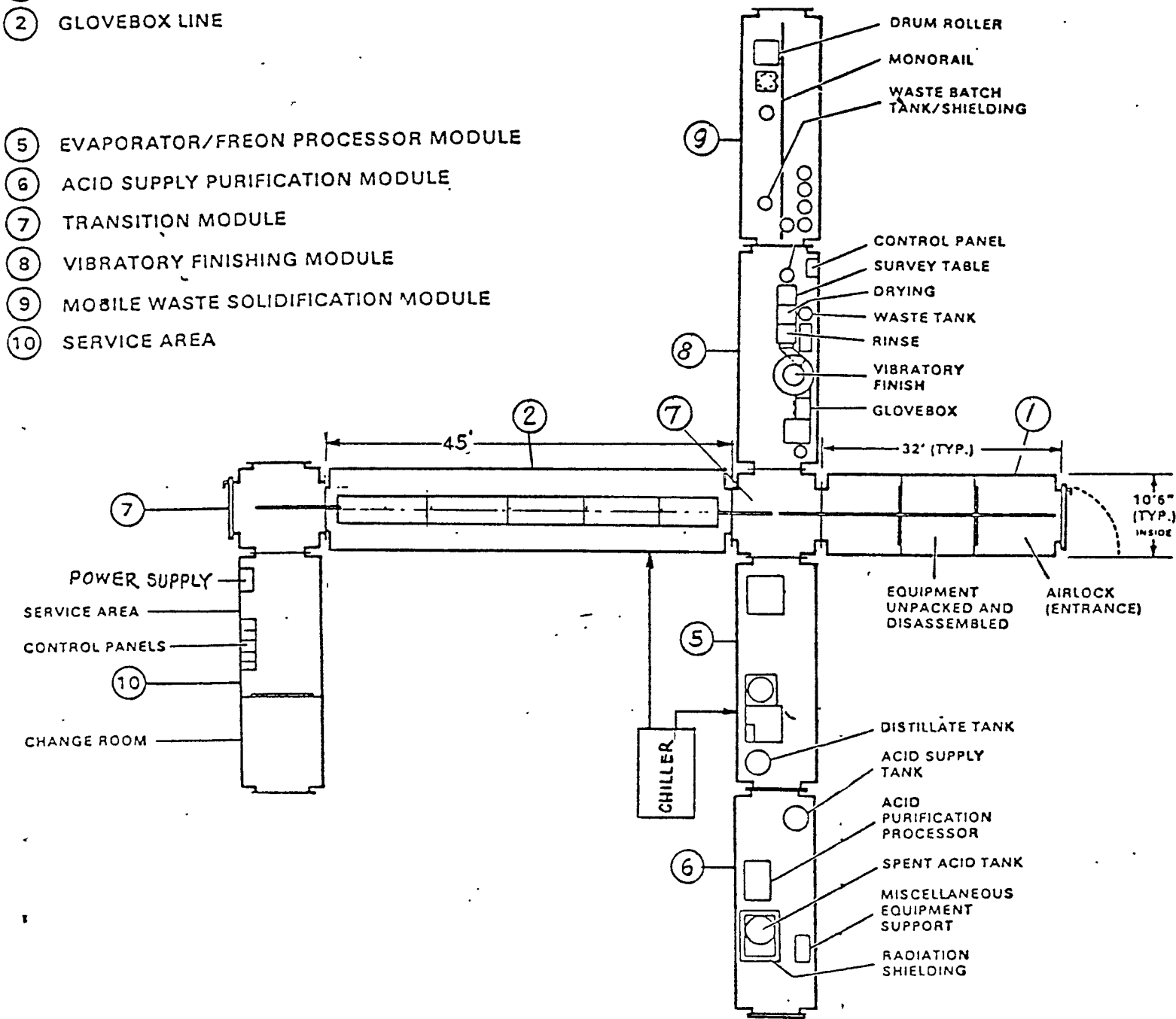


MOBILE DECONTAMINATION DEMONSTRATION FACILITY
FIGURE 6

MOBILE DECONTAMINATION DEMONSTRATION FACILITY

LEGEND

- 1 RECEIVING MODULE
- 2 GLOVEBOX LINE
- 5 EVAPORATOR/FREON PROCESSOR MODULE
- 6 ACID SUPPLY PURIFICATION MODULE
- 7 TRANSITION MODULE
- 8 VIBRATORY FINISHING MODULE
- 9 MOBILE WASTE SOLIDIFICATION MODULE
- 10 SERVICE AREA



MOBILE DECONTAMINATION DEMONSTRATION FACILITY

FIGURE 7

Permanent radiation shielding would be provided in areas such as the evaporator feed and spent acid tanks. However, considering the wide variety of applications, much of the radiation protection for personnel would be a combination of temporary shielding and area access control.

