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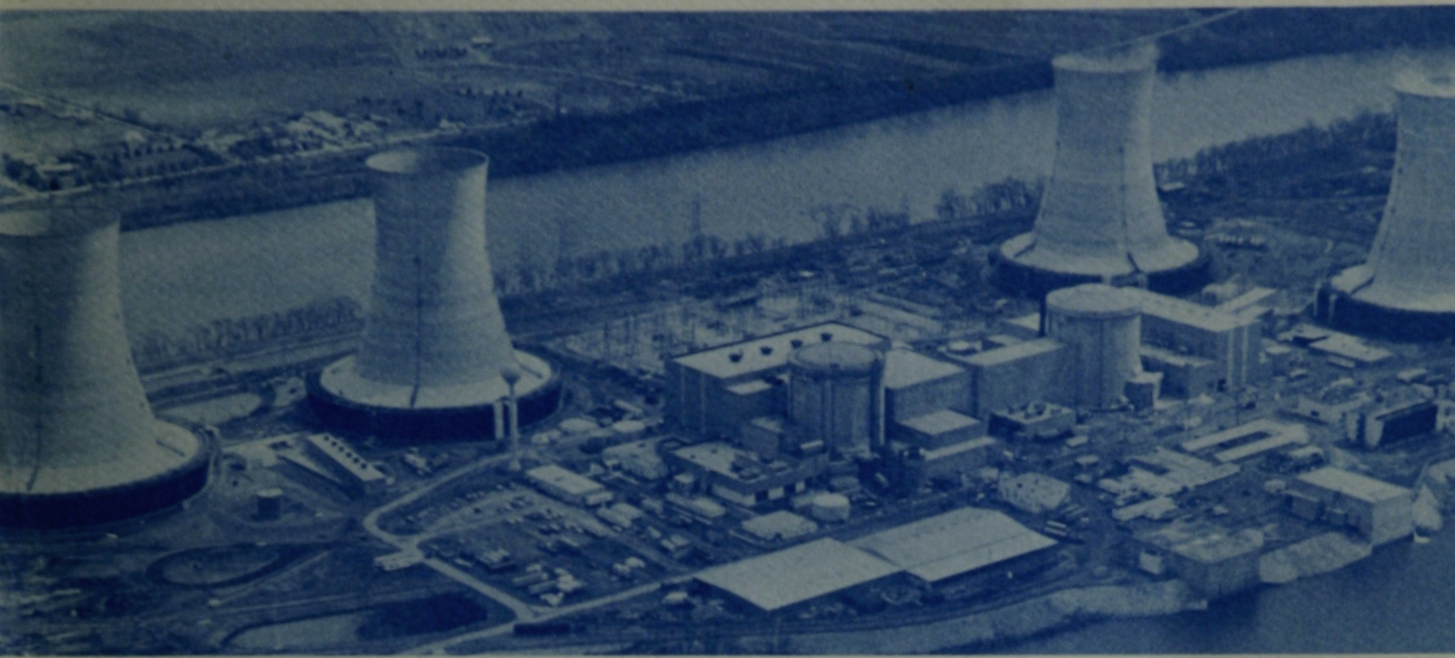
Attachment 2



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General Public Utilities • Electric Power Research Institute • U.S. Nuclear Regulatory Commission • U.S. Department of Energy

GEND Planning Report
Section 3.0

Technical Integration Office
EG&G Idaho, Inc.

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Three Mile Island Operations Office
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DRAFT
SHORT TERM PROGRAM PLAN OF RADIOACTIVE WASTE HANDLING FOR GENERIC RESEARCH AND DEVELOPMENT DURING CLEANUP OF TMI-2

Prepared by

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In

SUPPORT OF RADIOACTIVE WASTE HANDLING R&D PLANNING GROUP (3.0)

TMI TECHNICAL INFORMATION AND EXAMINATION PROGRAM.

Revision 07/31/80

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PREFACE

This short-term program plan was prepared for the Radioactive Waste Handling Technical Planning Group (Task 3.0) by the EG&G Technical Integration Office.

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1.0 INTRODUCTION/OBJECTIVES

The Technical Planning Group (TPG) Task 3.0 was formed to develop a plan and suggested task scope statements that could be used to enhance information and technology of generic value to the nuclear community in the areas of radioactive waste processing, storage, transportation, and disposal using the cleanup of TMI-2 as a reference data base. The group functions in a manner consistent with the overall objectives and mode of operation of the TMI Technical Information and Examination Program.

This plan considers only activities which could be of generic value to the nuclear industry. This plan only considers projects which may be completed in time to aid in the decision-making processes associated with the cleanup of TMI-2. Those projects of generic technology value, but would be completed on a longer schedule, are addressed in a Long-Term Waste Management Plan currently under preparation at ORNL.

The major objective of the TMI-2 Information and Examination Program is to utilize the experience from, and requirements established during the TMI-2 cleanup, to identify generic post-accident requirements for the design, operation, maintenance, cleanup and recovery of civilian nuclear power plants. The specific objective of this part of the TMI-2 Information and Examination Program is to identify radioactive waste handling programs, which could utilize the experiences and radioactive wastes which result from the TMI-2 cleanup, to satisfy the objectives of the overall TMI-2 Information and Examination Program. This plan considers the removal of the radioactive contaminants from accident liquids and decontamination solutions, the treatment and storage of the contaminated resins and zeolites, and the processing, transportation and disposal of the final waste forms. This plan does not consider radioactive waste handling activities relating to the reactor core and internals.

The resulting activities of this plan will not be critical path items on any TMI cleanup or regulatory plans. Implementation will not utilize facilities or equipment associated with the defense waste program.

2.0 GENERAL PUBLIC UTILITIES (GPU) PLAN AND SCHEDULE

The General Public Utilities (owner of TMI-2) baseline planning for processing of contaminated water and management of solid wastes from TMI-2 is formulated on state-of-the-art commercial methods. The following articles describe GPU's plan for immobilizing the accident radioactive contaminants.

2.1 Liquid Waste Processing

Radioactive liquid waste processing activities planned by GPU include the segregation, processing, collection, handling, and solidification of liquid radioactive waste. The primary objective is to concentrate radioactive fission products, which are presently dispersed in liquids and as surface contamination in the Reactor Coolant System, Reactor Building, Auxiliary Building and systems within both buildings. This processing will result in waste forms suitable for safe handling, storage, and disposal consistent with applicable regulatory requirements. There are two general categories of radioactive liquids which will require processing:

- accident liquids, i.e., liquids which were contaminated with fission products during and immediately following the accident and are now retained within the reactor coolant system, containment sump or in auxiliary buildings and tanks and,

- decontamination (decon) solutions, i.e., solutions which will be used in decontamination of systems, structures, and equipment contaminated during the accident, and which may become contaminated in the decontamination process.

Concentration of fission products contained in accident liquids and decon solutions will be accomplished by systems specifically designed and installed at TMI-2 for that purpose. These treatment systems are described briefly as follows:

2.1.1 EPICOR II - This system employs a series of filters and ion-exchangers (or "demineralizers") to remove suspended and dissolved impurities (both radioactive and non-radioactive) from contaminated water. EPICOR II has been specifically approved by the NRC for treatment of "intermediate level" accident water, contaminated to a level between 1 μCi/cc and 100 μCi/cc. The major source of this class of water is that which was released from the primary coolant system and transported to the auxiliary building early in the accident. Fission products removed from water treated by this system are captured via ion exchange on organic resin and inorganic media (zeolites) in steel liners. When loaded to administrative levels or depleted, these liners and their contents are removed from service, and stored for subsequent disposal.

The EPICOR-II system has been in operation since early October 1979, and as of June 4, 1980, had successfully processed about 330,930 gallons and removed more than three quarters of the 56,548 Ci of radioactivity from liquid in the Auxiliary and Fuel Handling Buildings. The Auxiliary and Fuel Handling Buildings storage tanks contained about 474,000 gallons of contaminated water after the accident. There is in-leakage of about 408 gallons per day into these buildings which is also being processed by EPICOR. Quantities of wastes requiring final disposition are summarized in Section 2.3. Average concentrations of cesium and strontium activity on the EPICOR ion exchange media range from less than 1 to approximately 44 curies per cubic foot.

GPU has been required by NRC to solidify these resins if they are to be shipped for commercial shallow land burial; GPU is conducting R&D to support implementation of the solidification requirement.

Solidification of resins and filter media has been an objective of the NRC for of all power reactor licensees. Effective July 1, 1980, the commercial burial grounds will require that resins with radioactive materials of half-life greater than 5 years and activity levels in excess of 1 μCi/cc to be solidified if they are for disposal in commercial shallow land burial facilities. Essentially all of the EPICOR II ion exchange media are above the activity and half-life thresholds for solidification.

NRC criteria is being formulated to classify the wastes from the EPICOR II system. The stability of the organic resins due to the radioactivity loadings of cesium and strontium is being evaluated as part of this classification. This evaluation may indicate a necessity to elute or transfer the activity from the organic resins to more stable inorganic ion exchange media such as zeolites. Solidification of the resins, as ordered by the NRC, may require removal of the resins (by sluicing) from their liners for immobilization in other media and possibly different containers prior to disposal.

Studies are being conducted by GPU which consider modifications of the EPICOR-II system to permit its use for other processing requirements, such as the water in the reactor coolant system (RCS).

2.1.2 Submerged Demineralizer System (SDS) - The SDS is an ion exchange system conceptually similar to the EPICOR-II system, but it will accomodate higher activity levels of radioactive waste water, such as that presently retained in the RCS and containment basement. There are two major differences between the SDS and the EPICOR-II systems. The SDS will utilize inorganic ion exchange materials (Zeolites) in the first demineralizer stage to enable higher concentration of radioactive contaminants than possible with organic resins. Major components of the SDS system will be located underwater in the TMI-2 spent fuel pool, to provide radiation shielding during operation.

SDS processing rates are designed to be 10 gpm through a 10 cubic-foot liner containing approximately eight cubic feet of resin. Activity concentrations of approximately 9800 Ci per liner are anticipated. Approximately 67 zeolite beds would be expended to process 1,000,000 gallons of containment sump water. A total of 550,000 to 600,000 Ci of radionuclides are to be removed. Conservative estimates of the quantities of waste to be disposed of are provided in Section 2.3.

Other products from the SDS include contaminated inorganic and organic ion exchange materials in containers and processed water which will meet the effluent water criteria of 10 CFR 20, Appendix B, Table 2, Col. 2. The SDS system is being fabricated and is anticipated to be operational by the end of 1980, contingent upon NRC approval to operate the system.

Disposal methods for the SDS first stage demineralizer liners is uncertain due to the high radioactivity concentration on the ion exchange media (approximately 1400 Ci per cubic foot) and due to the lack of similarity to other high level waste classifications. Activities from spent resins from normal nuclear plant operations are on the order of 0.1 to 10 Ci per cubic foot and are accepted at shallow land burial facilities. The higher specific activity levels in these SDS liners precludes their acceptance for shallow land burial unless a high integrity container (overpack) is developed to mitigate the possible internal radiation effects and the corrosion, thermal and mechanical effects which may be present in shallow land burial sites. NRC criteria for classifying SDS media could contribute to the decision on ultimate disposal of these wastes short of interim storage on-site or off-site. Present definitions of high level waste are limited to the first cycle raffinate from the solvent extraction of irradiated fuel, which contain large quantities of uranium and actinides. Containment sump water samples to date show the water to be free of significant quantities of actinides and therefore presents only a shorter term disposal problem from the fission products (30 year half-lives) and not from the longer-lived plutoniums (25,000 years half-life) and uraniums (4.5 billion years). Additional sampling after containment reentry may show significant differences in the above.

2.1.3 Evaporator/Crystallizer and Solidification System - Since ion exchange systems may not be suitable for processing contaminated decon. solutions which contain detergents or other chemical cleaning agents, it is necessary to provide other means of concentrating fission products from the decon. solutions. GPU is presently preforming a technical evaluation of an evaporator/crystallizer and solidification facility. The facility is planned to contain a large capacity radwaste evaporator designed for 30 gpm and associated support systems such as tankage, feed treatment, filtration, process control, polishing, solidification of concentrates, and storage and handling capabilities. The technical evaluation consists of completing the system design packages in order to evaluate the schedule, overall system costs, and existing plant facilities usage impacts so that a final decision of the use of the evaporator/crystallizer can be made. The present estimate for starting of the evaporator/crystallizer, if it is to be constructed, is mid to late 1982.

2.1.4 Low Activity Waste Processing System - At the present time, TMI-2 low activity waste water (water not generated by the accident and having fission product concentrations less than 1 µCi/cc) is being processed by an ion-exchange system called EPICOR-I (initially associated with Unit 1). At a future time, this system may be reserved exclusively for TMI-2 use.

2.1.5 Processed Water Storage System - The clean water effluents from all of the accident liquid processing systems are being stored in the processed water storage tanks. Based on the operating data for the Epicor II processing system, the tritium concentration is a maximum of 0.27 µCi/cc.

Because of uncertainty as to when permission to discharge such water might be granted, alternative methods of disposing of clean processed water, such as evaporation and solidification, are being examined. Also, the recycling of processed water for cleanup or other plant operations is being evaluated for feasibility by GPU.

2.2 Solid Waste Management

The objectives of solid waste management are to safely accumulate, volume reduce, package, stage, make available for, and transport off-site all solid radioactive waste material. The management of solid radioactive wastes consists primarily of inventory control and radiological protection.

The largest quantity of solid radioactive waste consists of cleanup materials expended during decontamination. Another major source of radioactive solids include the products of processing water contaminated as a result of the accident and used in decontamination operations. These include demineralization material, filter elements, and evaporator concentrates. Plant equipment and materials for which decontamination is not feasible or effective from the standpoint of cost or personnel dose also contribute to the solid radioactive waste inventory. The disposal of solid waste is to be accomplished in a manner which does not create a personnel hazard or spread contamination, yet satisfies packaging, shipping, and disposal regulations.

2.3 TMI-2 Radioactive Waste Quantities

Estimates of the non-fuel solid radioactive waste at TMI Unit II have been made. Table I shows the quantities of waste by type which must be shipped to a disposal site. This estimate shows a total of 300,907 ft^3 of waste volume. Table II summarizes the EPICOR waste generation and performance to date. Although no experience has been accumulated with the SDS system, conservative estimates of the SDS waste generation are shown in Table I.

TABLE I

ESTIMATED WASTE FORMS AND WASTE QUANTITIES TO BE GENERATED AT TMI UNIT II (NOTE 1)

Waste Type	Containers	Usable Contr. Volume (ft^3)	Total No. Of Containers	Containers Per Shipment	Shipments	Gross Specific Activity (Ci/ft^3)	Total Volume (ft^3)
COMPACTED TRASH							
a. Aux. & Fuel Hdlg. Bldg.	55 Gal. Drums	7.35	5,100	155	33	.003	37,485
b. Reactor Bldg.	55 Gal. Drums	7.35	7,320	155	47	.03	53,802
NON-COMPACTIBLE TRASH							
a. Aux. & Fuel Hdlg. Bldg.	4 1/4' x 3' x 6 1/2' Boxes	83	770	18	43	$2.0x10^{-4}$	63,910
b. Reactor Bldg	4 1/4' x 3' x 6 1/2' Boxes	83	960	18	53	$2.0x10^{-3}$	79,680
AUX. BLDG. DESLUDGING							
a. Sump	55 Gal. Drums	7.35	38	4	10	1.8	279
b. Tank	55 Gal. Drums	7.35	12	4	3	1.1	88
Small Equipment Decontamination (DOE R&D)	55 Gal. Drums	7.35	702	155	5	.066	5,160
	Spent Resin Liners	3	9	-	-	.066	27
REACTOR BUILDING DECONTAMINATION SOLUTIONS							
a. Low Activity	55 Gal. Drums	7.35	954	155	6	.25	7,012
b. Medium Activity	55 Gal. Drums	7.35	960	-	-	8	7,056
c. High Activity	55 Gal. Drums	7.35	861	-	-	14	6,328
REACTOR COOLANT SYSTEM DECONTAMINATION SOLUTIONS	55 Gal. Drums	7.35	1,000	-	-	14	7,350
CONTAINMENT SUMP & RCS LIQUIDS							
a. SDS Particulate Filters	Filter Vessel	10	134	2	67	.52	1,340
b. SDS First Stage Zeolite	2 x 4 Liner	10	105	2	53	1400	1,050
c. SDS Second Stage Organic Cation	2 x 4 Liner	10	44	2	22	11	440
d. SDS Mixed Bed Polishing Demin.	Dem. Vessel	195	18	1	18	1.2	3,510
AUX. BLDG. LIQUIDS (Note 2)							
a. Epicor II Prefilter	4 x 4 Liner	50	100	1	100	44	5,000
b. Epicor II 1st Stage Demin.	4 x 4 Liner	50	30	1	30	2	1,500
c. Epicor II 2nd Stage Demin.	6 x 6 Liner	170	21	1	21	0.1	3,570
LIQUID WASTES (<1mc/ml)							
a. Epicor I Demin.	6 x 6 Liner	170	63	1	63	.71	10,710
b. Misc. Demin.	6 x 6 Liner	170	33	1	33	.71	5,610
						Total Radwaste Volume	300,907 $ft.^3$

NOTES:

1. The above data is based on the GPU 5-year waste generation plan estimates, which were compiled by the NRC for use in the PEIS.

2. These estimates include approximately 30 liners for processing RCS water.
   The estimates for the SDS also include waste data for processing the RCS water.

Table II

EPICOR Radwaste Processing Results for Unit II ***

SYSTEM	ELEMENT	Water Processed (gal.)	Processing Rate (GPM)	Cumulative Activity Removed by System (Ci)	Units* Used	Avg.* Loading (Ci/Liner)	Liners* Thoroughput (gal/liner)
EPICOR I	6x6 spent resin liner	1,120,789	10	109	24τ	4.5	56,039
EPICOR I	Spent Filter liner	1,120,789	10	109	8	**	93,399
EPICOR II	Prefilter	330,930	10	47,269	43	1093	7,696
EPICOR II	1st DEMIN	330,930	10	47,269	13	16.8	25,456
EPICOR II	2nd DEMIN	330,930	10	47,269	7	3.7	51,755

* Based on combined Unit I and Unit II performance

τ Includes 4 resin filled prefilters

** Data not available

*** Data on Epicor I is from the "Epicor I Radwaste System Summary of Operational Data" dated 4/6/80 to 6/17/80. Epicor II data is from the "Epicor II Radwaste System Summary of Operational Data" dated 10/22/79 to 6/4/80. Both reports were prepared by GPU.

Interim storage facilities for radwaste will be constructed to provide a collection location between waste generation and shipment for off-site disposal.

2.4 TMI-II Radwaste Management Schedule

Figure 1 shows the timing of major radwaste activities as currently planned by GPU. This schedule is based on many assumptions. Planning and scheduling of many cleanup activities is dependent upon the availability of the evaporator for processing decontamination solutions.

3.0 RADWASTE DECISION CHART

3.1 Introduction

Figure 2 is a radwaste disposal decision chart. The purpose of the chart is to provide a simplified, graphic presentation of the licensing and processing decisions required for the ultimate disposal of post-accident nuclear power plant radwaste. The chart is arranged in columns and proceeds from left to right. The various waste sources, which are characterized using the TMI-2 wastes, provide a starting point in the chart. The chart shows the various pathways available through licensing and radwaste processing alternatives which would lead to specific radwaste disposal methods. The various candidate project (CP-) numbers are indicated in the various process or licensing decision points. Inclusion of the candidate project numbers in the chart makes it possible to determine how the generic R & D projects fit into the overall radwaste disposal program.