The receiving module would be of standard M.D.F. design (32x11x9 exterior) with entrance and exit air locks and an equipment unpackaging/disassembly work area where containers are received, opened and the contents sorted and sent to the various process areas.

The decontamination (glovebox) line will be contained in one extra long process module. The width of the gloveboxes designed for the fixed D.D.F. would probably remain the same and the height decreased to meet the 8 feet restriction. The decontamination line would consist of a disassembly glovebox, freon cleaning glovebox, electropolishing glovebox, rinse and in situ cleaning gloveboxes. Power supplies and the control panel for the decontamination line would be located in the change room support module.

The acid purification system will fit into a standard M.D.F. module. All tankage, controls, shielding, and support equipment related to the acid purification system can also be contained in this unit.

The evaporator freon processor module will contain the existing evaporator, freon processor and associated tankage and controls.

The evaporator would have to be modified to reduce the elevation of the electric boiler to 8 feet. At present, no design changes are expected to be made in the freon processor.

The vibratory finisher and all of its support equipment can be assembled in one M.D.F. module. The operation of

the vibratory finisher would be somewhat less efficient because there is not a conveyor between the glovebox and the vibratory finisher unit. In some situations, contaminated equipment would go from the receiving module to the disassembly box and then to the vibratory finisher.

The waste solidification module receives all effluents from the acid purification unit, the evaporator, the freon processor, and sediments and liquids from the vibratory finisher. The effluents will be neutralized and solidified as 55 gallon drums of concrete with no free water. Solid wastes generated in the process equipment such as filters can be encapsulated in cement, in 55 gallon drums.

Controls are included with each module to provide extra versatility. This philosophy may lead to some small increase in operator exposure, but temporary shielding can be used to mitigate any potential for large increases. The ability to send the vibratory finisher to one site and the decontamination line to another, resulting in greater flexibility and an overall exposure reduction to those performing the decontamination task, should more than offset the incremental exposure associated with placing the controls in the same module as the equipment.

4. Cost and Schedule

The design and construction costs for the M.D.F. as shown in Table III. These costs include what the utilities consider start up and test costs.

The site/program utilizing the services of the M.D.F. would be responsible for site preparation, transportation and assembly costs as well as the costs associated with operation and clean up.

Based on shipping costs of \$8/100 lbs., the estimated cost for shipping the M.D.F. would be \$40,000 to \$50,000. Assembly on the site is estimated to require 60 calendar days, using a mixed craft force of 20 men.

The schedule for the M.D.F. is presented in figure 8.

TABLE III
M.D.F. COST ESTIMATE

<u>ITEM</u>	<u>\$K</u>
BNW Manpower & Equipment Expenditures to 10/1/80	\$ 509
BNW Manpower to Complete Equipment Design (including evaluation and reporting)	630
Equipment	590
Module Design & Fabrication	1,113
Equipment Installation (Including Design)	717
<hr/>	
TOTAL	\$3,559

MODULAR DECONTAMINATION FACILITY SCHEDULE

DESIGN

EQUIPMENT
MODULES

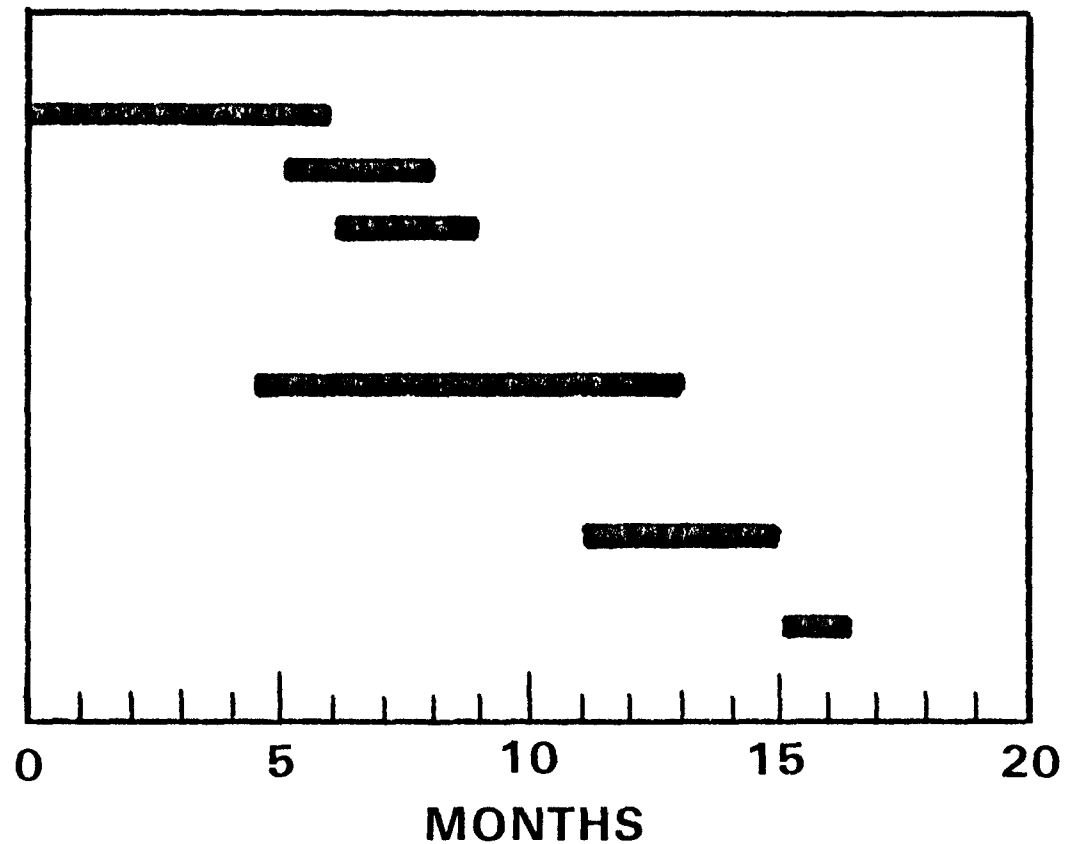
INSTALLATION

PROCUREMENT

EQUIPMENT
MODULES

INSTALLATION

CHECK OUT



D. Comparison of Alternates

The material presented here will focus on a comparison of the D.D.F. and the M.D.F. (the fixed vs the mobile designs). Alternate #1 will not be discussed, because this alternate represents a net increase in project costs for no preceived benefits.

The cost and schedules will be compared in the first section. A listing of the generic benefits of a demonstration at Three Mile Island is presented in the second section, to provide a reference plane for comparing the benefits of the fixed vs mobile facility in the third section.

1. Cost and Schedule Comparison

The cost for the fixed facility, is estimated to be \$3,267,000 and the cost for the mobile facility, is estimated to be \$3,559,000. A comparison of the cost data from Tables II and III are summerized below:

<u>\$K</u>			
<u>ITEM</u>	<u>FIXED FACILITY</u>	<u>MOBILE FACILITY</u>	<u>Δ</u>
BNW Manpower & Equipment Expenditure to 10/1/80	509	509	0
BNW Manpower to Complete (Including Evaluation & Reporting	403	630	227
Equipment	545	590	45
Facility Engineer- ing Construction & Equipment Installation	1,810	1,830	20
	<hr/> 3,267	<hr/> 3,559	<hr/> 292(9%)

It can be readily seen that the largest portion of the increase is associated with the "BNW Man Power to Complete" costs. This reflects the fact that almost all of the decontamination line has been designed, and that a significant amount of redrawing would be required. The licensing support and all of the shop/field supervisor and check out would be shifted to Battelle. It should be noted that although significant redrawing is required very little additional engineering is required for the decontamination line. The increase in equipment costs represents an allowance for modifying existing equipment to meet the spacial limitations. The only comparison that can be made on the facility costs is that the $\$445/\text{ft}^2$ for the fixed facility increases to $\$610/\text{ft}^2$ for the mobile facility. This is what would be expected and the increment appears reasonable for the complexity of the facility.

It is difficult to make a direct comparison of the overall schedules, because the schedule for the D.D.F. has not been finalized. However, it is valid to state that the 16 month schedule for the M.D.F., would put it at the site in time to provide a meaningful demonstration.

2. Generic Benefits of a Demonstration at Three Mile Island.

The decontamination demonstration at Three Mile Island has significant potential benefits to the nuclear power industry in the following areas:

- Reduction of Operator Exposure. The utilization of these advanced decontamination techniques can materially reduce the radiation exposure to personnel in the TMI recovery operation. The data, obtained under rigorous field conditions is directly applicable to reactor operators performing scheduled and unscheduled maintenance. Special attention will be given to the dissemination of the successfully demonstrated

exposure reduction technology to the commercial reactor industry.