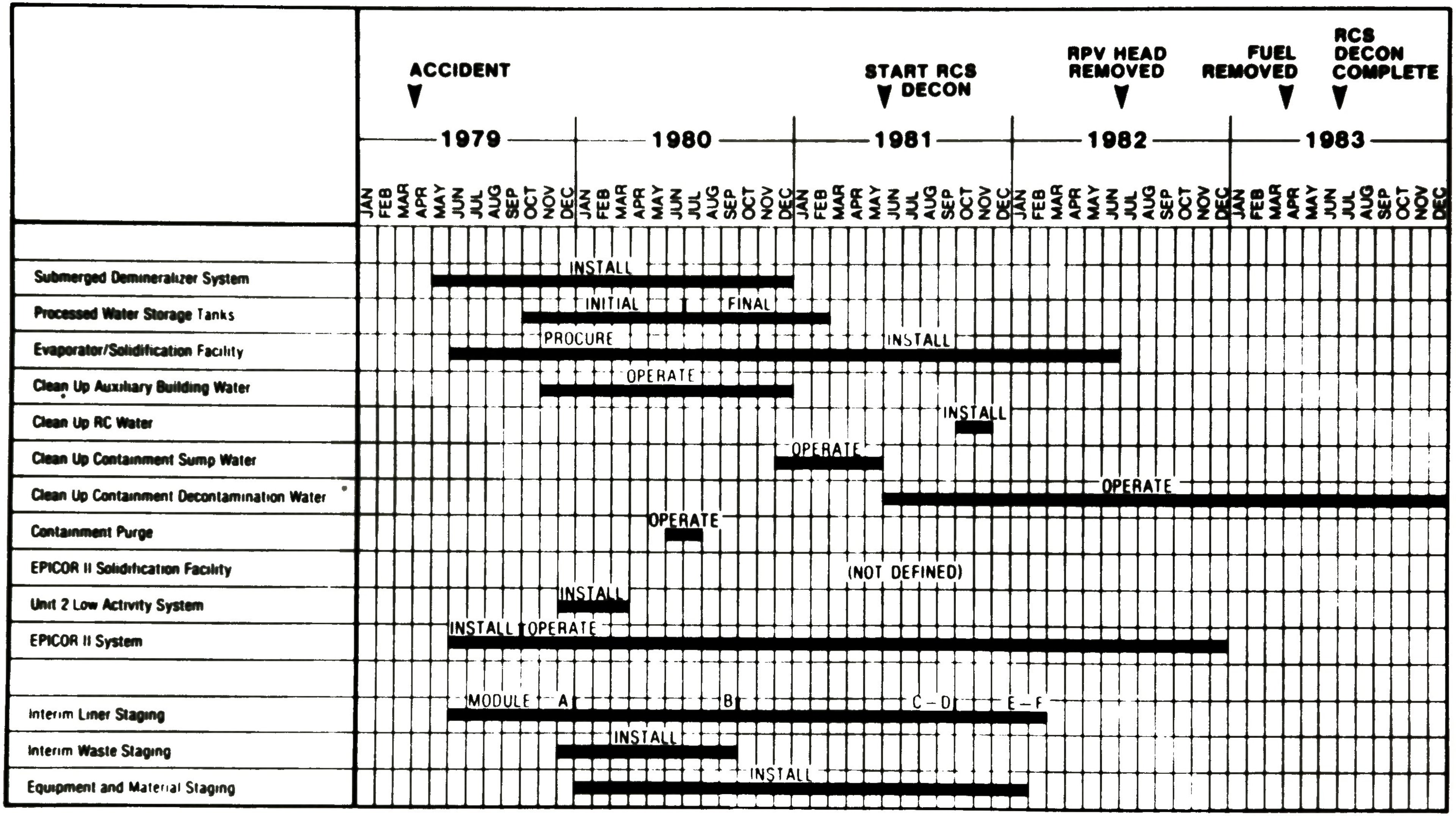
3.2 Relationship of Candidate Projects to TMI-2 (to be supplied later)

4.0 SCHEDULE SUMMARY AND MATRIX TABLES

Figures 3 and 4 present a schedule for the candidate projects recommended to be undertaken in order to aid in developing key decisions on the radioactive products from EPICOR II and SDS respectively.

Each schedule is divided into three distinct phases. Phase I represents an engineering evaluation of the feasibility of the proposed short term candidate projects resulting in the advancement of specific radwaste technology development that may assist in resolution of areas of concern. Selected candidates may be further developed for demonstration and prototype testing during Phase II. The intent is to perform sufficient R&D during Phase I and II on a completion schedule that may enable GPU to construct any additional radwaste production facilities that may be required to process and dispose of TMI-2 wastes.

FIGURE I—GPU BASELINE SCHEDULE



NOTE. The above schedule is being re-evaluated by GPU

RADWASTE DECISION CHART FIGURE 2
7-25-80

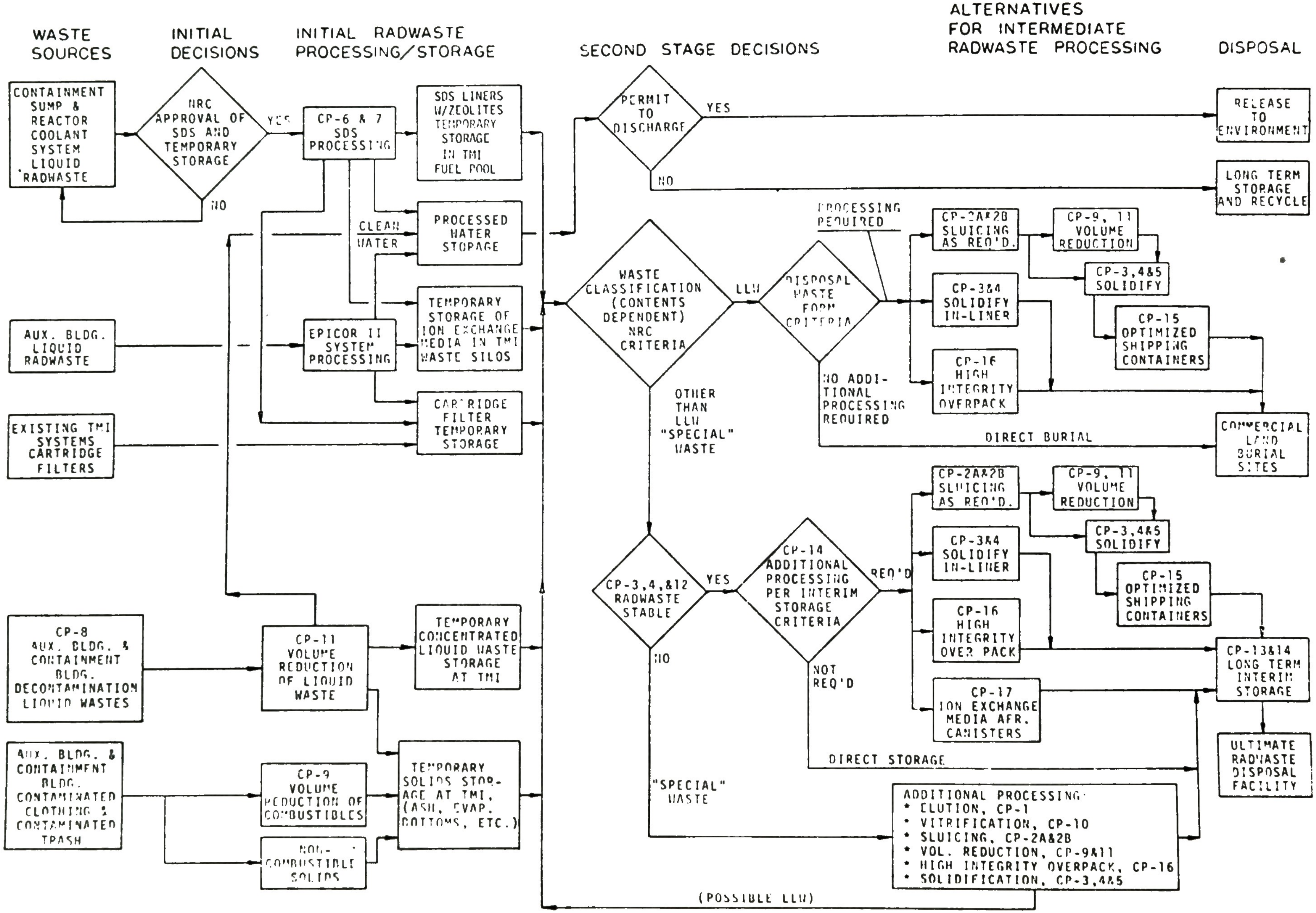


FIGURE 3 EPICOR II WASTE PROCESSING & DISPOSAL

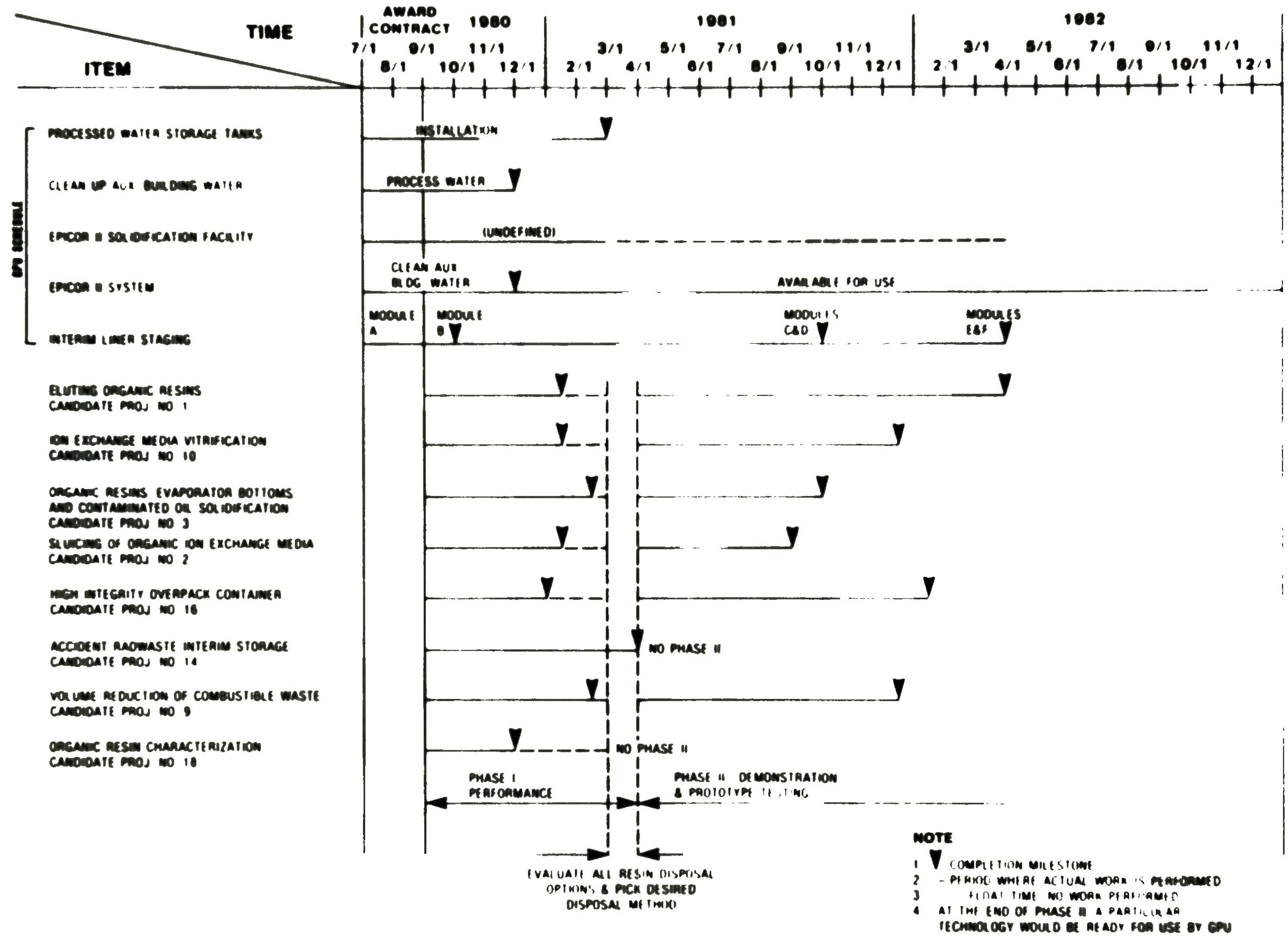
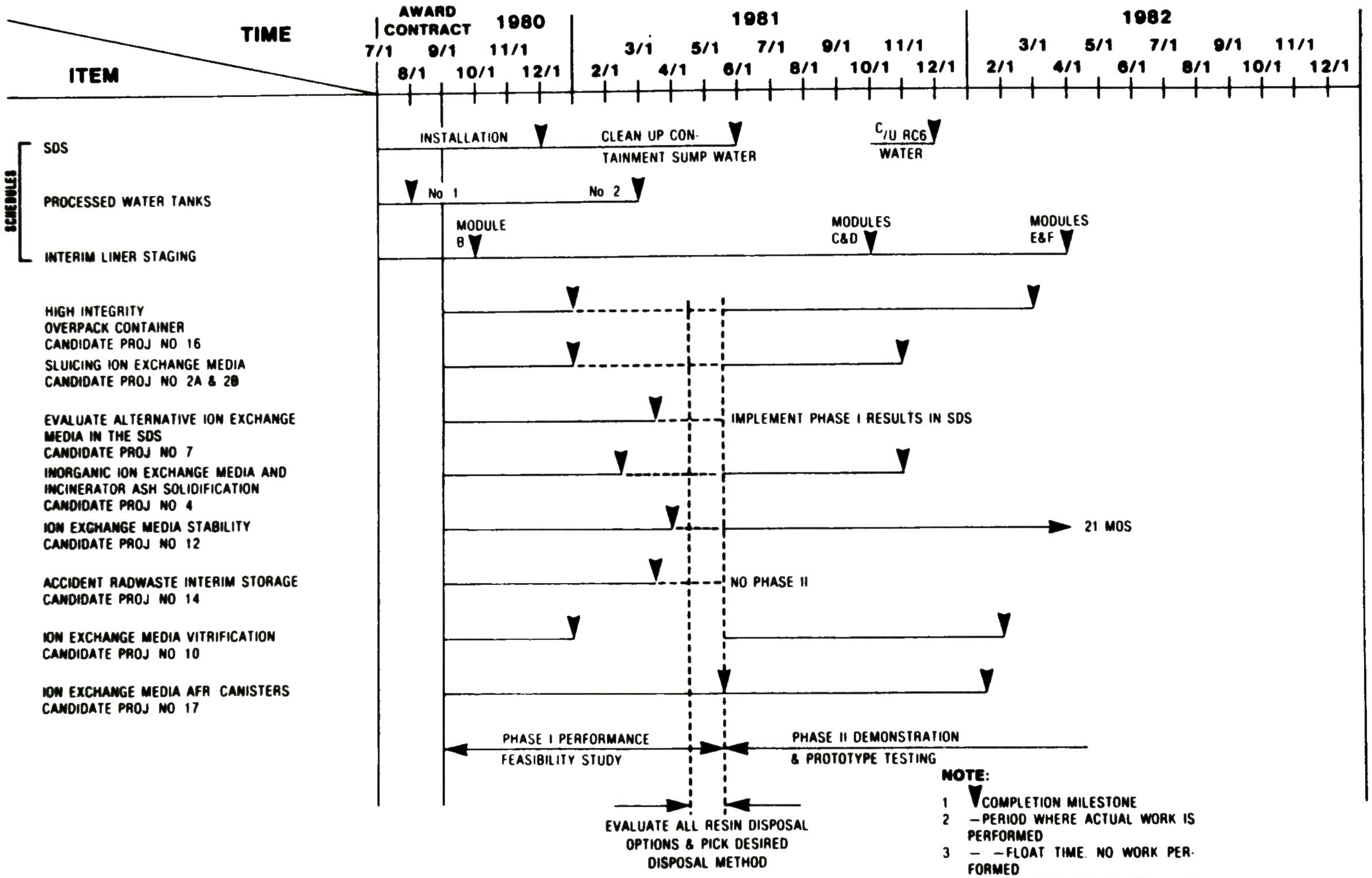


FIGURE 4 SDS WASTE PROCESSING & DISPOSAL



NOTE:

1. ▼ COMPLETION MILESTONE
2. — PERIOD WHERE ACTUAL WORK IS PERFORMED
3. – – FLOAT TIME. NO WORK PERFORMED
4. AT THE END OF PHASE II, A PARTICULAR CONCEPT WOULD BE READY FOR TURNOVER TO GPU
5. CP-6 MODIFICATIONS TO SDS. NOT INCLUDED DUE TO LOW PRIORITY

The GPU baseline schedule (Figure 1) shows the basic tasks related to EPICOR-2 and SDS, along with their target completion dates. The Phase 1 completion dates for the R&D tasks related EPICOR-II processing is April 1981. The Phase I completion of R&D tasks related to SDS processing is December 1981. Phase II completion dates vary but are targeted to interface with the GPU baseline schedule.

Table III shows the summary of all candidate projects with reference to the project brief submitted by the Technical Planning Group and evaluation of their respective priorities on a scale of low, medium and high.

TABLE III

MATRIX TABLE OF CANDIDATE SHORT-TERM R&D PROJECTS

Candidate Project	No.	Phase I Feasibility Priorities* H	M	L	Phase I & II Overall Cost Estimate** H	M	L	Schedule Phase I/ Phase II	Needed To Resolve Regulatory Requirements Yes	No	Reference Project Briefs	REMARKS
Elution of Organic Resins	1	x			x			4 months/ 10 to 12 months		x	NRC-1 ORNL-3.1	Resin stability may require eluting organic resin high level wastes prior to placement in long term interim storage.
Sluicing of Organic Ion Exchange Media	2A			x			x	4 months/ 5 months		x	EG&G/TIO	High ALARA impact. Sluicing is required for some disposal options, but not for others such as overpacks. Low priority due to feasibility study conducted by GPU.
Sluicing of Inorganic Ion Exchange Media	2B		x				x	4 months/ 5 months		x	EG&G/TIO	Medium priority due to lack of definite plans for processing, storage or final disposal of these high level wastes.
Organic Resins, Evaporator Bottoms, and Contaminated Oil Solidification	3	x				x		5 1/2 months/ 5 1/2 months	x		NRC-5 EG&G/TIO ORNL-3.3, 3.5, 3.7, GPU-CAN-X	Essential as the baseline plan for ion exchange media disposal and for high level wastes.
Inorganic Ion Exchange Media and Incinerator Ash Solidification	4		x			x		5 1/2 months/ 5 1/2 months	x		ORNL-3.4, 3.6 NRC-5	Need NRC criteria for long term interim storage to determine solidification requirements.
Cartridge Filters Solidification	5	x					x	6 months/ 6 1/2 months	x		GPU-CAN-1	Solidification of sludges attached to filters will be required after July 1, 1981 at all nuclear facilities licensed by NRC.
Modifications to SDS Ion Exchange Columns and Filter Media	6			x		x		15 1/2 months/ Implement Phase I Recommendations in SDS.		x	ORNL-2.2	Low priority due to the fact that flow sheet modifications are the responsibility of GPU and are not technology development. Technology was provided to GPU by DOE. - ORNL on 4/28/80. No further work will be done on this project.

* H-high
M-medium
L-low

** H->$500,000
M-$100,000 to $500,000
L-<$100,000

TABLE III

MATRIX TABLE OF CANDIDATE SHORT-TERM R&D PROJECTS
(Continued)

ndidate roject	No.	Phase I Feasibility Priorities* H	M	L	Phase I & II Overall Cost Estimate** H	M	L	Schedule Phase I/ Phase II	Needed To Resolve Regulatory Requirements Yes	No	Reference Project Briefs	REMARKS
valuate Alternative on Exchange Media n the SDS System	7			x		x		6 1/2 months/ Implement Phase I Recommendations in SDS		x	GPU-CAN-7 DOE/DOWP	Low priority since system's first stage is designed for zeolites and zeolites should provide adequate performance for containment building cleanup. Use of DURASIL or other alternatives must not impact SDS startup.
Decontamination Reagent Compatibility	8	x					x	4 months/ 5 1/2 months		x	ORNL-6.1 Bechtel	It is necessary to ascertain the effects of the various decontaminants used in TMI cleanup operations prior to operation of a processing facility which is planned.
Vol. Deduction of Combustible Waste	9	x				x		4 months/ 8 1/2 months		x	NRC-8, EG&G/TIO GPU ARJ-1	Reduces shipping and loading at the waste disposal burial sites.
Ion Exchange Media Vitrification	10		x			x		4 months/ 8 1/2 months		x	EPRI-2, EG&G/TIO	Desirable to demonstrate vitrification technology for high activity wastes.
Volume Reduction of Decontamination Solutions	11	x				x		4 months/ 8 1/2 months		x	NRC-8 GPU/CAN-1 EG&G/TIO DOE/DOWP	GPU has taken steps to obtain and install an evaporator/crystallizer to handle liquid wastes which are not processed by EPICOR II or SDS.
Ion Exchange Media Stability	12	x				x		7 months/ 15 to 21 months	x		ORNL-3.2 EG&G/TIO GPU/CAN-9	Information on radiation stability of EPICOR II resins is essential prior to a decision on further treatment.

* H-high
M-medium
L-low

** H->$500,000
M-$100,000 to $500,000
L-<$100,000

TABLE III

MATRIX TABLE OF CANDIDATE SHORT-TERM R&D PROJECTS
(Continued)

Candidate Project	No.	Phase I Feasibility Priorities* H	M	L	Phase I & II Overall Cost Estimate** H	M	L	Schedule Phase I/ Phase II	Needed To Resolve Regulatory Requirements Yes	No	Reference Project Briefs	REMARKS
Disposal Site Test Device	13	x			x			10 to 13 months/ 2 to 3 years	x		DOE/NPD PA/DER NRC-5	Mechanism for determining acceptability of SDS and EPICOR II waste forms for ultimate disposal.
Accident Radwaste Interim Storage	14	x					x	6 1/2 months/ no Phase II	x		EG&G/TIO NRC-4	High priority is required to resolve the licensing issues with respect to the waste disposal forms and locations of the high level wastes.
Optimized Shipping Container	15		x			x		4 months/ 13 1/2 months		x	CAN-4	Improved shipping efficiency for evaporator bottoms is not essential to TMI cleanup, but is advantageous for schedule and cost impact.
High Integrity Container	16	x				x		4 months/ 9 1/2 months	x		NRC 2, 3, 4 GPU/CAN-2	High priority as an alternative to solidification. Elimination of sluicing and processing could significantly reduce the radiation exposures to TMI personnel.
Ion Exchange Media AFR. Canisters	17		x			x		8 1/2 months/ 8 months	x		EG&G/TIO	This option is not desirable in terms of personnel exposures, cost, or final disposition of the waste. Cannot be dismissed because of uncertainty over how the waste will ultimately be classified.
Organic Resin Characterization	18	x				x		3 months/ no Phase II	x			High priority since waste characterization is necessary prior to final waste classification.

* H-high
M-medium
L-low

** H->$500,000
M-$100,000 to $500,000
L-<$100,000

5.0 CANDIDATE PROJECT DESCRIPTIONS

The short term project briefs submitted by the Technical Planning Group members have been condensed into sixteen project descriptions. Included in the following pages are the project descriptions and the scope of work considered necessary to establish feasibility in Phase I and to perform demonstration, where required, in Phase II.

Each technology development candidate evaluated has been as to its benefit to the nuclear industry and advantages and disadvantages to the resolution of TMI concerns. Development risk assessment of the candidate radwaste processes, preliminary review of the schedules, rough estimates of cost and priority recommendations, are also provided.

Proposed R & D candidate projects have been reviewed in light of the following criteria:

1. They must offer generic benefit to the nuclear industry as a whole.

2. They must represent reasonable advances in state-of-the-art proven technology so as to provide a reasonable probability that feasibility and demonstration can be achieved in a reasonably short time frame.

3. The implementation of the candidate projects, after Phase II completion, is the decision of GPU.

4. The candidate projects address only licensing and technical problems.

The scope of work has generally been segmented into tasks in order to expedite the performance of tasks and allow early decisions. Only Phase I of the work is being considered at the outset of contractual commitments. The Phase II demonstration, where required, will not be authorized until evaluation of the feasibility is completed.

The following candidate projects were deleted from this short-term plan as a result of the TPG meeting on June 17, 1980.

Candidate Project	Referenced Project Brief(s)	Reason for Deletion
Develop Ion Exchange Systems	NRC-6 ORNL-2, 3	Transferred to a long-term project
Leaching Characteristics of Failed LWR Fuel Rods	ORNL 5.1	Transferred to TPG 7.4
Transportation Planning for Radioactive Shipments	ORNL 4.1, 4.2, 4.3 GPU/CAN-3, -4	This is considered part of this base recovery effort

CANDIDATE PROJECT DESCRIPTION

CP No. 1

TITLE

Eluting of Organic Resins.

PURPOSE/GENERIC BENEFIT

The long term capability of the organic resins used during the cleanup of TMI-2 wastewater to retain their structure and the matrix bond of radioisotopes has been questioned by the NRC. This project will develop specifications to remove the radioactivity from organic resins and recommend treatment and processing methods for the resulting wastes. The generic benefit of this project will be the development of processes, specifications and/or procedures which would allow the disposal of the organic resin waste at low level burial grounds. This project is also of direct application to the EPICOR II organic resins.

SCOPE OF WORK

The project will develop elution specifications and procedures, from actual testing of nonradioactive resins, to process the organic resin wastes. The scope of work for this project is divided into two phases.

Phase I - This phase will include full scale testing of nonradioactive resins and the development of specifications and procedures to elute the radioactive isotopes from organic resins. The results of CP-3 will determine the stability of organic resins. If the stability of the resins is questionable, the activity on the resin will be eluted and recommendations as to the disposition of the liquid and solid waste will be developed. Current DOE technology will be evaluated in performing this project. Engineering evaluations of the following methods will be made to determine which method produces the least waste with the smallest occupational exposure. The EPICOR II resin liners will be used as typical examples of commercial systems requiring elution.

Two methods will be evaluated. (1) Elution of the activity from the resins, neutralization of the elutriant, solidification by cement, or evaporation with the sludge then solidified. (2) Elution of the activity from the resin, using inorganic deep bed resin to decontaminate the elutriant, and solidification of the resins.

Phase II - This phase will proceed with the design, construction and operation of an elution facility. The facility may be located at a DOE or commercial disposal site. Wastes from this demonstration may be directed to evaluating solidification techniques.

ADVANTAGES

The advantages of this project are that if required, more stable waste forms can be generated from heavily loaded organic resins. The generated waste forms could be suitable for low-level waste disposal.

DISADVANTAGES

The occupational exposures from this project will increase with increased handling and processing of the waste. Sample organic resin waste will probably be shipped off-site for processing at facilities with experience and staffing to process the waste. Actual formulations of the TMI-organic resins are not known and some investigative work may be required.

SCHEDULE

See network diagram.

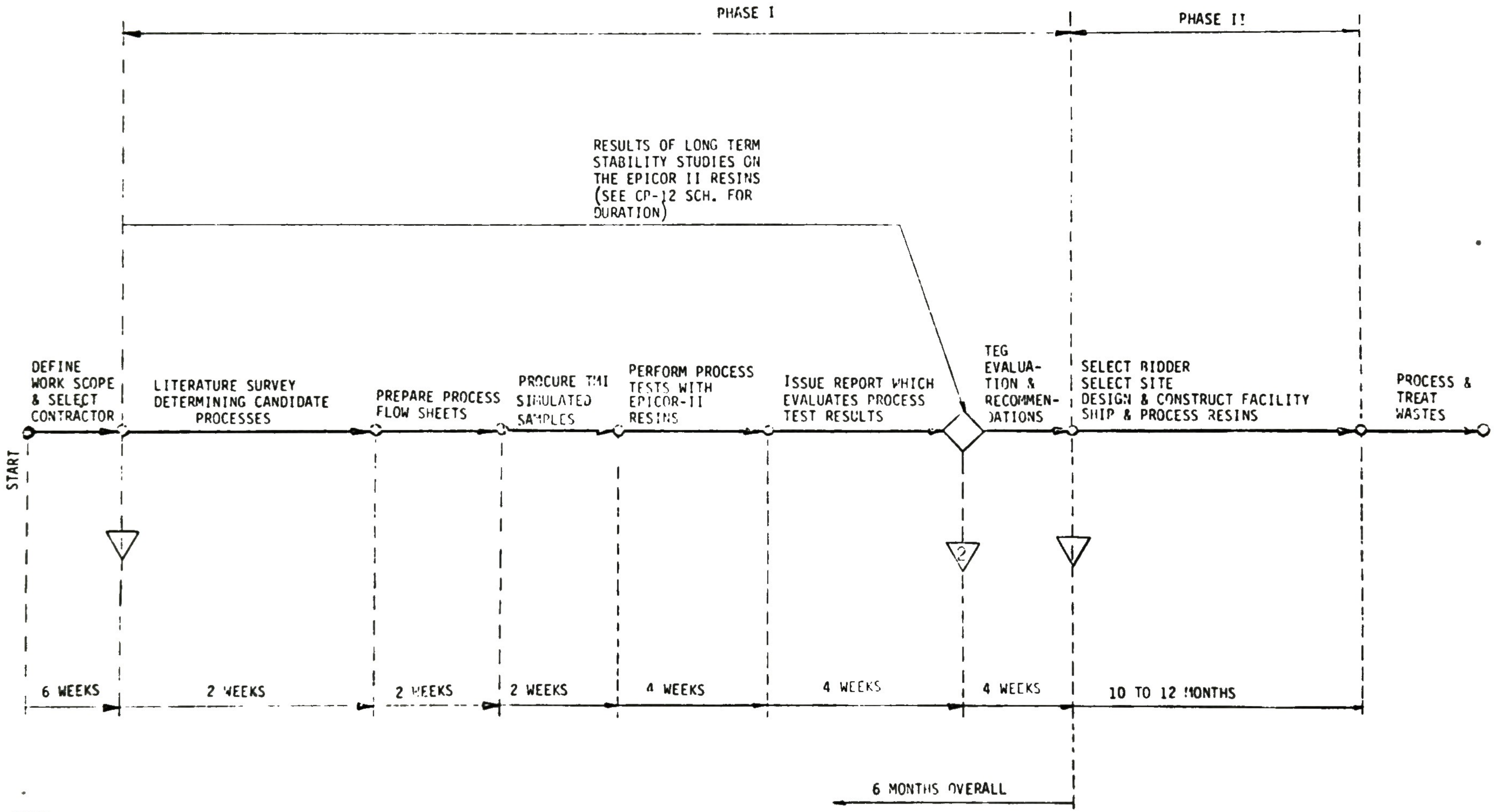
PRIORITY

High priority is assigned for this project because of the high specific activity in much of the TMI organic waste which indicates that resin degradation may occur soon.

COST

Phase I cost is medium and estimated to be over $100,000.
Phase II cost is high and is estimated to be over $1,000,000.

ELUTION OF ACTIVITY FROM EPICOR II RESINS CP-1



NOTES:

1 = FUNDING APPROVAL, BEGIN WORK ON PROJECT

2 = END PHASE I

◇ = BEGINNING OF MAJOR EVALUATION/ DECISION PERIOD IN PROGRAM

CANDIDATE PROJECT DESCRIPTION

CP No. 2A

TITLE

Sluicing of Organic Ion Exchange Media.

PURPOSE/GENERIC BENEFIT

This project will identify techniques, equipment, and auxiliaries for sluicing ion exchange media liners to an, as yet, unidentified immobilization system for solidification. Allows processing of resins for volume reduction as well as increasing stability for retention of radionuclides.

SCOPE OF WORK

Phase I - This phase will include the following activities.

1 Survey current status to establish quantities, locations, activities, description and rate of generation of liners anticipated.

2 Review sluicing feasibility study and tests conducted by GPU.

3 Conduct literature/telephone survey of sluicing done elsewhere (e.g., U.S. Navy sluicing from underground tanks at Shippingport, Pa.)

4 Develop a flow diagram and equipment list for a demonstration sluicing system considering:

- Equipment used by GPU
- Recirculation or disposal of sluice water
- Source of sluice water
- Sluicing resin to the ultimate disposal container either direct or via an intermediate spent resin storage tank
- Equipment available
- Potential locations for the demonstration system
- Shielding requirements
- Frequency of sluicing

5 Develop a test procedure and range of process variables to optimize the sluicing operation. Describe data to be obtained.

6 Deliverables are to include:

- A summary sheet tabulating results of liner and sluice surveys.
- If not already available, a flow diagram and report of the GPU test.
- A bill of material and suggested source of equipment for the demonstration sluicing system.
- A test procedure for Phase II.
- A flow diagram, system description and equipment list for the proposed systems.
- An estimate of material and labor costs and schedule for Phase II.
- A list of references, file of documentation and final report.

Phase II - Demonstration (Only if recommended from Phase I)

This phase will include the writing of equipment specifications and procurement of equipment, generation of drawings, and conduct of a demonstration test using a typical commercial liner and non-radioactive resin. Preparation of procedures for a radioactive liner and establishment of optimum process variables will be provided.

A report describing the test procedures, results, equipment and process parameters recommended for a permanent sluicing system, and estimated budgetary cost for the permanent installation will be delivered.

ADVANTAGES

There will be greater assurance of resin solidification if sluicing is performed to a container designed for a solidification system. The disposal container could be a DOT approved shipping container.

DISADVANTAGES

There is potential for additional personnel exposure resulting from sluicing. Complications are possible due to resin agglomeration or degradation because of radiation effects while in storage are unknown.

SCHEDULE

See network diagram.

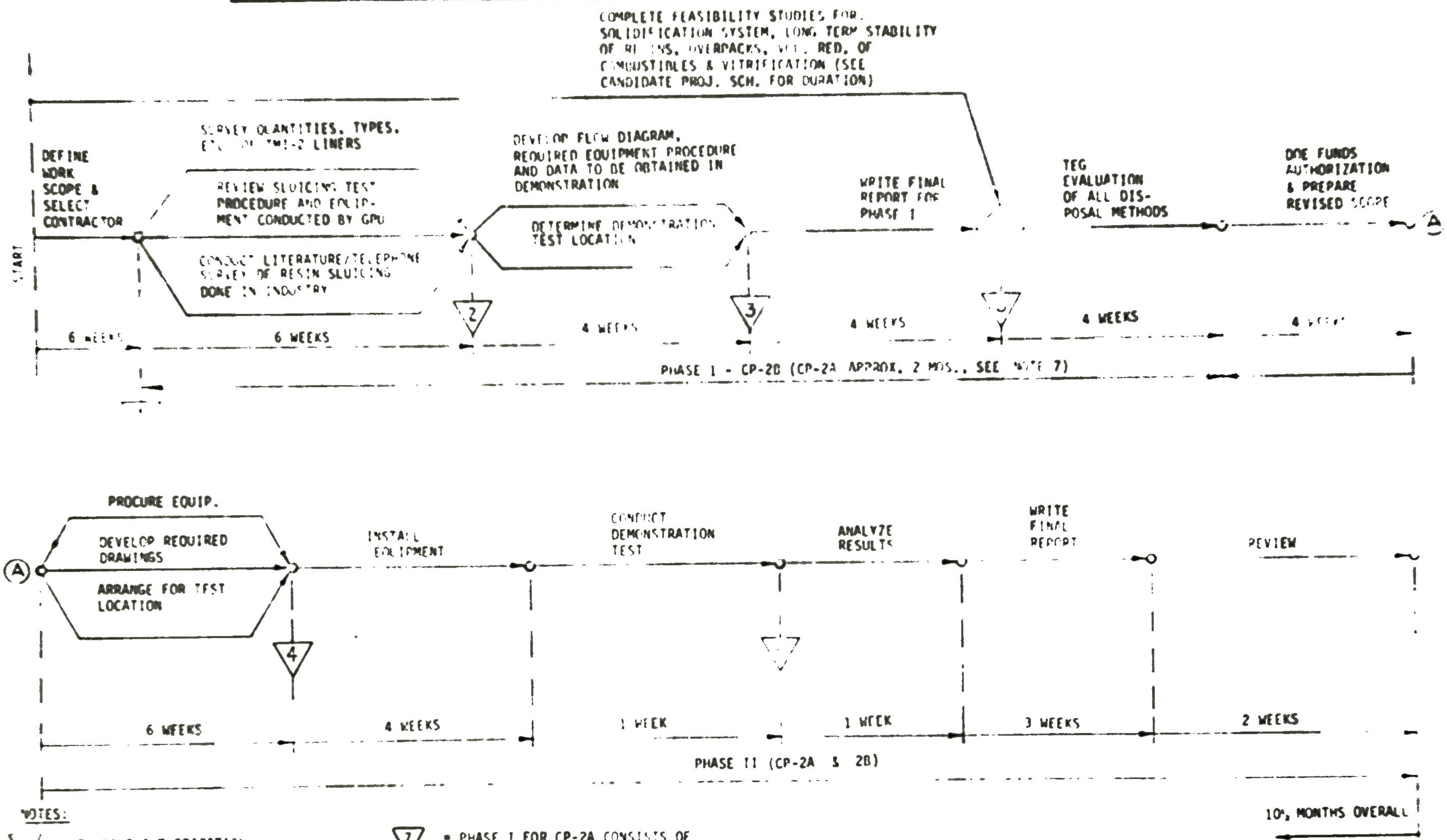
PRIORITY

Low due to feasibility study and test conducted by GPU.

COST

Low

SLUICING SDS RESINS FROM CONTAINERS / (CP-2B)
SLUICING EPICOR II RESINS FROM CONTAINERS (CP-2A)



NOTES:

1 = FUNDING AUTHORIZATION

2 = PROGRESS REVIEW MEETING - DISCUSS CONCEPTS/ALTERNATIVES

3 = PROGRESS REVIEW MEETING - DISCUSS AND FINALIZE PLANS FOR TEST

4 = PROGRESS REVIEW MEETING

5 = PROGRESS REVIEW MEETING

6 = DECISION POINT TO RECOMMEND PROGRAM CONTINUATION

7 = PHASE I FOR CP-2A CONSISTS OF REVIEWING THE GPU STUDY ON THIS SUBJECT

◇ = BEGINNING OF MAJOR EVALUATION/ DECISION PERIOD IN PROGRAM

CANDIDATE PROJECT DESCRIPTION

CP No. 2D

TITLE

Sluicing of Inorganic Ion Exchange Media.

PURPOSE/GENERIC BENEFIT

This project will identify techniques, equipment, and auxiliaries for sluicing ion exchange media liners to an, as yet, unidentified immobilization system. This will allow immobilization in a form suitable for disposal.

SCOPE OF WORK

Phase I - This phase will include the following activities:

1 Survey SDS system design to establish quantities, locations, activities, description and rate of generation of liners anticipated.

2 Review the sluicing feasibility study and test conducted by GPU for EPICOR II liners.

3 Conduct literature/telephone survey of sluicing done elsewhere (e.g. U.S. Navy sluicing from underground tanks at Shippingport, Pa.)

4 Develop a flow diagram and equipment list for a demonstration sluicing system with a large commercial liner considering:

- Equipment used in GPU test
- Recirculation or disposal of sluice water
- Source of sluice water
- Sluicing resin to the ultimate disposal container either direct or via an intermediate spent resin storage tank
- Equipment available at TMI
- Potential locations for the system
- Shielding requirements
- Frequency of sluicing

5 Develop a test procedure and range of process variables to optimize the sluicing operation. Describe data to be obtained.

6 Deliverables of this project include:

A Summary sheet tabulating results of liner and sluice surveys.

If not already available, a flow diagram and report of the GPU test.

A bill of material and suggested source of equipment for the demonstration sluicing system both with the liner removed and in place.

A test procedure for Phase II.

A flow diagram, system description and equipment list for the proposed systems.

An estimate of material and labor costs and schedule for Phase II for each sluicing system.

A List of references, file of documentation and a report.

Phase II - Demonstration (Only if recommended from Phase I)

This phase will include preparation of equipment specifications and procurement of equipment, generation of drawings as required, and conduct of a demonstration tests on a large commercial liner with nonradioactive resin. Preparation of procedures planned for a radioactive liner and establishment of optimum process variables will be provided.

A report describing the test procedures, results, equipment and process parameters used in Phase II and recommended for construction of permanent sluicing system, and estimated budgetary cost for a permanent system will be provided.

ADVANTAGES

There will be greater assurance of ion exchange media solidification if sluicing is performed to a container designed for a solidification system.

The disposal container could be a DOT approved shipping container.

DISADVANTAGES

1. There is potential for additional personnel exposure resulting from sluicing.

SCHEDULE

See network diagram.

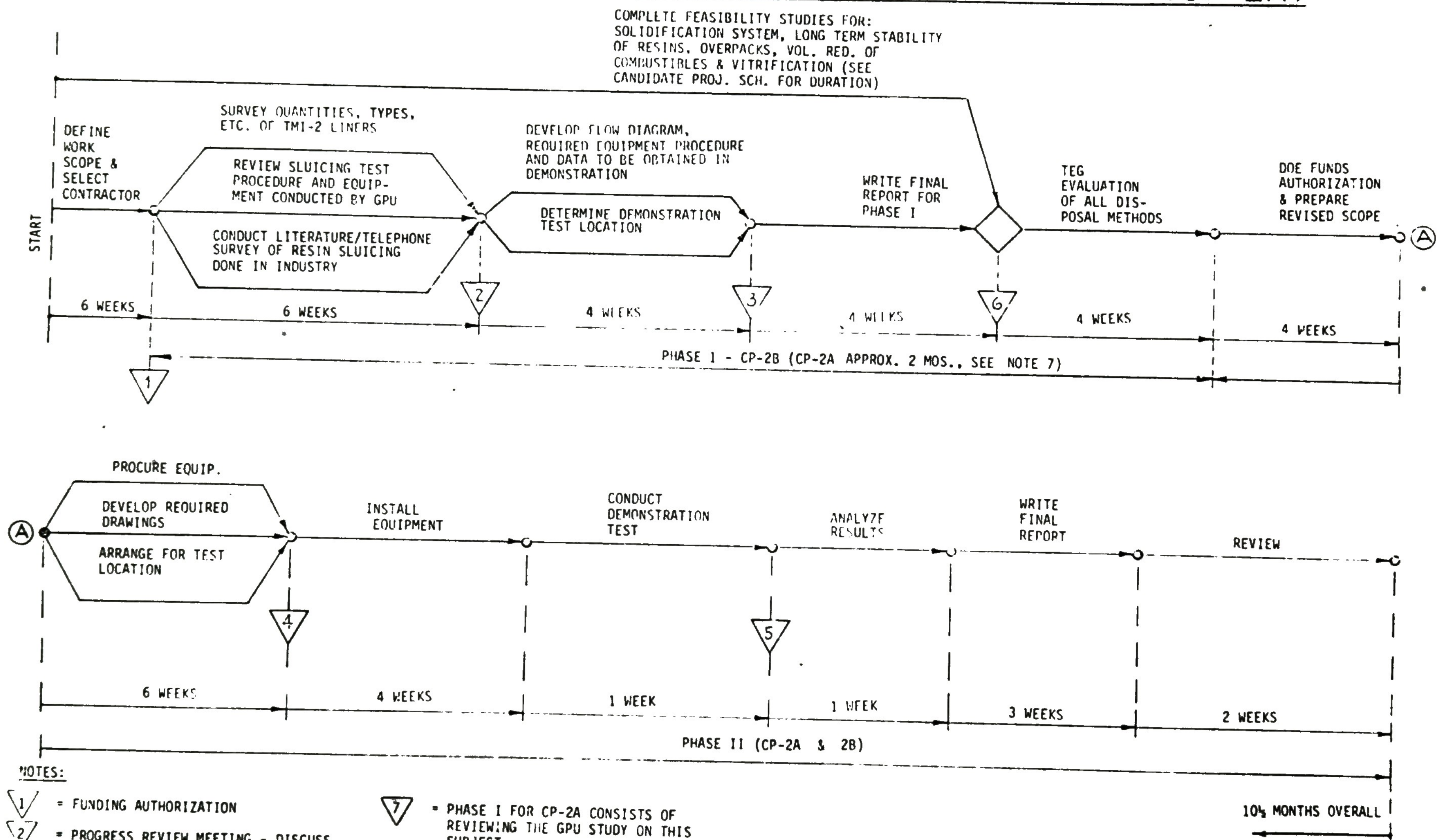
PRIORITY

Medium

COST

Low

SLUICING SDS RESINS FROM CONTAINERS / (CP-2B)
SLUICING EPICOR II RESINS FROM CONTAINERS (CP-2A)



NOTES:

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- 2 = PROGRESS REVIEW MEETING - DISCUSS CONCEPTS/ALTERNATIVES
- 3 = PROGRESS REVIEW MEETING - DISCUSS AND FINALIZE PLANS FOR TEST
- 4 = PROGRESS REVIEW MEETING
- 5 = PROGRESS REVIEW MEETING
- 6 = DECISION POINT TO RECOMMEND PROGRAM CONTINUATION
- 7 = PHASE I FOR CP-2A CONSISTS OF REVIEWING THE GPU STUDY ON THIS SUBJECT
- ◇ = BEGINNING OF MAJOR EVALUATION/DECISION PERIOD IN PROGRAM

CANDIDATE PROJECT DESCRIPTION

CP No. 3

TITLE

Organic Resins, Evaporator Bottoms and Contaminated Oil Solidification.