- Decontamination and Decommissioning. The DOE is currently planning to decommission more than 400 facilities (Nucleonics Week, October 25, 1979, p.11). The data and techniques derived from the DDF can provide a significant portion of the planning base for these programs. It is possible that much of the design efforts can be utilized directly, reducing program costs. Furthermore, the use of sectioning technology can increase the capability of a DDF type facility many fold for this type use.
- Commercialization. The DDF decontamination technology was developed under the DOE TRU Waste Decontamination Program. Successful demonstration of this new technology via the DDF is the most likely course to hasten commercialization. This approach also squarely faces the regulatory issues, which are usually significant impediments to the injection of new nuclear related technology. The current status of commercialization of this type technology is small component decontamination provided by mobile facilities, utilizing a piece of technology here and there. The DDF provides an integration of state of the art of component decontamination techniques, consolidated in one facility, taking advantage of the complementary features of electropolishing, freon cleaning, and vibratory finishing.
- Waste Disposal Volume Reduction. The ability of effective decontamination to reduce the volume of radioactive waste requiring disposal is an incentive for the development of improved techniques. Existing low level waste disposal sites are rapidly becoming more difficult to utilize. They are decreasing in number and increasing in the severity of restrictions placed upon their use. The prospect of siting, developing and licensing new sites for this purpose in the near future is discouraging. The widespread application of sound, proven effective decontamination techniques in operating

nuclear generating stations and throughout the nuclear industry can extend the useful life of the limited existing sites.

- Process System Waste Management. The DDF is designed to recycle decontamination solutions and to solidify secondary wastes. Actual solution treatment effectiveness information can be obtained, allowing accurate calculation of waste volume reductions. These data would be very beneficial in planning the decontamination of other facilities.
- Public Welfare. Although those familiar with low level radiation recognize its minimal hazard, even as compared to the natural radioactivity so ubiquitous in our environment, there is no such perception among the general public. The ability to decontaminate equipment to a level permitting unrestricted use, particularly amid the glare of publicity that surrounds TMI, could do much to ease the unfounded fears that exist. At the same time, the contamination removed from the material, when treated by the waste processing elements of the DDF, will be put into a preferable form for ultimate disposal.
- Resource Utilization. The changing situation on resource availability necessitates a continuing review of the source of strategic materials. Consideration will be given to "mining" our waste disposal sites. The ability to cost effectively decontaminate components to a releasable condition should be a key factor in developing a strategic material recovery program. Data from the DDF can provide reliable insights into such program analysis.
- Cost-Benefit Data. The data developed will provide a solid basis for making clear cost-benefit choices between reclamation and disposal. Further, the data will provide a basis for making cost-benefit decisions on decontaminating to change waste category.
- Post Accident Analysis. The DDF can be used for the

decontamination of components that are to be shipped to other sites for post accident analysis. The spectrum of techniques available makes it possible to selectively decontaminate without destroying the evidence, thus facilitating offsite shipments.

The decontamination demonstration is an essential step in the accomplishment of these objectives. Locating it at TMI provides a unique opportunity to bring together at one location the latest in technology and the wealth of contaminated tools, equipment and material resulting from the accident. Hopefully, this opportunity will not reoccur and should not be passed over. The demonstration could be established anywhere, using artificially contaminated material if necessary to demonstrate its capabilities, but the question would always remain open whether these simulated contaminants were representative of those likely to be encountered in the real world and which already exist at TMI.

3. Benefits of Fixed vs Mobile Demonstration.

The generic benefits listed above can be accrued by conducting the decontamination in either a fixed or mobile facility. The total expenditure for either concept is very close \$3,267,000 for the fixed facility and \$3,559,000 for the mobile facility. This is a difference of 292 thousand or about 9%. With either approach the near term benefits are essentially the same and are as listed in the previous section.

Examining the potential for longer term benefits, it is assumed that the fixed facility might be retained to support future maintenance requirements at Three Mile Island. Although this would be beneficial to GPU, few if any continuing benefits would be accrued by the nuclear industry or the government.

If the facility were mobile the longer range benefits to the nuclear industry and the government change markedly. Two significant benefits were identified and they are:

- At the completion of the demonstration program the mobile facility is available to support other industry applications and/or government decontamination and decommissioning (D&D) obligations and restorative action programs (RAP).
- The mobile facility will represent a proven strategic mobile unit for accident response.

If one assumes the mobile facility has a ten year operational life at the end of the demonstration program, the availability of the mobile facility represents a savings of many millions of dollars to potential industrial needs and to D&D and R.A.P. efforts. Conservatively this saving figure approaches 6.5 million dollars.

Based on the increase in the long range benefits, the authors believe that the mobile facility represents the most effective investment.

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