PURPOSE/GENERIC BENEFIT

Solidification of organic bead resins at commercial nuclear power stations has had little application in past operation practices. Evaluations have indicated potential problems, which include cracking and spalling, with the solidification of organic resins by cement.

Additional testing is needed to evaluate other solidification media such as epoxy, polymers, ureaformaldehyde, bitumen, etc.

The results of this project will be beneficial to operating power stations which in the near future will face regulatory requirements to solidify all resins. (Solidifying evaporator bottoms and oil also require consideration but are lower priority). A project to identify suitable agents and techniques could be used to solidify the organic resin wastes at TMI.

SCOPE OF WORK

I. <u>General Requirements</u>

Program management services are required to demonstrate processes that will solidify organic resins, evaporator bottoms and contaminated oil before shipment to a commercial low level waste burial site. The Program Manager will also investigate the cracking and spalling problem associated with solidified cement-organic resin mixtures. The Scope of Work is divided into two phases. Phase I is a feasibility study which will include small scale testing of solidified samples. Phase II may continue long term tests begun in Phase I and will include initial process and equipment design for a solidification facility.

II. <u>Detailed Requirements, Phase I</u>

A. Conduct a literature survey and establish state of the art in <u>proven</u> solidification processes for organic resins, evaporator sludge and contaminated oil, (including methods available in Europe).

B. Develop solidification criteria which will meet applicable requirements of proposed 10 CFR Part 61.

C. Develop a priority listing of available solidification alternatives which meet the criteria for demonstration and licensing within two years. The list of solidification methods should be ranked according to the most promising method first and the least promising last. The ranking should be determined by availability, degree of proven technology, cost of the process, resistance to radiation damage, liquid content, chemical and structural integrity, and other factors that affect the stability of the solid waste form.

The ranked list of solidification methods shall be presented to the TIO for discussion. The most promising solidification methods will be selected by agreement between the Project Manager and the TIO. The solidification process should include polymers, epoxies, ureaformaldehyde, cement, bitumen, etc.

D. Provide project management services to direct, coordinate, and procure the following services.

1. Determine the TMI-2 accident waste composition, quantities and radioisotope content of the wastes in question.

2. Define the desired size, shape, leachability, chemical and structural characteristics of the solidified-waste samples that are to be procured for testing. (Should be coordinated with II.D&F.)

3. Initiate discussions with vendors of solidification processes to determine the following:

   a) How much simulated waste will be needed to produce the sample products.

   b) Contract terms.

   c) Shape of solidified-waste form specification per D.2. above.

   d) Schedule.

   e) Budget.

4. Procure the required services from the selected vendors. After discussions with the vendors (in part II.E.3. of the proposal) the Project Manager will consult with the TIO to decide on those vendors best able to meet radioactive waste handling program needs.

5. Procure TMI-2 simulated waste samples of organic resins, evaporator bottoms and contaminated oil in quantity to supply the selected vendors requirements.

6. Deliver waste samples to vendors.

7. Define the testing requirements for the solidified simulated waste samples.

8. Initiate discussions with testing laboratories (the laboratories should be high quality facilities such as a national laboratory or university) to determine the following:

5. Testing agency results on leachability and chemical and structural stability of the various solidification samples.

6. Results of demonstration tests from the testing facility on recommended solidification process for organic resins and cement.

7. Recommendations for continuing Phase II Program.

III. Detailed Requirements - Phase II

A. Perform the following using the sample test results:

1. Prepare optimum process and equipment flow sheets and perform cost estimate for facility. Prepare conceptual designs as necessary to achieve a $\pm$50% level of costing accuracy.

2. Proposed test and demonstration program including system criteria and feasibility for licensing (proposed 10 CFR Part 61).

B. Deliverables Phase II

1. Description of demonstrated process including optimum process and equipment flow sheets and cost estimate.

2. Summary of test and demonstration data consistent with the requirements of proposed 10 CFR Part 61.

3. Final project report.

ADVANTAGES

The solidification of organic resins, evaporator bottoms and contaminated oil into stable, solid radiation waste forms will insure a very long retention of the radioactive material after the waste is disposed. The benefit of this is a lower radiation exposure to future personnel working or living around the disposal site.

DISADVANTAGES

The radioactive waste must be processed for disposal so there will be some additional radiation exposure. Finding and developing a stable waste form for organic resins exposed to higher than normal radiation fields will be expensive.

SCHEDULE

Completion of work (Phase I):

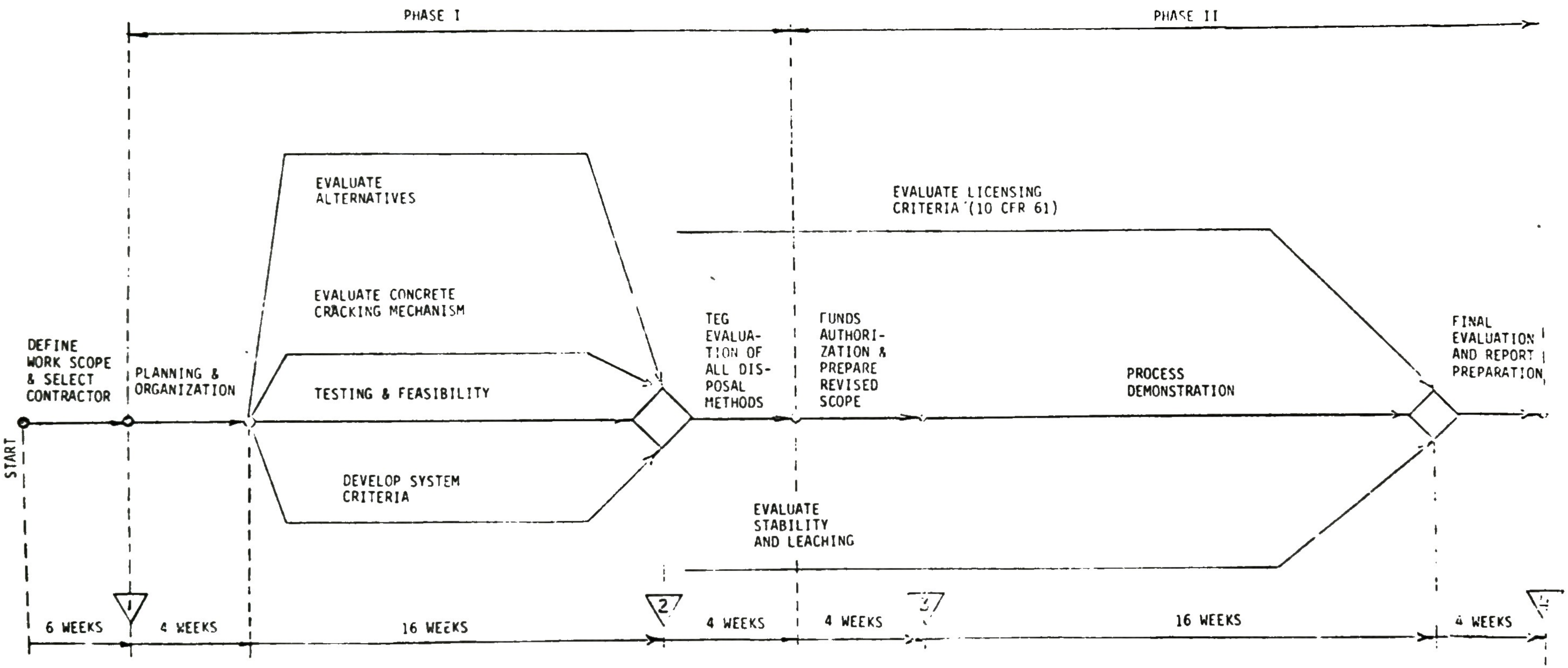
Desired completion is 6 months from date of contract, see network diagram for additional information.

COST

Medium for Phase I, approximately $418,000.
Cost estimate for Phase II cannot be made until Phase I is complete.

DEVELOP/DEMONSTRATE SOLIDIFICATION SYSTEM FOR ORGANIC RESINS AND EVAPORATOR BOTTOMS

CP-3



12½ MONTHS OVERALL

NOTES:

◇ = BEGINNING OF MAJOR EVALUATION/ DECISION PERIOD IN PROGRAM

▽1 = FUNDING AUTHORIZATION

▽2 = DECISION POINT TO RECOMMEND PROGRAM CONTINUATION

▽3 = ISSUE REPORT AND RECOMMENDATIONS FOR FURTHER PROGRAM WORK

▽4 = ISSUE REPORT AND FINAL RECOMMENDATIONS ON WHETHER GPU SHOULD BUILD A FACILITY.

CANDIDATE PROJECT DESCRIPTION

CP No. 4

TITLE

Inorganic Ion Exchange Media and Incinerator Ash Solidification.

PURPOSE/GENERIC BENEFIT

This project will determine the feasibility of fixing zeolites, other SDS sorbents and incinerator ash into homogeneous concrete, polymer resin, or epoxy materials within the exchange container. In order for these ion exchange media or incinerator ash to be sent to a commercial site for low level waste disposal, they must be solidified so as to produce a monolithic free standing form, with long term stability and low leachability. The capability of performing the solidification in the ion exchange containers reduces handling due to transfers of the zeolite materials, and thus reduces personnel exposure to radiation. The technology would also provide an option of potential benefit for other applications, such as the solidification of inorganic ion exchange media (or zeolites) during transportation or prolonged storage, where safety of personnel or protection of the environment may have become an issue.

SCOPE OF WORK

Phase I - This phase of the project will include the following:

1. Perform literature search and evaluate the state of the art for incorporating incinerator ash and zeolite materials (titanates and other inorganic ion exchange media) into concrete, polymer resin, or epoxy for disposal as freestanding monolithic form. Compare and arrange available options in order of priority or preference in accordance with their merits. Include the Dow System, glass system developed and demonstrated by Battelle Pacific Northwest and also by Penberthy Electromelt, the expoxy system under development by UNC Resources and the slate products developed by Delaware Custom Products. Pertinent European experience should be reviewed. Only proven technology should be considered in this task. The fixation of zeolites in concrete should be examined after the results of the development studies on cracking mechanism, additions, sealers, and special forming techniques for concrete are completed in Candidate No. 3. The results of this program are directly applicable to the solidification of zeolites.

2. During the Phase I demonstration of the organic resin solidification process (Candidate No. 3) a decision will be made as to the desirability of demonstrating the solidification process for inorganic exchange media. A contingency development plan will be prepared whereby inorganic ion exchange materials and incinerator ash may be subjected to a demonstration of solidification during Phase I of the Candidate 3 program, using actual/simulated zeolite and representative incinerator ash materials.

The deliverables of this task include a report summarizing the state of the art of the solidification of zeolite ion exchange materials and incinerator ash with recommendations for the optimum proven process, and a contingency development plan for the demonstration of zeolite and incineration ash solidification during the Phase II development under Candidate 3.

ADVANTAGES/DISADVANTAGES

The technology would be useful if regulatory criteria were to permit the burial of highly loaded inorganic ion exchange media as low level waste.

SCHEDULE

See network diagram.

PRIORITY

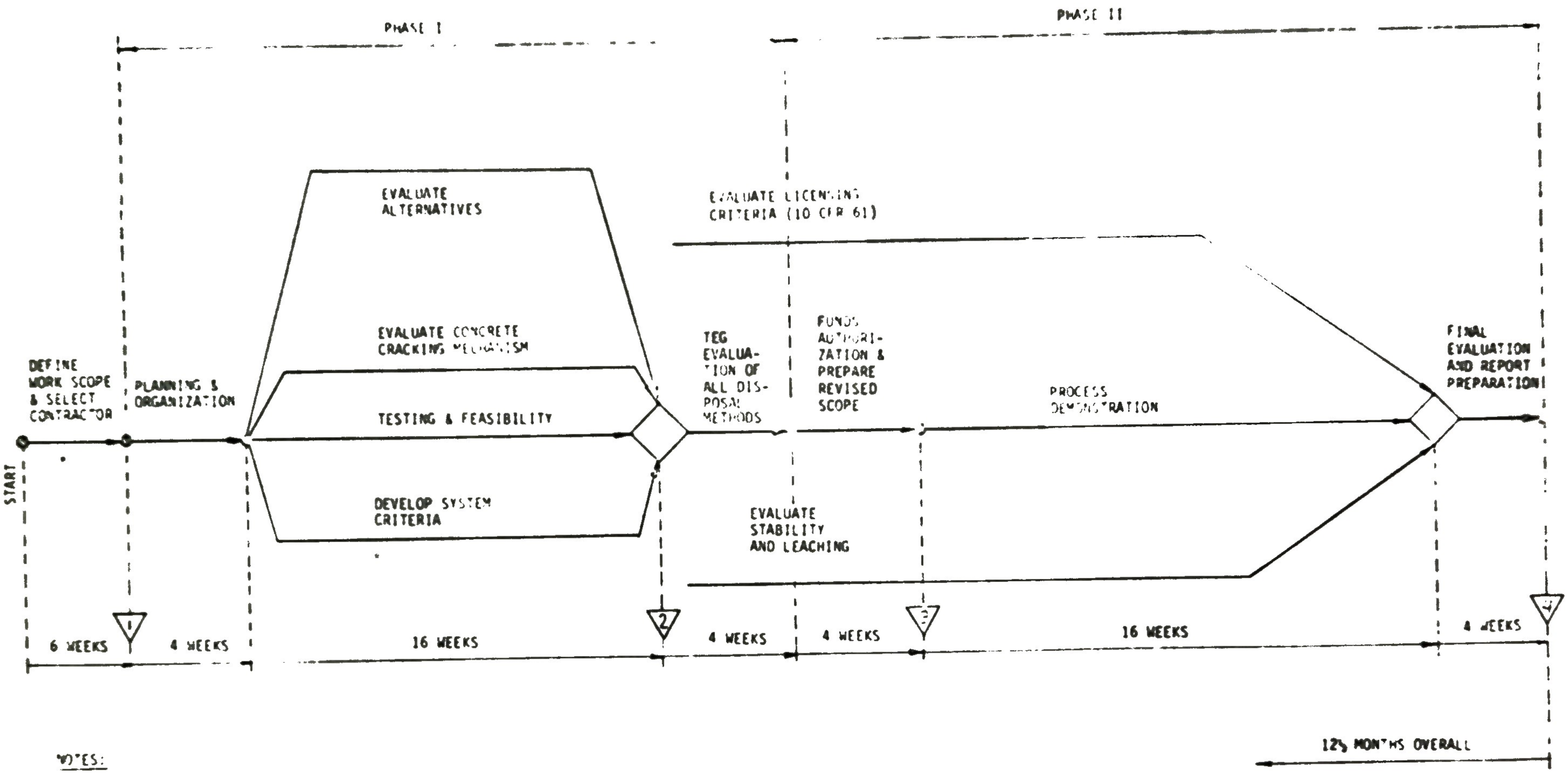
Medium

COST

Low for Phase I - $20,000
Medium if process actually is demonstrated - $250,000 - $500,000

DEVELOP/DEMONSTRATE SOLIDIFICATION SYSTEM FOR INORGANIC ION EXCHANGE MEDIA

CP-4



NOTES:

- BEGINNING OF MAJOR EVALUATION/ DECISION PERIOD IN PROGRAM
- FUNDING AUTHORIZATION
- DECISION POINT TO RECOMMEND PROGRAM CONTINUATION
- ISSUE REPORT AND RECOMMENDATIONS FOR FURTHER PROGRAM WORK
- ISSUE REPORT AND FINAL RECOMMENDATIONS ON WHETHER GPU SHOULD BUILD A FACILITY

CANDIDATE PROJECT DESCRIPTION

CP No. 5

TITLE

Cartridge Filter Solidification.

PURPOSE/GENERIC BENEFIT

Cartridge filters containing highly radioactive sludge from a nuclear accident such as TMI must be solidified as a result of regulatory indications. They constitute a significant radwaste problem during cleanup activities with no current technology for solidification and disposal. This project will advance state-of-the-art processes for contaminated filter management.

SCOPE OF WORK

General

Determine regulatory criteria and select a process for the solidification of highly contaminated filter cartridges and sludge representative of post accident cleanup systems. The work will be conducted in two phases. Phase I is a feasibility study to establish criteria for a solidification process and prepare demonstration test planning documents. Phase II will consist of equipment procurement and installation and performance of the required tests.

Phase I - This phase of the project will include the following:

A. Establish Needs and Criteria

1. Document current and anticipated regulatory criteria for handling, personnel protection, solidification and disposal for post accident filter cartridges contaminated with isotopes classified as low level, high specific activity, and transuranic contaminated waste.

2. Determine design process requirements from the above regulatory criteria.

3. Conduct a literature and telephone survey of solidification processes and techniques available at vendors, DOE facilities and other utilities, for possible application to filter cartridge and sludge solidification and disposal. Distinguish between those in actual use and those in the design stage. The survey is to consider requirements for filters containing high and low level isotopes and transuranics.

4. Establish quantities, location (present and future), description, isotopic content and activity level of filter cartridges and sludge and projected rate of generation at a representative post accident location.

B. Sludge Removal Process Development

On the basis of high activity sludge remaining after filter cartridge removal perform the following:

1. Devise a process to remove sludge from housings and to capture the sludge for subsequent solidification and disposal.

2. Determine requirements for criticality analysis and measurements.

C. Solidification Process and Container Development

1. Determine suitable solidification processes and agent(s) to comply with previously established regulatory criteria.

2. Determine availability of NRC and DOT approved containers for solidification and transportation.

3. Determine by experimental methods the long term stability of the selected solidification matrix which encapsulates the filter cartridge or sludge. Calculate the heat generation rate and equilibrium container temperature for a filter cartridge or sludge container with the highest radioactivity level.

4. Generate a preliminary design for equipment to remove and process the sludge for solidification.

5. Calculate the maximum number of filter cartridges that can be packaged. as determined by activity or dimensional limits in one solidification container.

The deliverables for Phase I include the following:

1. Criteria that will satisfy regulatory requirements.

2. Report on the solidification processes and agents reviewed and the basis for the agent(s) selected.

3. Summary sheet of post accident filter description, quantities, isotopic content, activity, and locations.

4. Summary of filter cartridge solidification procedures used in the industry.

5. Test plan for solidification testing.

6. Recommended process flow sheet, equipment and process description of the selected filter cartridge solidification process.

7. Recommended flow diagram, equipment list and description of sludge and solidification process.

8. Recommendations for Phase II (demonstration)

9. Estimates for materials and labor cost and schedule for Phase II.

10. Feasibility study of a location for the demonstration test in Phase II. This may be at TMI, a DOE installation, a solidification system available at one of the vendors or another nuclear facility.

Phase II of this project may include the following items:

1. Determine filter cartridge solidification process interface with other systems selected for solidification of EPICOR II and SDS ion exchange media and evaporator bottoms.

2. Perform detail design, procurement, fabrication and construction necessary to demonstrate the solidification process selected in Phase I.

3. Using a non-radioactive filter, demonstrate the complete solidification process from filter removal through the various process steps.

4. Using non-radioactive sludge and simulated filter housing, demonstrate the sludge removal process from the housing and solidification process.

5. Revise flow sheet, equipment and operating procedures as required.

The deliverables for Phase II include the following:

1. Report describing process, equipment and results of the demonstration tests. Include recommendations for improvements.

2. Budgetary estimates for materials, labor and schedule for Phase III.

3. Equipment list required for Phase III.

ADVANTAGES

1. Filter is in a form that is less likely to contaminate the environment in the event the disposal container is ruptured.

2. Provides guidance for the industry in establishing solidification criteria.

3. Provides a generic benefit for utilities when dealing with the disposal of cartridge filters from future accidents.

4. Resolves disposition of TMI-2 cartridge filters and sludge resulting from the accident.

DISADVANTAGES

1. Solidification of filters, compared to unsolidified may result in additional personnel exposure due to additional handling.

2. Filter handling systems for normal plant operation are fairly well developed. However, removal of highly radioactive filters and loose filter sludge which may contain particles of failed fuel will require an extension of this technology.

SCHEDULE

6 months for Phase I

7 months for Phase II

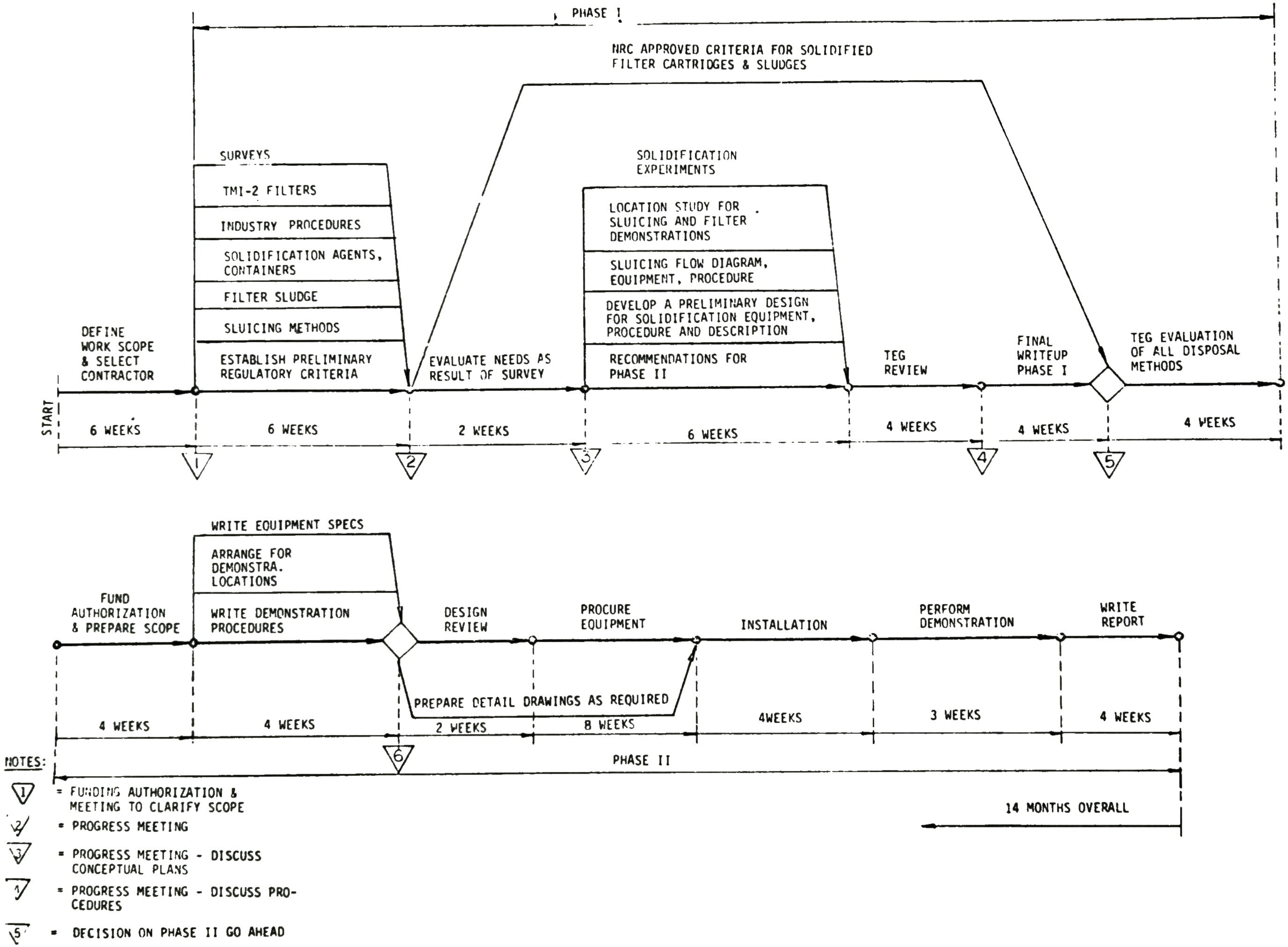
PRIORITY

High - Solidification of filter sludges will be required after July 1, 1981, and this will necessitate a solidification resolution.

COST

Low

SOLIDIFICATION OF FILTER CARTRIDGES AND SLUDGES CP-5



CANDIDATE PROJECT DESCRIPTION

CP No. 6

TITLE

Modifications to SDS Ion Exchange Columns and Filter Media.

PURPOSE/GENERIC BENEFIT

The purpose of this project is to determine experimentally if different ion exchange or filter media would enhance the decontamination factor of the SDS, and reduce the waste volume being generated.

The benefit of this project is that the SDS processed liquid will be at the lowest contamination level possible and the ion exchange media/filter waste will be the smallest volume practical.

SCOPE OF WORK

The work scope of this project is to develop by experimentation a combination of resins and/or filters that produces the best possible decontamination effort for the SDS. The work is divided into two phases.

The first phase is the experimental determination of the best combination of resins and/or filters for the SDS to produce the best decontamination factor and the least waste volume. The experiments in phase I will be used to evaluate the effects of time, temperature, acidity and other variables on the removal of residual activity ("recalcitrant" and nonexchangeable species) which would be determined at appropriate stages of the process. The relationship between decontamination and waste volume will be studied with the secondary goal of reducing waste volume. Experiments will be made with synthetic tracer solutions and if practical, actual TMI containment building and reactor coolant system water. The initial steps of this work will be to determine from vendor records or discussions the resin and filter content of the SDS. Using this information as a basis, begin experiments to determine the factors and/or materials to produce the best decontamination factor of the TMI liquid wastes and the least volume of solid wastes.

The experiments will include as a minimum, column tests, distribution coefficient tests, absorbent modifications and leach tests. The results of the testing and experimentation will be evaluated and a report will be prepared explaining the results. The report will contain a recommendation for the best method of using the SDS and will provide the specifications for the equipment and materials to be used in the SDS.

This second phase will be the application of the results of phase I to the SDS.

ADVANTAGES

The results of this project could have significant impact on the use of the SDS. Better decontamination of the containment building water and reactor coolant. Lower SDS waste volumes could also be realized. The technology for this project exists and would not require the development of new experimental methods.

DISADVANTAGES

The results of this project are not expected to have significant impact on occupational exposure at TMI or during waste processing, transport and burial. The project, if not completed within a year, will have less impact on the SDS operation, as construction of the SDS has started with operation expected to begin in January 1981.

SCHEDULE

This project is estimated to take about one year. See the flow chart, Modification to SDS Resin Columns and Filter Media, for specific time sequence. This project is the longest duration Phase I project, and as such is critical path for alternative evaluations.

PRIORITY

The priority on this project is low. The SDS is under construction and is expected to be operational by January 1981. Any delay in this project will render it less effective to the operation of the SDS.

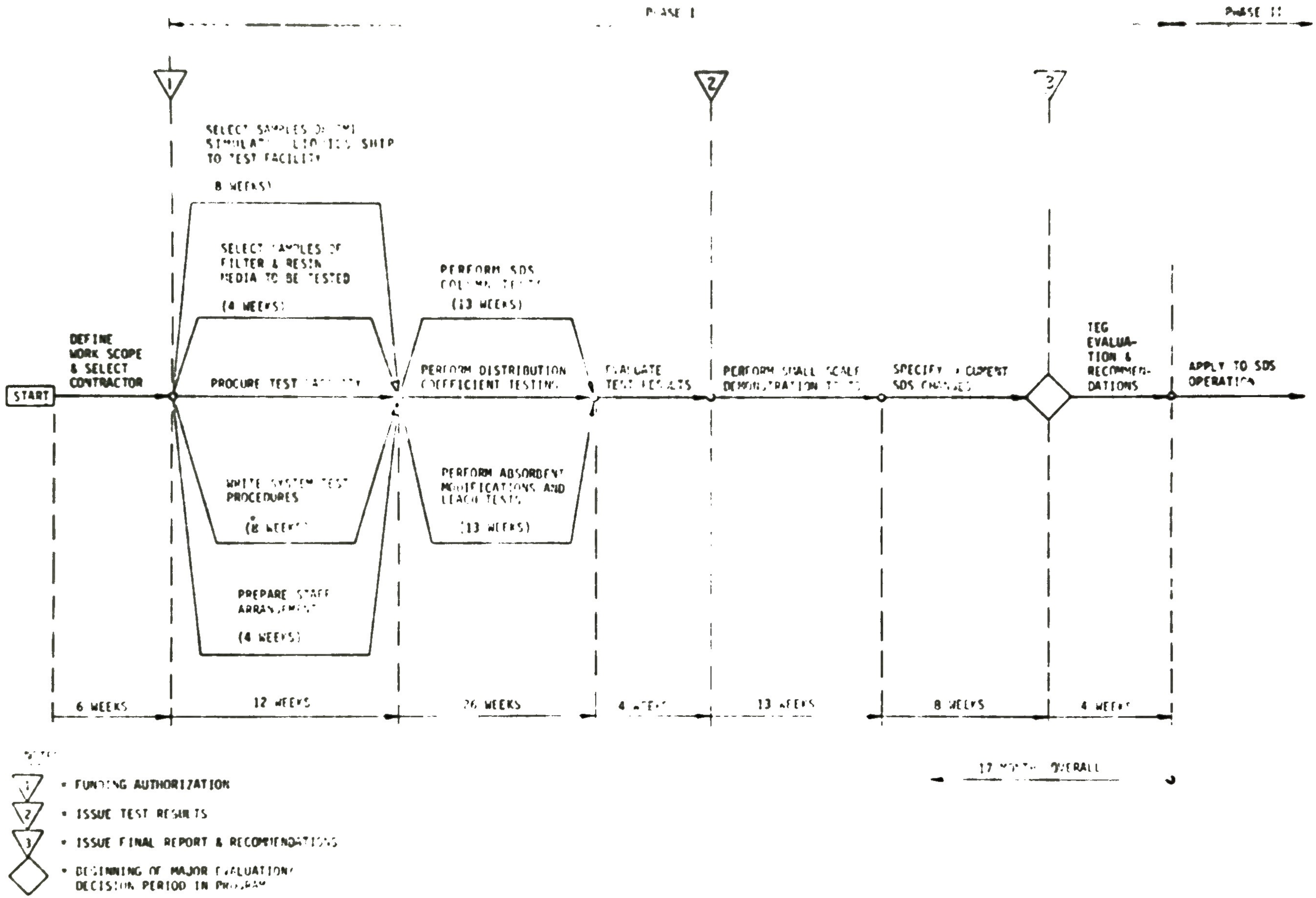
COST

The overall cost is medium. Phase I costs are estimated to be $350,000
2 man years @ $100,000 each.

Equipment & facilities $150,000

Phase II costs are not expected to differ significantly from originally planned SDS operation.

MODIFICATION TO SDS ION EXCH. COLUMNS AND FILTER MEDIA CP-6



CANDIDATE PROJECT DESCRIPTION

CP No. 7

TITLE

Evaluate Alternate Ion Exchange Media in the SDS System.

PURPOSE/GENERIC BENEFIT

This project will attempt to identify alternative absorbents superior to Zeolite for both Cs and Sr removal and the final waste form. The benefits to TMI could be higher decontamination factors and more stable waste forms resulting from TMI waste processing.

SCOPE OF WORK

The work scope in this project is to evaluate inorganic ion exchanges other than Zeolite for use in the SDS to improve water decontamination and yield a superior product with respect to waste solidification and disposal. The work is divided into two phases.

The first phase is to perform a literature survey, explore current working knowledge at DOE sites, and perform experiments to verify the literature and discussions. The initial work in this phase will be to perform a literature survey in the area of inorganic ion exchanges (such as Durasil) other than Zeolite. The results of this survey should provide leads to research currently being performed in the U.S. or other countries. Contacts should be followed up with discussions of the work being performed. Promising leads should be explored/followed with summary reports to be included in the final project report. If experiments are warranted to further verify the results of the survey, they shall be started and completed with minimal delay. Experiments should include TMI simulated materials, tracer K_D tests and tracer column tests. A report shall be prepared describing all areas of the survey and its results, the experimental methods, components, materials, and results. The report, if possible, will recommend a method for the SDS use and provide specifications for material procurement. If procedures are required to perform the recommendations they shall also be prepared.

Phase II will be the implementation of the recommendations of Phase I.

ADVANTAGES

Other absorbents (including Durasil glass, titanate and other inorganic ion exchangers) may yield superior decontamination of highly radioactive wastes in the first clean-up cycle. The results of this work will provide a ready reference to the current state-of-the-art in the area of inorganic ion exchangers.

DISADVANTAGES

The current technology is not adequately known. The investigations could show that extensive research is required to fulfill the project requirements. The results of this project will not lead to reduced occupational exposures during processing, handling or disposal of the TMI waste. The project should start quickly to be beneficial to the SDS operation as construction has started and operation is expected to begin in January 1981. Other drawbacks include the high cost of some absorbents and the availability in quantity and on a timely basis.

SCHEDULE

The proposed schedule of thirty-four weeks is tentative. Results of the survey should be known within sixteen to twenty weeks. See the flowchart, Alternate Ion Exchange Media in the SDS, for the times of the various activities.

PRIORITY

The priority is low due to lack of timeliness with respect to SDS startup in late 1980 and the use of zeolites is adequate.

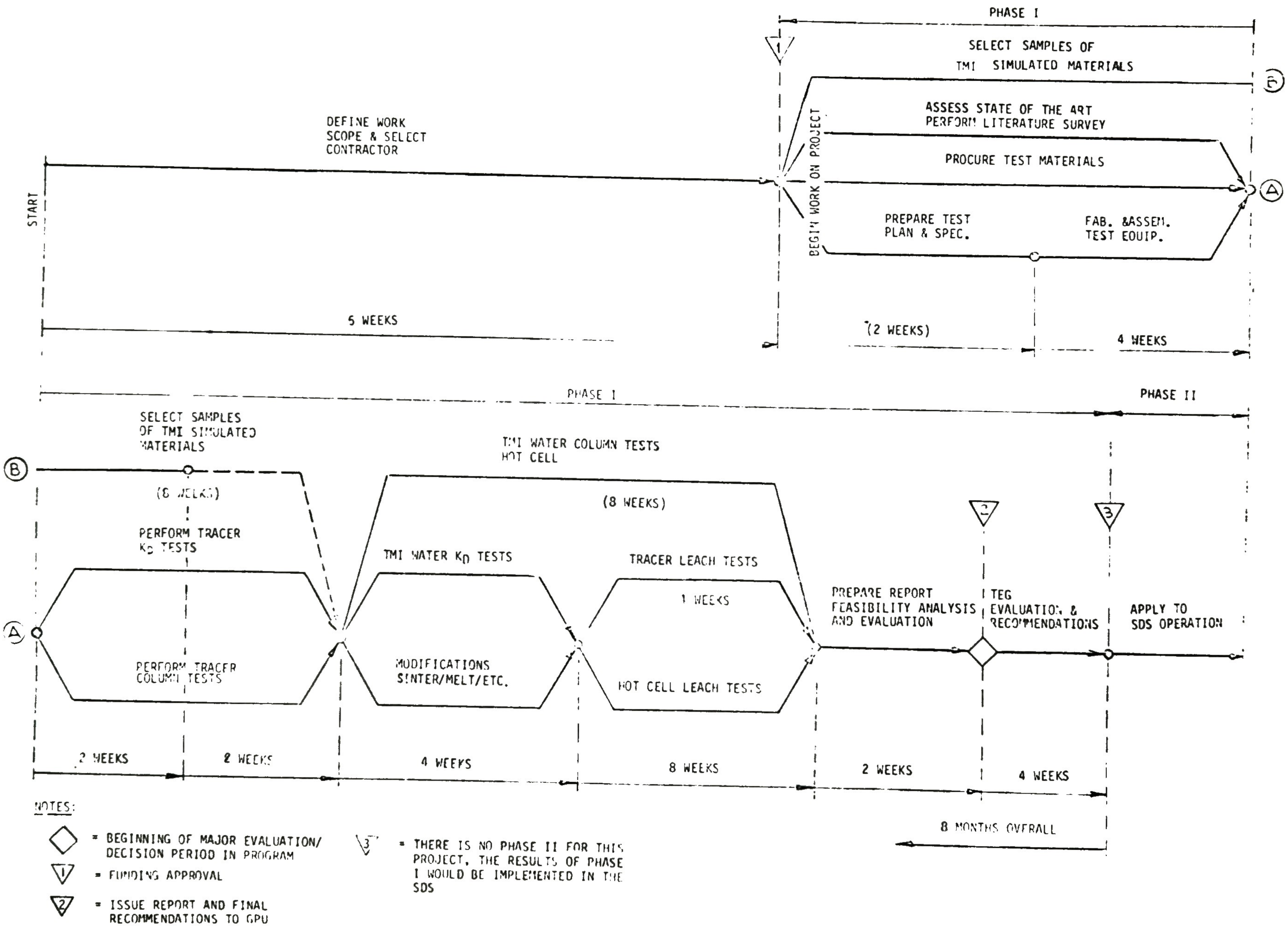
COST

The survey and evaluation of the project is of low cost. If demonstrations are required the cost could be medium.

Phase I - Survey -- \$40,000
Testing -- \$200,000

Phase II --- \$250,000

EVALUATE DURASIL IN THE SDS CP-7



CANDIDATE PROJECT DESCRIPTION

CP No. 8

TITLE

Decontamination Reagent Compatibility.

PURPOSE/GENERIC BENEFIT

The decontamination techniques planned for contamination cleanup operations involve a wide variety of chemical solutions, as well as various proprietary commercial solutions. Because of the large volume of waste products that will be generated containing these solutions, an evaporation/crystallizer facility (ECF) is utilized to reduce the volume and solidify the resulting concentrates and/or slurries. In order to ensure the success of this facility, analyses and lab tests are desirable to determine the compatibility of mixtures of decontamination reagents (1) with one another; (2) with materials of the evaporator/crystallizer facility; and (3) concentrates with various potential solidification agents. Determination of these effects will permit the development of radwaste systems best suited to support accident recovery activities.

SCOPE OF WORK

Phase I - This phase will include the following activities:

1. Survey current plans for decontamination reagents, materials of construction and solidification agent in the ECF.

2. Determine the compatibility or explosion or other hazard of mixtures of the decontamination reagents at concentrations and temperatures planned for the ECF by a literature/telephone survey and analysis of potential chemical reactions.

3. Determine the compatibility of mixtures of the reagents with the selected materials of construction at the planned operating temperatures by analysis of potential metallurgical/chemical reactions and a literature/telephone survey.

4. Determine by a literature/telephone survey, the solidification characteristics of mixtures of the reagent concentrates or slurries solidified by the selected solidification agent.

5. Develop laboratory test procedures equipment, description and data to be obtained for verification of Items 2, 3 and 4. Describe test or analyses to be conducted on material and solidification samples.

The deliverables for Phase I include:

- Summary of decontamination reagents, construction materials and radwaste processes planned for accident radwaste management.

- o Matrix of mixtures of decontamination reagents potential for explosion or other hazard.
- o Matrix of mixtures of decontamination reagents and compatibility with construction materials.
- o Anticipated compatibility of decontamination reagent mixture concentrates/slurries with the selected solidification agent.
- o Written report on laboratory test procedures, equipment description and data to be obtained.
- o Recommendation for Phase II (laboratory tests).
- o Estimates for material and labor costs and schedule for Phase II.

The Phase II demonstration tests may include the following:

1. Procure require equipment and materials to conduct laboratory tests planned in Phase I.
2. Conduct tests; analyze samples where applicable.
3. If a selected construction material is found to be incompatible recommend and, upon approval, test alternate materials.
4. If the solidification agent is found to be incompatible, or is compatible at low reagent mixture concentration (less than 50%), suggest and, upon approval, test alternate solidification agents.
5. A report of the tests conducted and the results obtained will be prepared. Discussion, if applicable, of potential problems with the accident radwaste facilities and recommend alternate reagents, construction materials or volume reduction/solidification systems.

ADVANTAGES

1. Has potential application to all decontamination programs and waste systems and will provide a much needed data base to the industry regarding this common problem.
2. Potential explosive mixtures will be minimized by laboratory tests.
3. Alternate or improved construction materials and solidification agents may be determined.
4. Solidification of decontamination solutions has had problems in the past, therefore development is required to demonstrate solidification of the high concentrations planned from the decontamination solutions.

DISADVANTAGES

None

SCHEDULE

Phase I - 3 months

Phase II - 5 months

PRIORITY

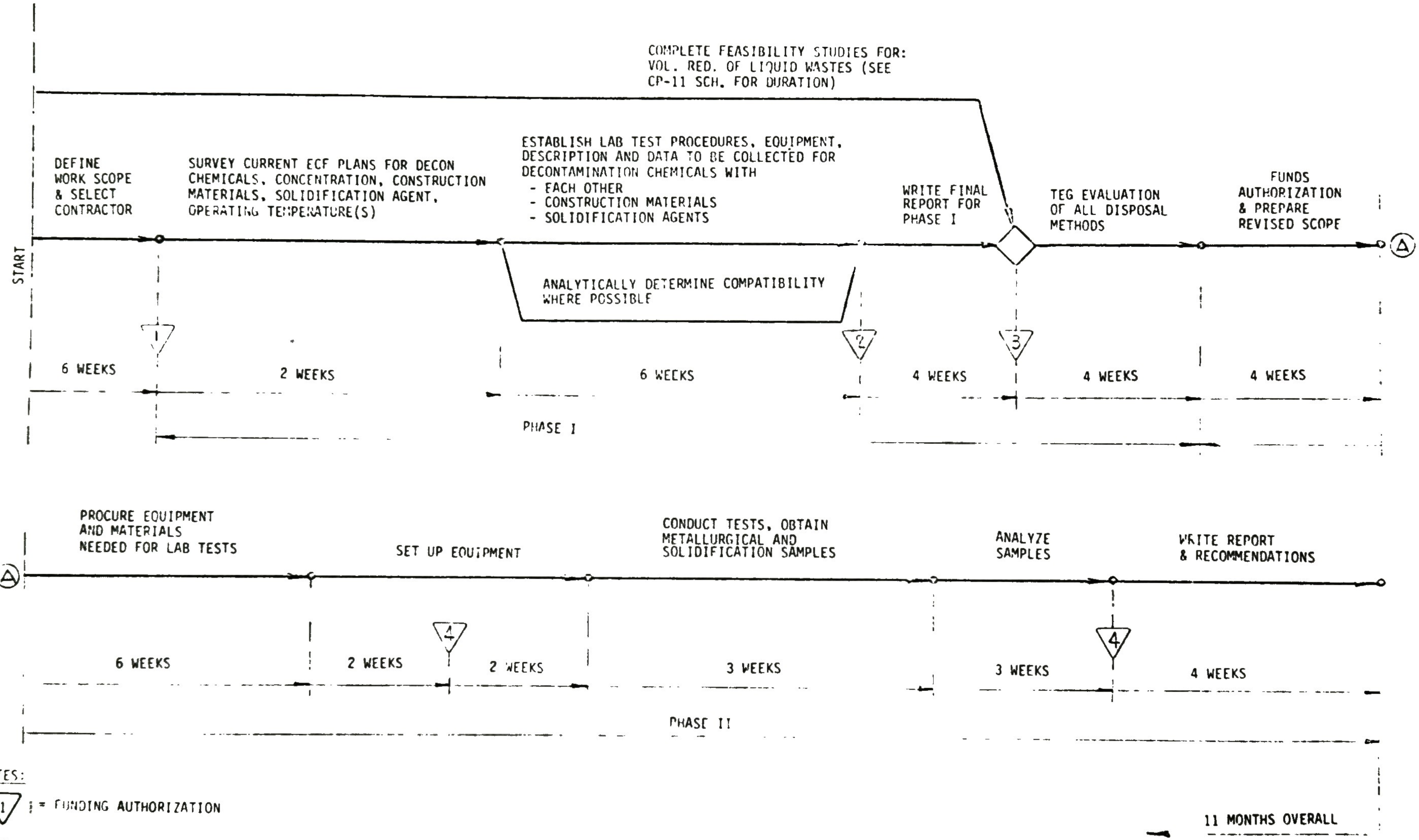
High: It is necessary to ascertain the effect of the various decontaminants used in TMI clenaup operations with downstream waste processes before operation of the ECF.

COST

Phase I - Low

Phase II - Low

DECONTAMINATION REAGENT COMPATIBILITY
EVAPORATOR/CRYSTALLIZER FACILITY (ECF) CP-8



NOTES:

1 = FUNDING AUTHORIZATION

2 = PROGRESS REVIEW MEETING - DISCUSS AND FINALIZE PLANS FOR TEST

3 = PROGRESS MEETING - DECISION FOR GO AHEAD ON PHASE II

4 = PROGRESS REVIEW MEETING

◇ = BEGINNING OF MAJOR EVALUATION/ DECISION PERIOD IN PROGRAM

CANDIDATE PROJECT DESCRIPTION

CP No. 9

TITLE

Volume Reduction of Combustible Wastes.

PURPOSE/GENERIC BENEFIT

Initiate a program to technically evaluate the various methods for volume reduction of combustible radioactive wastes such as coveralls, gloves, rags, paper contaminated oils and spent resins resulting from an accident such as TMI-2. Increased volume reduction, above that achieved with compaction, may justify the cost of incinerator systems due to reduced waste shipments and disposal costs.

SCOPE OF WORK

I. General Requirements - Provide for the development and demonstration of a process to reduce the volume of the combustible waste streams which are accident generated using TMI-2 characteristics. The volume reduction processes to be considered shall be capable of handling all combustible radioactive wastes, e.g., coveralls, gloves, rags, paper, contaminated oils, and shall be evaluated as to their ability to handle spent resins. This task is divided into two phases, with phase I being the feasibility/study portion and phase II being the demonstration and design finalization portion.

II. Phase I - Perform a feasibility study of the available processes for improved volume reduction of TMI-2 combustible radwaste. The study shall include the following work elements:

1. Perform a literature search to determine suitable candidate volume reduction processes.

2. Gather process design and performance data on the various processes which are found to be viable in the literature search. Processes to be considered shall include acid digestion, incineration (including electromelt, controlled air, fluidized bed, microwave, cyclone, slagging pyrolysic etc.), extruders, and other pertinent processes. The data shall be obtained from published literature and from meetings with the various process developers. Where possible, demonstrations of the processes shall be witnessed to gain additional information on the most promising processes.

3. Obtain estimates, from GPU, of future quantities and composition of combustible radwaste.

4. Obtain, from GPU, current data on compaction of combustible wastes and the costs of disposing of them.

5. Preparation of an evaluation report of the alternative concepts. This report shall rank the alternatives by considering the following factors:

a) The relative feasibility of bringing the various processes on line without any technical delays, i.e., is the technology mature.

b) The construction time.

c) Licensing impacts where known.

d) The relative cost of the equipment.

e) The support equipment, facilities and services required.

f) Estimated costs (rough order of magnitude) for the items in e.

g) Estimates on the cost of processing the waste (including disposal costs). These costs shall be compared to GPU's compaction costs to determine if any disposal cost savings will be realized.

h) The capabilities of a particular process to handle spent resins, and any potential cost savings which would be realized through volume reduction resins.

i) Other pertinent factors.

6. The evaluation report shall include a system description and flow diagram of the most promising volume reduction processes.

7. The evaluation report shall make a recommendation regarding what equipment should be purchased for the volume reduction of combustibles excluding spent resins, and what equipment should be purchased for the volume reduction of combustibles including spent resins. In addition, the report shall make recommendations concerning what additional demonstration or testing work will be required in the phase II portion of the project.

III. <u>Phase II</u> -

Continue the work started in phase I, including the following:

1. Develop the conceptual design of the process picked in phase I to sufficient detail to enable a revised phase I system cost estimate to be made. This cost estimate shall be within 50% accuracy. Conceptual designs of the support structures and facilities will be developed in this phase to enable a more accurate total cost estimate.

2. Develop and finalize a system design criteria.

3. A study to determine if the facilities for the process picked in phase I should be installed at the TMI site or at a DOE facility.

4. Coordination and reponsibility for the effort to resolve all regulatory issues concerning this project.

5. Preparation of a final evaluation report of the chosen process. The report shall consider the analogous items listed in II. 5 except that all costs data shall be revised to reflect the additional design data gained in phase II. The report shall also provide recommendations as to whether or not this particular waste processing method should be utilized by GPU for TMI-2 wastes.

The developer of the process picked in phase I will provide the following:

1. Additional demonstration testing as called for in the phase I technical evaluation.

2. Support for the licensing effort.

IV. Deliverables -

The deliverables for part II consist of a comprehensive technical evaluation report and include:

1. Updated process flow diagrams.

2. General arrangement drawings.

3. Meetings and correspondence to support the licensing efforts.

4. Siting study report included as part of item 5.

5. Final technical evaluation report.

6. Demonstration test reports.

7. Meetings and correspondence to support the licensing efforts.

ADVANTAGES

Possible advantages of the various systems for improved volume reduction (improved over the present practice of compaction) included the following:

1. Further volume reduction.

2. Mass reduction.

3. Stabilization of the radioactive wastes in the case of spent resins and contaminated oils.

An additional advantage is that many of the volume reduction systems which will be evaluated have reached the stage of commercial application and have existing pilot plants where demonstration testing could be performed. Thus, there is a a good possibility that one of these processes could be brought on line in a reasonable amount of time. Also, improved volume reduction will produce less loading on the burial sites. Finally, some of the systems for combustible waste volume reduction can also be used to process liquid wastes and evaporator bottoms. Therefore, one system may be capable of providing multiple waste handling capabilities.

DISADVANTAGES

The primary disadvantage of an improved volume reduction system is the high capital costs which would be involved for the equipment, the buildings to house it, and in some cases the need for a solidification system to immobilize by-products such as incinerator ash. However, the capital costs should be somewhat offset by the reduced waste disposal costs which would be realized from the system operation. A final disadvantage is the relatively long lead time which would be required to get a large facility constructed and into operation. This time is estimated to be a minimum of 2 to 2 1/2 years.

SCHEDULE

See network diagram.

PRIORITY

A high priority is recommended for this project. Even though it could take about 2 1/2 years before a system could be operational, maximum volume reduction of the wastes should be a goal because of the very large quantities of waste which will be generated during the recovery. The burial site restrictions on waste volumes accepted, and the desire to reduce shipments, make this option important.

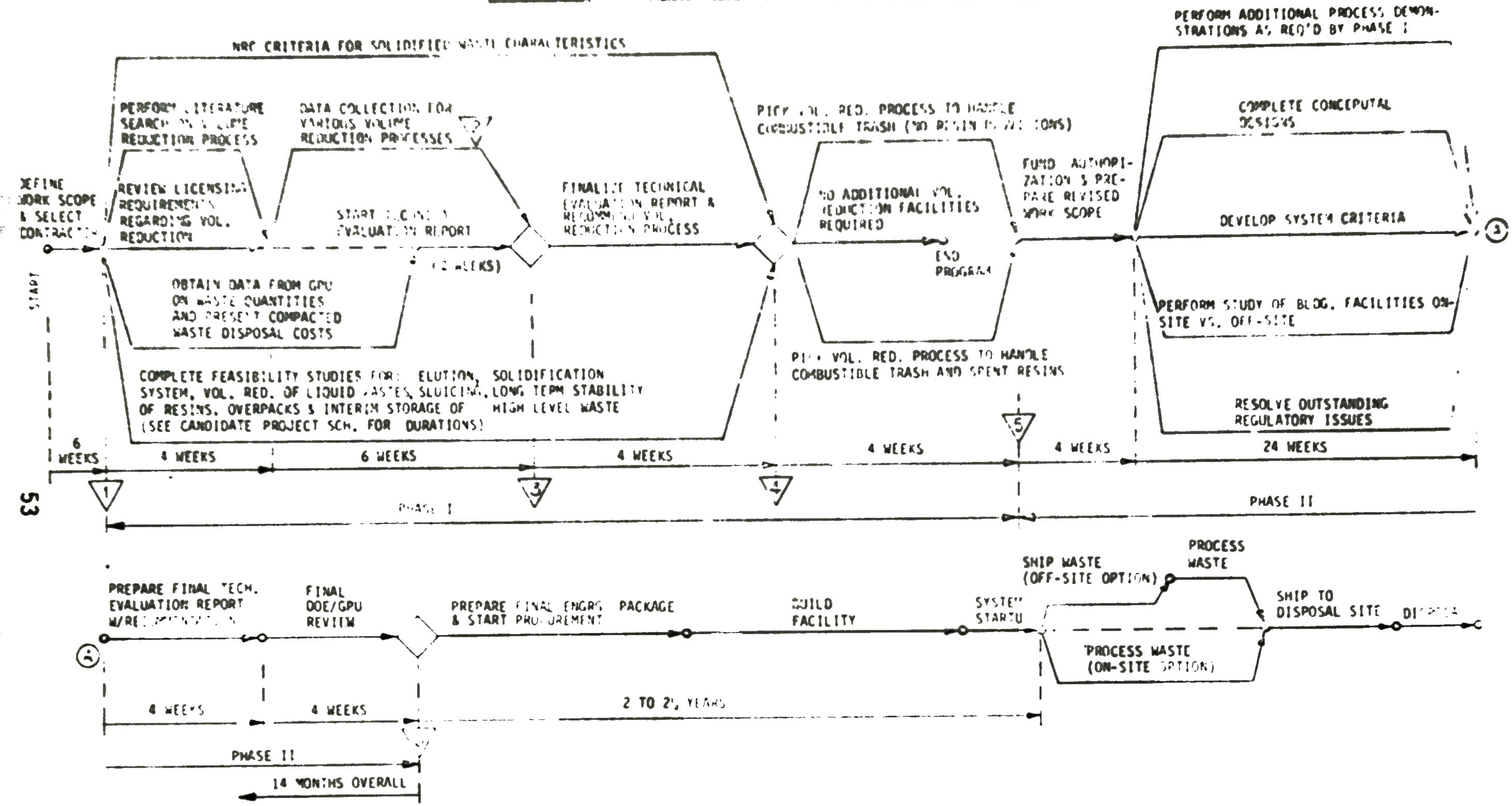
COST

Overall - medium

Phase I - Sufficient funding to allow detailed assessment for a decision relative to other candidates, $65,000.

Phase II - Prototype testing and development to allow a GPU decision on the process use, $200,000.

ALTERNATIVES FOR IMPROVED VOLUME REDUCTION OF COMBUSTIBLE WASTE CP-9



NOTES:

- BEGINNING OF MAJOR EVALUATION/DECISION PERIOD IN PROGRAM
- FUNDING AUTHORIZATION
- PROCESSES TO BE INVESTIGATED INCLUDE ACID DIGESTION, INCINERATION (INCLUDING ELECTROLYT, CONTROLLED AIR, FLUIDIZED BED, MICROWAVE, CYCLONE, SLAGGING PYROLYSIS ETC.) EXTRUDERS, AND OTHER APPLICABLE PROCESSES FOUND IN THE LITERATURE SEARCH
- PICK A PREFERRED VOL. REDUCTION PROCESS, BASED ON THE DATA IN TECHNICAL EVALUATION REPORT
- DECISION POINT TO ... PROGRAM CONTINUATION
- ISSUE REPORT AND RECOMMENDATIONS FOR FURTHER PROGRAM DEVELOPMENT
- ISSUE REPORT AND FINAL RECOMMENDATIONS ON WHETHER GPU SHOULD BUILD FACILITY

CANDIDATE PROJECT DESCRIPTION

CP No. 10

TITLE

Ion Exchange Media Vitrification.

PURPOSE/GENERIC BENEFIT

Initiate a program to convert high and low level radioactive ion exchange media to a vitrified glass product. The primary benefit of vitrifying these wastes would be in meeting the NRC requirement that most spent resins be solidified before shipment to a disposal site. A secondary benefit would be the stabilization of the wastes, which are in the interim storage area awaiting shipment to a disposal site, into a more acceptable waste form.

SCOPE OF WORK

I. General Requirements -

Provide for the development and demonstration of a process to vitrify the various ion exchange media which have been used at TMI-2. This task is divided into two phases, with phase I being the feasibility/study portion and phase II being the demonstration and design finalization portion.

II. Phase I -

Develop a process and conceptual design for vitrification of radioactive organic (Epicor resins) and radioactive inorganic zeolites to a containerized form of glass which shall have suitable characteristics for ultimate disposal in a geologic medium. This work shall include the following:

1. Conceptual designs, including process flow diagrams and calculations, in sufficient detail to verify feasibility of the radwaste processing system. The waste processing system shall include sufficient waste handling equipment to process the waste to a form suitable for shipment in a commercially available shipping cask.

2. Conceptual designs including process flow diagrams and calculations, in sufficient detail to verify feasibility of the off-gas treatment system. The off-gas treatment system shall be capable of meeting NRC effluent limitations and the EPA fuel cycle standard 40 CFR 90.

3. Provide for the parallel effort to assess the regulatory licensing impact of the process and system design. This effort will begin in phase I, but the major effort will occur in phase II.

4. Support for candidate project No. 12, Long Term Stability/ Properties of Solidified, Vitrified and Unsolidified Ion Exchange Media, in the form of samples and data. This effort will start in phase I, but the major effort will occur in phase II.

5. Supply a report to the program manager. The report shall document the process and conceptual design. It will include such items as a) a preliminary construction schedule, b) cost estimates for all major equipment, c) process test reports and operating history, d) required support services and equipment and e) other pertinent factors.

6. Provide program management services for the contractor of item II. This work shall include the following:

   a) Preparation of the purchase requisitions for contractors of the work scope in II. A.

      As a minimum, this would include requisitions for the data submittals and development work for the Electromelt incinerator, the in-can melter and the joule-heated ceramic melter and effluent control system. A literature search will be performed to determine other suitable candidate processes.

   b) Preparation of preliminary design criteria to be included with the purchase requisitions in II.B.1.

   c) Preparation of an evaluation report of the alternative concepts. This report shall rank the alternatives by considering the following factors:

      1) the relative feasibility of bringing the process on line without any technical holdups, i.e., is the technology mature,

      2) the construction time,

      3) licensing impacts,

      4) the relative cost of the equipment,

      5) the support equipment, facilities and services required,

      6) estimated costs (rough order of magnitude) for the items in e,

      7) estimates on the cost of processing the waste (including disposal costs), and

      8) other pertinent factors.

The evaluation report shall make a recommendation regarding what equipment should be purchased and what additional testing or demonstration work will be required in the phase II portion of the project.

III. Phase II -

Continue the work started in phase I, including the following:

1. Develop the conceptual design of phase I to sufficient detail to enable a revised phase I system cost estimate to be made. This cost estimate shall be within 50% accuracy. Conceptual designs of the support structures and facilities will be developed in this phase to enable a more accurate total cost estimate to be made.

2. Finalize system design criteria.

3. A study to determine if the vitrification equipment should be installed at the TMI site or at a DOE facility.

4. Coordination and responsibility for the effort to resolve all regulatory issues concerning this project.

5. Supervision of the demonstration/testing program which was recommended in phase I.

6. Preparation of a final evaluation report of the chosen process. The report shall consider the analogous items listed in II.B.3 except that all cost data shall be revised to reflect the additional design data gained in phase II. The report shall also provide recommendations as to whether or not this particular waste processing method should be utilized by GPU for TMI-2.

The developer of the process picked in phase I will provide the following:

1. Additional demonstration testing as called for in the phase I technical evaluation.

2. Additional licensing support.

3. Additional support for the CP-12 effort.

The deliverables for Phase I include:

1. Process system flow diagrams.

2. Off-gas treatment system flow diagrams.

3. Meetings and correspondance to support CP-12 and licensing efforts.

4. Waste product samples to support the CP-12 effort.

5. A report on the system submitted to the program manager.

6. Purchase requisitions.

7. Preliminary design criteria.

8. A technical evaluation report discussing the merits of each process.

The deliverables for Phase II include:

1. Updated process and off-gas systems flow diagrams.

2. General arrangements for the process and off-gas systems.

3. Meetings and correspondence to support CP-12 and licensing efforts.

4. Siting study report included as part of item 5.

5. Final technical evaluation report.

6. Demonstration test reports.

7. Meetings and correspondence to support the CP-12 and licensing efforts.

ADVANTAGES

The advantage of vitrifying the ion exchange wastes is the production of a waste product which has many desirable characteristics. These characteristics include low leachability, chemical stability, radiation resistance, minimum volume, and noncorrosiveness. There is no real disadvantage to this waste product form from a stand point of waste handling, disposal and safety.

DISADVANTAGES

Since this concept has not been successfully applied commercially, there is a distinct risk that the cost could prove prohibitive and that the development time could exceed acceptable levels. The incineration of organic ion exchange media with subsequent solidification (not vitrification) would provide almost the same benefits as vitrification as well as providing total flexibility in the handling of varied waste streams. Also, some of the incineration processes which do not end up with vitrified waste have reached a commercial stage of development and would be available for use in a more timely manner.

In addition, there are presently no definitive NRC regulations or criteria covering aspects of solidified wastes such as leachability and mechanical ruggedness. Without official concurrence or guidance on the concept, particularly with respect to the high level zeolite wastes, additional requirements might be imposed in the future which would make the concept undesirable for various reasons.

SCHEDULE

See network diagram.

PRIORITY

A medium priority is recommended for this project. The reasons for this recommendation are:

1. Considerable low to medium level activity organic spent resins have been generated and are being generated at this time. In consideration of the public reaction to storing large volumes of waste on site and in consideration of the possible instability of the organic spent resins due to radiation exposure, it is important that a viable disposal method be chosen soon. Thus it is not recommended that vitrified ion exchange disposal methods be pursued to the exclusion of other methods which have much shorter lead times, e.g., overpacks and commercial incinerators. However, the vitrification systems can be included in the overall evaluation of incineration of organic spent resins.

2. In terms of high level zeolite wastes and EPICOR resins which are classified as high level, vitrification should be evaluated against other high level waste disposal methods. It should also be pursued to supply an alternative to various storage concepts of handling high level wastes. Since the final forms the high level wastes must take have not been specified in any criteria, all viable options should be pursued at this time.

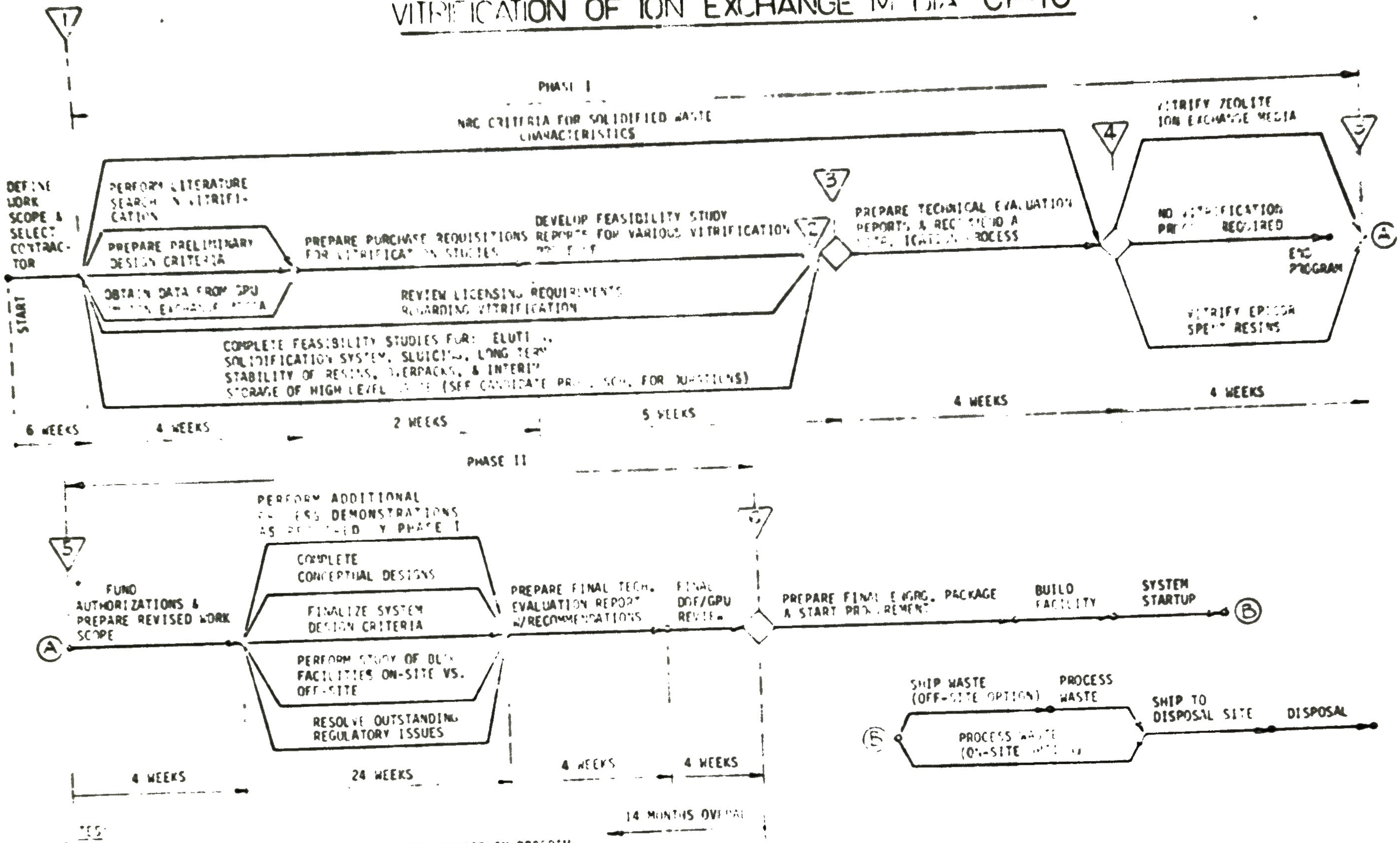
COST

Overall - Medium

Phase I - Sufficient funding to allow detailed assessment for a decision relative to other candidates, $60,000.

Phase II - Prototype testing and development to allow a GPU decision on the process use, $100,000.

VITRIFICATION OF ION EXCHANGE MEDIA CP-10



KEY

- BEGINNING OF MAJOR EVALUATION/DECISION PERIOD IN PROGRAM
- FUNDING AUTHORIZATION
- PROCESSES TO BE INVESTIGATED INCLUDE THE ELECTROMELT INCINERATION, THE IN-CAN MELTER, THE JOULE-HEATED CERAMIC MELTER & EFFLUENT CONTROL SYSTEM AND OTHER APPLICABLE PROCESSES FOUND IN THE LITERATURE SEARCH.
- PICK A PREFERRED VITRIFICATION PROCESS BASED ON THE DATA IN THE TECHNICAL EVALUATION REPORT.
- DECISION POINT TO RECOMMEND PROGRAM CONTINUATION.
- ISSUE REPORT AND RECOMMENDATIONS FOR FURTHER PROGRAM DEVELOPMENT.
- ISSUE REPORT AND FINAL RECOMMENDATIONS ON WHETHER GPU SHOULD BUILD FACILITY

CANDIDATE PROJECT DESCRIPTION

CP No. 11

TITLE

Volume Reduction of Decontamination Solutions.

PURPOSE/GENERIC BENEFIT

Initiate a program to technically evaluate the various methods for volume reduction of liquid wastes. This program will investigate alternatives to an evaporator/crystallizer unit.

SCOPE OF WORK

I. General Requirements - Provide for the development and demonstration of a process to reduce the volume of decontamination solutions which have TMI-2 waste characteristics. The volume reduction processes to be considered shall be capable of handling a variety of liquid wastes. This task is divided into two phases, with Phase I being the feasibility/ study portion and Phase II being the demonstration and design finalization portion.

II. Phase I - Perform a feasibility study of the available processes for improved volume reduction of decontamination solutions. The study shall include the following work elements:

1. Perform a literature search to determine suitable candidate volume reduction processes.

2. Gather process design and performance data on the various processes which are found to be viable in the literature search. Processes to be considered shall include calcination (fluidized bed, rotary kiln, and spray), vitrification, evaporator-blenders, evaporator/bitumen system, monolith volume reduction system, rising film evaporation and other pertinent processes. The data shall be obtained from published literature and from meetings with the various process developers. Where possible, demonstrations of the processes shall be witnessed to gain additional information on the most promising processes.

3. Obtain TMI-2 estimates of future quantities and composition of liquid radwaste.

4. Obtain TMI-2 current cost and performance data on the HPD evaporator.

5. Preparation of an evaluation report of the alternative concepts. This report shall rank the alternatives by considering the following factors:

a) the relative feasibility of bringing the various processes on-line without any technical delays, i.e., is the technology mature?,

b) the construction time,

c) licensing impacts where known,

d) the relative cost of the equipment,

e) the support equipment, facilities and services required,

f) estimated costs (rough order of magnitude) for the items in e,

g) estimates on the cost of processing the waste (including disposal costs). These costs shall be compared to TMI-2's HPD unit cost data to determine if any disposal cost savings will be realized, and

h) other pertinent factors.

6. The evaluation report shall include a system description and flow diagram of the most promising volume reduction processes.

7. Make a recommendation regarding what system satisfies the needs of the criteria. In addition, the report shall make recommendations concerning what additional demonstration or testing work will be required in the Phase II portion of the project.

III. Phase II

Continue the work started in Phase I, including the following:

1. Develop the conceptual design of the process picked in Phase I to sufficient detail to enable a revised Phase I system cost estimate to be made. This cost estimate shall be within 50% accuracy. Conceptual designs of the support structures and facilities will be developed in this phase to enable a more accurate total cost estimate.

2. Develop and finalize a system design criteria.

3. A study to determine if the facilities for the process picked in Phase I should be installed at the TMI site or at a DOE facility.

4. Coordination and responsibility for the effort to resolve all regulatory issues concerning this project.

5. Supervision of the demonstration/testing program which was recommended in Phase I.

6. Preparation of a final evaluation reports of the chosen process. The report shall consider the analogous items listed in II.5 except that all cost data shall be revised to reflect the additional design data gained in Phase II. The report shall also provide recommendations as to whether or not this particular waste processing method should be utilized by GPU for TMI-2 wastes.

The developer of the process picked in Phase I will provide additional demonstration testing as called for in the Phase I technical evaluation, and support for the licensing effort.

The deliverable for Phase I is a comprehensive technical evaluation report.

The deliverables for Phase II include:

1. Updated process flow diagrams.

2. General arrangement drawings.

3. Meetings and correspondence to support the licensing efforts.

4. Siting study report included as part of Item 5.

5. Final technical evaluation report.

6. Demonstration test reports.

7. Meetings and correspondence to support the licensing efforts.

ADVANTAGES

Possible advantages of the various systems for improved liquid waste volume reduction include further volume reduction and mass reduction. An additional advantage is that many of the volume reduction systems which will be evaluated have reached the stage of commercial application and have considerable amounts of operating experience. Thus, there is a good possibility that one of the processes could be brought on-line in a reasonable amount of time. Also, improved volume reduction will reduce the amount of loading on the burial sites. Finally, some of the systems for liquid waste volume reduction can handle other waste streams. Therefore, one system may be capable of providing multiple waste handling capabilities.

DISADVANTAGES

The primary disadvantage of any of the liquid waste volume reduction systems is the high capital costs which would be involved for the equipment, the buildings to house it or building modifications, and in some cases, the need for a solidification system to immobilize the process by-products. However, the capital costs should be somewhat offset by the reduced waste disposal costs which would be realized from the system operation. Another disadvantage is the relatively long lead time which would be required to get a large waste processing facility constructed and into operation.

SCHEDULE

See network diagram.

PRIORITY

A medium priority is recommended since an evaporator/crystallizer is usually sufficient. However, a backup would be desirable as well as a system which could produce a dry product.

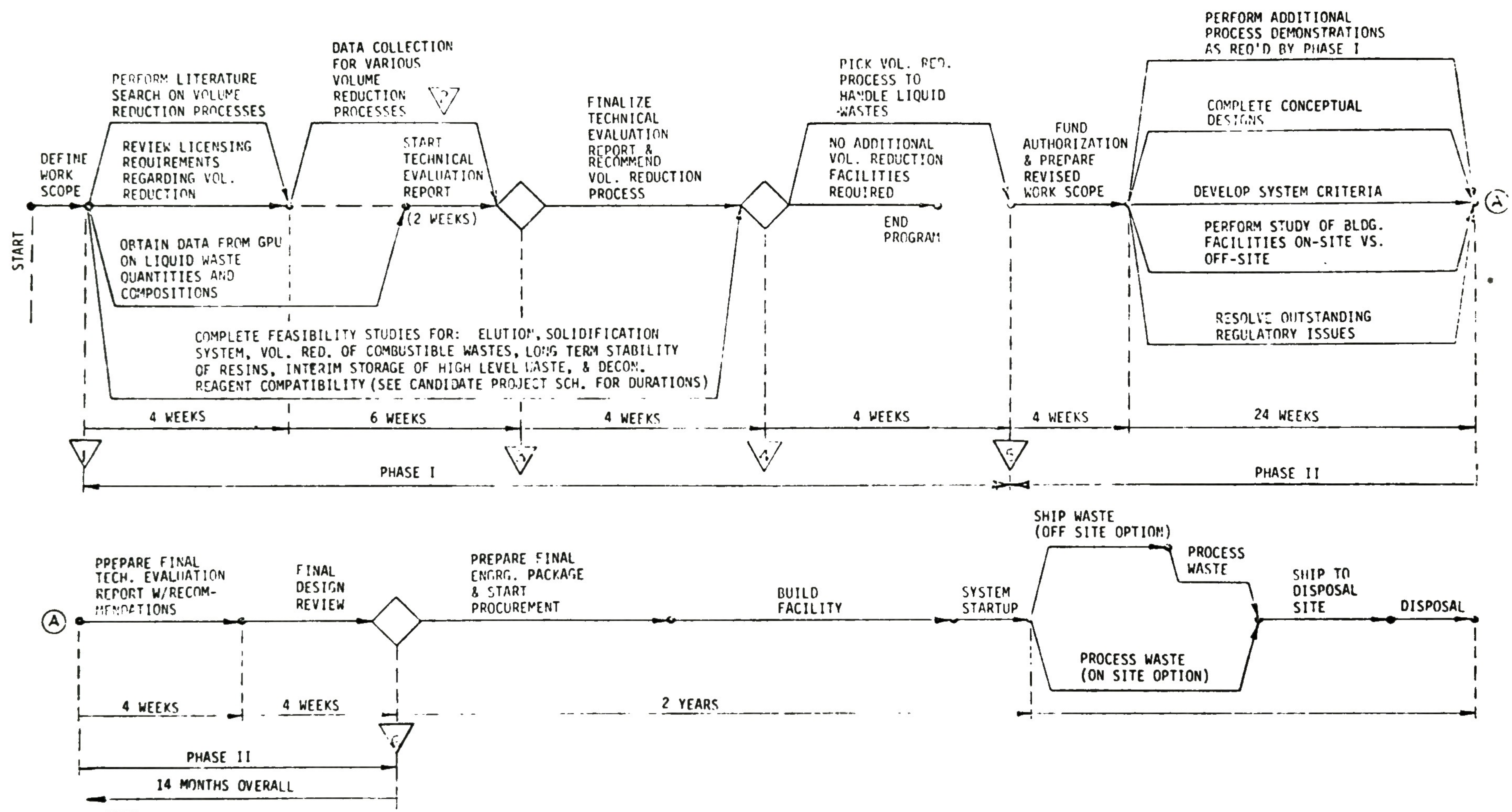
COST

Overall - Medium

Phase I - Sufficient funding to allow detailed assessment for a decision relative to other candidates, $50,000.

Phase II - Prototype testing and development to allow a GPU decision on the process use, $250,000.

ALTERNATIVES FOR IMPROVED VOLUME REDUCTION OF LIQUID WASTES CP-II



NOTES:

- ◇ = BEGINNING OF MAJOR EVALUATION/DECISION PERIOD IN PROGRAM
- 1 = FUNDING AUTHORIZATION
- 2 = PROCESSES TO BE INVESTIGATED INCLUDE CALCINATION, EVAPORATORS, EVAPORATOR-BLENDERS, LIQUID SILICONE PROCESS, EXTRUDER-EVAPORATOR, EVAPORATOR/BITUMEN SYSTEM, AND OTHER APPLICABLE PROCESSES FOUND IN THE LITERATURE SEARCH.
- 3 = PICK PREFERRED VOL. REDUCTION PROCESS, BASED ON THE DATA IN THE TECHNICAL EVALUATION REPORT.
- 4 = DECISION POINT TO RECOMMEND PROGRAM CONTINUATION
- 5 = ISSUE REPORT AND RECOMMENDATIONS FOR FURTHER PROGRAM DEVELOPMENT.
- 6 = ISSUE REPORT AND FINAL RECOMMENDATIONS ON WHETHER GPU SHOULD BUILD FACILITY.

CANDIDATE PROJECT DESCRIPTION

CP No. 12

TITLE

Ion Exchange Media Stability.

PURPOSE/GENERIC BENEFIT

Ion exchange media from cleanup operations such as organic resins, inorganic ion exchange media, and zeolite absorbers may undergo chemical/radiation degradation while in storage. Such instability, if it occurs, could result in (1) decomposition products which could cause corrosion of the liner, (2) deterioration or changes in the ion exchange media which could affect the elution of the nuclide loading, or (3) the possible inability to sluice the resin from the liner. The extent of these effects will determine the need, the urgency, and the technical options needed for further treatment of the stored ion exchange media.

SCOPE OF WORK

Work under this project will be performed in two phases. Phase I represents a study to estimate radiation effects on organic and inorganic ion exchange media and zeolite absorbers in terms of the impact that radiation decompo-sition products will have on liners used for storage, the effects on the sluicing of resins from the liners, and the effects that radiation damage may have on eluting the radioactive nuclides from the ion exhange media. The results of the work will (1) demonstrate whether a resin stability problem exists, (2) the time, chemical, and radiation parameters within which the resin stability is reasonably assured and (3) the technical options that are recommended to solve or circumvent the problem within the regulatory and time constraints.

Phase II may require an accelerated experimental program of radiation exposure and evaluation of ion exchange media.

Phase II will focus on long term stability of ion exchange media and zeolites and on the demonstration of technical solutions and options of radiation stability problems that may be identified in Phase I. Details of Phase II work will be developed during the course of the Phase I program.

The TIO will select and procure the services of a consulting organization to be the program manager for this project.

More specifically, the Phase I scope of work will include the following:

A. Perform Literature Survey

Develop an understanding of the problem related to ion exchange stability and an awareness of ongoing programs and active expertise by means of a study of:

1. Specific TMI-related information provided by the T1O from GPU.

2. Documents from a key-word search.

3. Telephone interviews with key workers in the field.

B. Review the DOE National Laboratories

Make visits to DOE laboratories as required, interview experts and inspect experimental facilities, including ORNL, HEDL, and BNL and others which are expected to be the candidates for doing the work. Potential experimental facilities would be determined at these sites. Additionally, in accordance with findings in the preliminary literature survey, visits to other DOE facilities (e.g., PNL, SRL and INEL) may be made to interview experts. A recommendation will be made as to the most appropriate DOE laboratory to perform the work.

C. Define Scope of Work and Cost Estimate

On the basis of the literature survey and the laboratory review establish a Scope of Work, with estimates of cost and schedule for approval of TIO, along with recommendations for the candidate laboratory or laboratories to be used in the preparation of an RFP to be prepared and distributed as directed by TIO. The conduct of accelerated radiation testing of organic and inorganic ion exchange media and zeolites is expected to be a major element of the National Laboratory Program, with the following specific objectives:

1. Evaluate the extent of radiation dosage necessary to produce measurable damage within the time frame and storage parameters estimated for storage of EPICOR and SDS type materials.

2. Allowable storage period for EPICOR and SDS materials before stabilility of ion exchange and/or zeolite is expected to become a problem.

3. Recommended solutions to problems which are demonstrated or anticipated from ion exchange and zeolite instability under TMI storage conditions. Such problems may include, but not be limited to:

   a) Ability to sluice ion exchange and zeolite media from the liners.

   b) Corrosion damage to the liners.

   c) Elution of nuclides from the zeolite and ion exchange materials.

Phase II

Task I - Perform long term radiation and stability testing of ion exchange media and zeolite materials.

Task II - Demonstrate technical recommendations which have been developed to solve problems created by instability of ion exchange and zeolite media (if any).

Deliverables Phase I

1. Report of literature survey and bibliography. Summarize the information, where possible, into a format that relates more directly to power plant conditions and makes the information more directly applicable in analyzing potential utility problems.

2. Summary of review of National Laboratories and facilities for performing the Scope of Work.

3. Scope of Work proposed for National Laboratory, with cost estimate and schedule.

4. Monthly progress reports.

5. Final Phase I Report with recommendations.

6. Proposed Phase II Program.

Project Monitoring

The DOE laboratory project description will include the requirements or reports of the Phase I work (i.e., of estimations of radiation effects) and of the Phase II work. Additionally, progress reports will be required. The project manager will provide reviews and comments of drafts of the Phase I and Phase II reports. The project manager will also monitor and comment on DOE laboratory progress reports and provide progress reports of technical coordination efforts.

ADVANTAGES

Resolution of the question of the radiation stability of EPICOR resins is paramont to decision making on elution, sluicing and liner reliability for storage of these resins. Regulatory questions will be answered. Results of this study will provide useful guidelines for the nuclear industry in dealing with highly radioactive liquids requiring cleanup in terms of preferred media for retention, stroage conditions, and period of storage which is permissible before degradation occurs. Similar analysis of the stability of SDS ion exchange media and zeolite will also be required.

DISADVANTAGES

Schedule for the initial phase is timely but an extensive experimental program may be too lengthy to provide detailed data on a variety of ion exchange stability variables and corrective options.

SCHEDULE

See network diagram.

PRIORITY

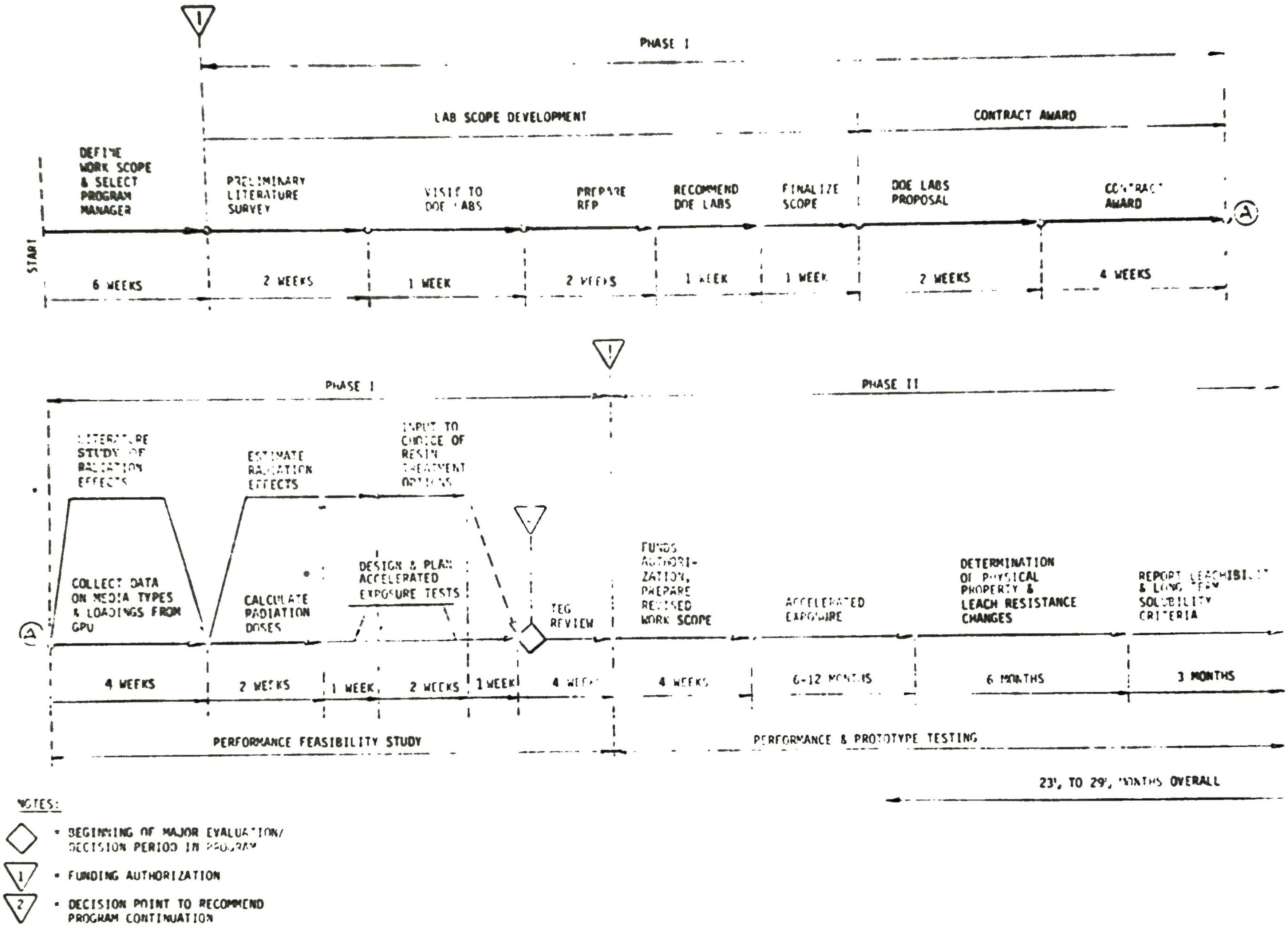
High: Information on radiation stability of EPICOR resins is essential to provide information of effects of extended storage and to a decision on further treatment.

COST

Phase I - $40,000 ($15,000 FY80)

Phase II - $200,000

LONG TERM STABILITY PROPERTIES OF ION EXCHANGE MEDIA AND ZEOLITES CP-12



CANDIDATE PROJECT DESCRIPTION

CP No. 13

TITLE

Disposal Test Device.

PURPOSE/GENERIC BENEFIT

Provide means for establishing "ultimate" waste forms from EPICOR and SDS processing.

SCOPE OF WORK

The Test Device for Disposal Site Test Program is anticipated to be conducted in three phases. The first phase, which is discussed in more detail below, consists of developing criteria for field testing the suitability of waste forms in an "ultimate" storage repository. The second phase involves the processing of waste into a suitable test form(s). The third phase would consist of field testing in a repository test facility.

Phase I Criteria Development

The criteria for field testing the suitability of waste forms in a geologic repository are dependent upon the isotopic composition of the radwaste, the specific activity of the waste and its chemical form. The isotopic composition will influence health and safety aspects of waste isolation and the time period of concern. The specific activity will influence waste form-host medium interactions (thermal and radiological). The chemical form is important in terms of waste form-canister-host medium interactions in the long term. Information will be provided by the TIO as it is developed under Phase I of Candidate Project No. 14.

Task I - Review of Waste Form Characteristics

Since, at this early stage, the ultimate waste form will not be known, existing data on the waste forms generated by cleanup processes and repre-sentative waste forms which might result from conversion of these process wastes will be reviewed. An example would be the cesium encapsulated sources developed from the Hanford high-level liquid waste. Much of this information will also be obtained under Phase I Candidate Project No. 14.

Task II - Review of Existing Applicable Criteria

Available EPA, NRC, and DOE existing and/or proposed criteria for highly radioactive waste disposal will be reviewed in relationship to the type of waste being generated. (see also Candidate Project No. 14)

Task III - Criteria Development

As a result of these reviews, criteria for a test device program will be developed. It is envisioned that these criteria could be subdivided into those applicable to the waste form itself, and those related to the waste form packaging or overpack. Obviously, these are not entirely separable since, for example, a potential unsuitable waste form characteristic may be compensated for by the packaging design. The need for accelerated testing will also be considered as part of the test criteria.

The deliverable for Phase I will be a draft of proposed criteria for a test program for potential TMI radioactive waste forms. Where possible, potential waste forms will be identified along with the National Laboratory(s) which would most likely be involved.

Phase II - Preparation of Test Waste Form(s)

In Phase II, suitable test waste forms will be produced in the appropriate facility, most likely a national laboratory. These forms should be compatible with commercial liquid waste treatment processes and the criteria established in Phase I.

The deliverables of Phase II will be one or more waste forms suitably processed and packaged for testing in a special repository.

Phase III - Field Test Program

The third phase will be actual testing in a special repository test facility. Since the schedule for an operating high-level waste repository is well beyond the schedule envisioned for this task, some other test facility will be necessary. Highly radioactive waste test programs using spent fuel are planned, or already under way, at Hanford as part of the BWIP program and at NTS as part of the NNWSI (Nevada Nuclear Waste Storage Investigation) program. Because of the state of flux of the entire waste disposal program, definitive plans for such a test facility are premature. The potential exists for the development of an intermediate-level waste repository on a demonstration basis as part of the overall U.S. radioactive waste disposal program.

Deliverables would be the test results with interpretations and recommended modification to the waste from package or repository design, as necessary.

ADVANTAGES

Development of criteria (Phase I) would help resolve the present uncertainty in acceptable waste forms. Disposal of contaminated reactor coolant system wastes must be resolved for nuclear plants if access to low-level burial facilities is denied.

DISADVANTAGES

Phase II emplacement of waste in intermediate level repository presupposes a repository exists; ONWI is currently projecting 1997 for the earliest operating date for a waste repository for LWR fuel. An intermediate level waste repository could be available earlier perhaps in 5 years on an initial demonstration basis if the states and other parties were sufficiently motivated.

SCHEDULE

See network diagram.

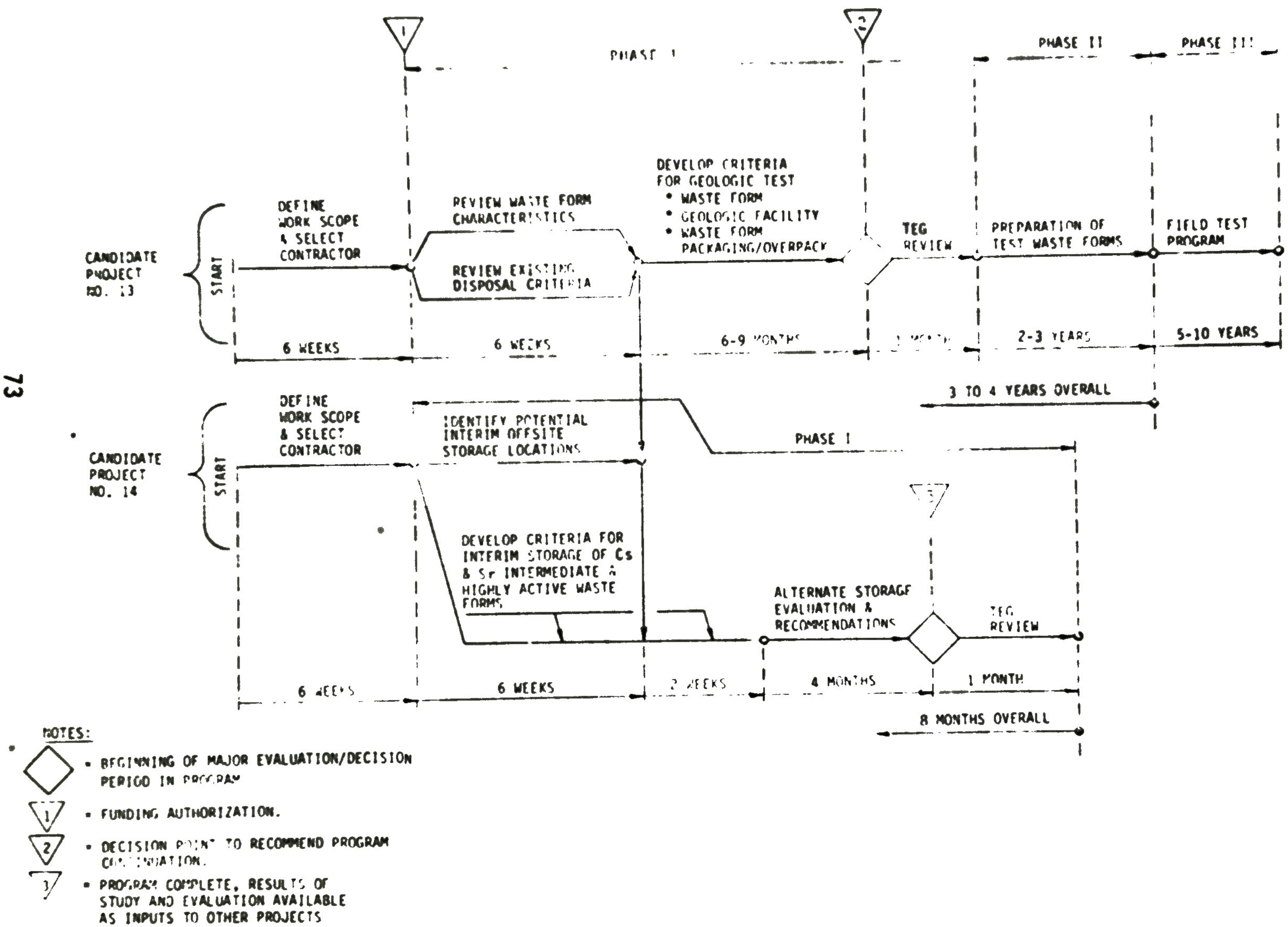
PRIORITY

High: For Phase I criteria development which would help define problems and potential avenues for a solution.

COST

High. Several millions of dollars for entire program; however, the initial phase could be accomplished for $100,000 to $200,000.

INTERIM STORAGE CRITERIA FOR HIGHLY RADIOACTIVE WASTE CP-13 CP-14



CANDIDATE PROJECT DESCRIPTION

CP No. 14

TITLE

Accident Radwaste Interim Storage.

PURPOSE/GENERIC BENEFIT

This Candidate Project provides for the expeditious cleanup of a contaminated facility by (1) characterization and classification of wastes from the radwaste processing, and (2) by establishing the criteria for Interim Storage of highly radioactive waste (special wastes) prior to the time that ultimate disposal facilities are available.

The current schedule for establishing a national repository for the long term storage of highly radioactive waste is estimated to be at least twenty years away. Consequently, interim storage facilities are required for the storage of wastes that will be generated at TMI-2, and which are not eligible for disposal in commercial burial facilities.

The processing of the radwaste from the auxiliary building, the RCS building, the containment sump, from decontamination solutions, and other miscellaneous sources, will generate wastes which because of regulatory constraints cannot be sent to commercial waste burial sites. These wastes, therefore, might more properly be designated as "special wastes" at this time since they have not been classified or otherwise characterized. The wastes to be considered consist principally of organic and inorganic ion exchange materials, zeolites, prefilters, evaporator bottoms, sludges and other decontamination related materials.

The work to be performed under this Candidate Project consists in the characterization and classification of wastes from the radwaste processing at TMI-2, and the development of criteria for an interim storage facility necessary to accomodate these wastes for a period up to 20 years. The TIO will select and procure the services of a consulting organization to be the program manager for this project.

SCOPE OF WORK

I. <u>General Requirements</u>

The radioactive wastes generated during an accident at a civilian nuclear power plant and the subsequent decontamination cleanup are not identified for a waste repository. The accident wastes must be stored. The work scope in this Candidate project is to recommend criteria for the accident waste form, and for interim storage of the radioactive waste resulting from the cleanup of civilian nuclear power plant after an accident. TMI-2 is to be used as a reference base. Criteria should be recommended for interim storage of:

1. Wastes such as ion exchange media and evaporator bottoms, which after suitable solidification may be suitable for burial in shallow land burial.

2. Wastes which are the same in composition as (1) but contain higher levels of radioactivity and for which regulatory authorities believe to be suitable for disposal in intermediate depth land burial.

3. Accident wastes which will be of such a physical or chemical form or which because of higher activity levels cannot be disposed of by land burial and for which engineered storage is required. Extensive DOE, EPA and NRC studies related to high level waste forms for ultimate waste disposal have been made. This work should be utilized where applicable.

II. Detailed Requirements

Task 1 - Accident Waste Characterization and Classification

Develop information required for characterization and classification of representative inorganic and organic resins and absorbants, cartridge filters, sludges, oil, evaporator bottoms, incinerator ash, and other related accident decontamination materials. This information must include:

1. Identification of radioactive nuclides and their concentration mci/gram of waste,

2. physical characteristics,

3. chemical form including water content,

4. description and dimensions of containers and

5. other information which might be required for shipping, proposed storage conditions, or interim disposal site for accident waste.

Task 2 - Review available criteria from EPA, DOE, NRC

Review draft criteria for various waste classification (including high level wastes) developed by EPA, DOE and NRC that are applicable to the interim storage of these "special waste" forms.

Task 3 - Recommend Interim Storage Criteria

The results of Task 1 and Task 2 will be combined to recommend criteria for accident radwaste interim storage. The proposed 10 CFR 61 will also be considered in this recommendation along with current draft regulatory guides for interim on-site storage of low level waste.

Task 4 - Recommend Interim Accident Waste Form Criteria

Recommend criteria for the waste form for interim storage of the accident waste. During the course of the work scope provide monthly progress reports, including cost, schedule and status.

Deliverables

1. Report on characterization and classification of accident radwastes.

2. Report recommending criteria for interim storage.

3. Report recommending accident waste form criteria.

4. Final Report will be due three months from the date of contract award. The master (along with five copies) must be in camera ready condition for reproduction and distribution by TIO. A draft of the Final Report must be submitted to the TIO for comments and approval. Allow two weeks for the receipt of comments and approval.

ADVANTAGES

1. Provides an interim solution for removal of rapidly accumulating highly radioactive waste from the immediate vicinity of the recovery area.

2. Provides precedent setting experience in handling highly radioactive cleanup waste.

3. Permits waste to decay to a somewhat lower activity level prior to processing.

DISADVANTAGES

None foreseen. Should expedite the cleanup process.

SCHEDULE

Waste classification interim storage criteria study; 6 months, see network diagram.

PRIORITY

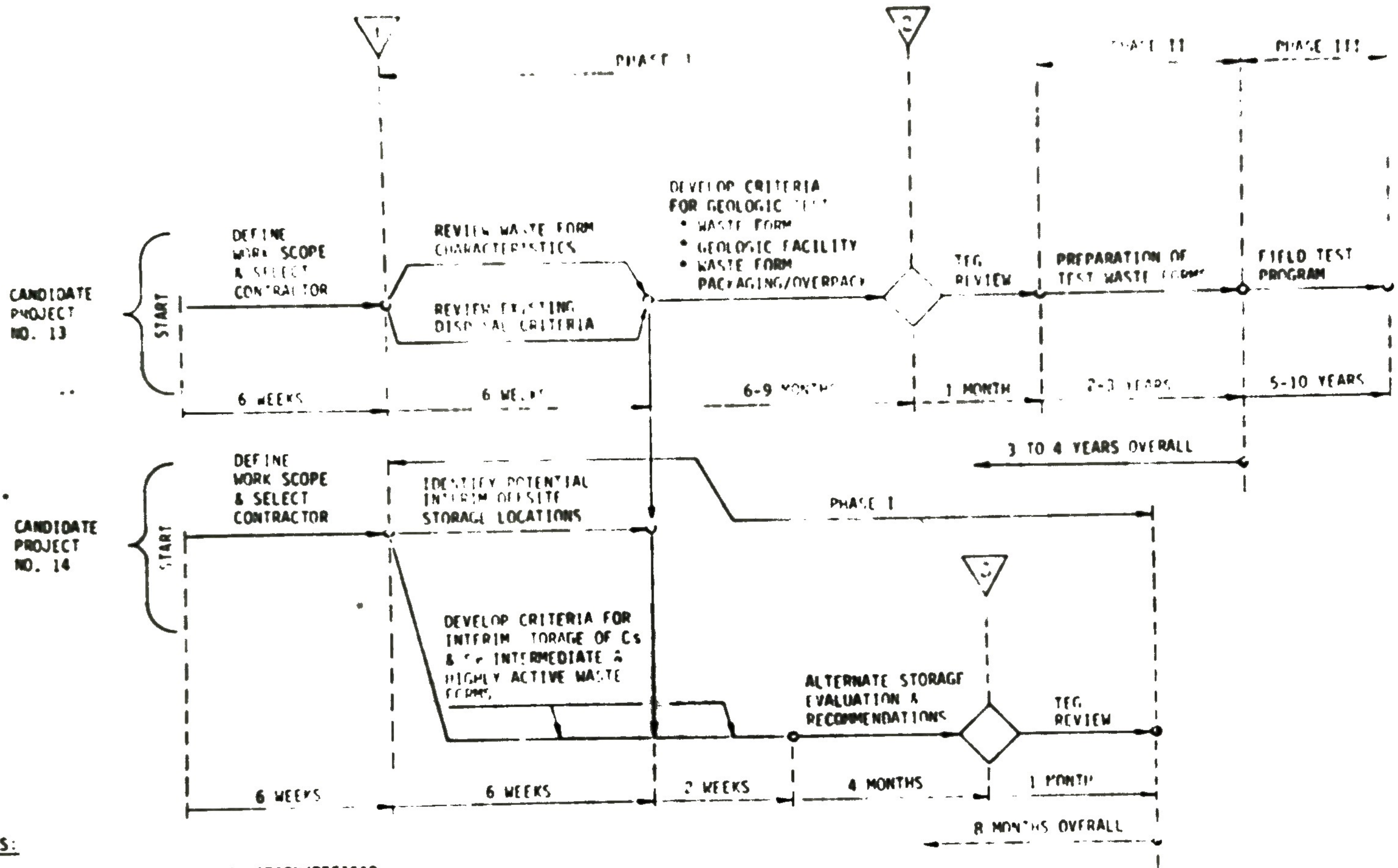
High. This priority is assigned because there is currently no criteria for the disposal form or location of some of the TMI waste.

COST

Low. Phase I - $28,000

Phase II indeterminate

INTERIM STORAGE CRITERIA FOR HIGHLY RADIOACTIVE WASTE CP-13 CP-14



NOTES:

◇ = BEGINNING OF MAJOR EVALUATION/DECISION PERIOD IN PROGRAM.

▽1 = FUNDING AUTHORIZATION.

▽2 = DECISION POINT TO RECOMMEND PROGRAM CONTINUATION

▽3 = PROGRAM COMPLETE, RESULTS OF STUDY AND EVALUATION AVAILABLE AS INPUTS TO OTHER PROJECTS

CANDIDATE PROJECT DESCRIPTION

CP No. 15

TITLE

Optimized Shipping Container.

PURPOSE/GENERIC BENEFIT

The purpose of this task is to develop a weight and volume efficient system for transporting evaporator bottoms to the burial site. Increased weight or volume efficiency can result in significant savings by reducing the number of shipments or the cost per shipment.

SCOPE OF WORK

Phase I -

1. Perform conceptual design of a cask for shipping 400 R/h 55 gallon drums. The cask will be sized to maximize the number of drums to be contained consistent with constraints imposed by truck shipment (weight and outside dimensions).

Design constraints

   1. Cask must be licensed type B.

   2. Should satisfy vehicle gross weight limit of 80,000 lb. -- 73,280 lb. limit desirable.

   3. Outside dimension should not exceed 96" Dia.

2. Perform conceptual designs for 3 waste containers geometrically optimized for use in existing commercial casks. The container/cask combination will be based on the following specific radiation levels:

   a) 50 $R/h/ft^3$
   b) 13 $R/h/ft^3$
   c) 0.25 $R/h/ft^3$

3. Prepare a cost/benefit evaluation for each approach and recommend which option should be carried into Phase II. The evaluation should be based on procurement costs and operating costs. Waste containers should not be reusable. Waste in containers can be assumed to be solidified for purposes of this task.

4. Prepare specification for Phase II design effort.

5. Prepare cost and schedule estimates for Phase II.

6. Prepare list of potential contractors for Phase II. Phase I deliverable will include output of items 3, 4, 5, and 6 as well as conceptial design reports on items 1 and 2.

Phase II -

1. Perform detailed design on concept selected in Phase I. Design should include any engineering analysis needed for qualification or licensing under existing codes and regulations. The design effort shall include:

   a) Detailed and assembly drawings.
   b) Supportive engineering analyses.
   c) Materials selection.
   d) Identification of potential fabrication problems.

2. Fabricate demonstration hardware.

3. Demonstrate/evaluate hardware.

4. Update cost/benefit evaluation from Phase I.

5. Qualify hardware for NRC licensing.

6. Prepare estimated production costs and schedules for hardware quantities appropriate to a large scale decontamination effort. Phase II deliverables will be:

   a) Design report
   b) All hardware fabricated for the program.
   c) Test report on hardware evaluation.
   d) Updated cost/benefit report.
   e) Report on licensing status and requirements.
   f) Estimated production costs and schedules.

ADVANTAGES

In addition to economic advantages this approach reduces the chances for a shipping event by reducing the total number of miles and time on the road.

DISADVANTAGES

There may be more radioactive material carried per truckload.

SCHEDULE

Phase I - 16 weeks from contract award
Phase II - 59 weeks from contract award
See attached network diagram.

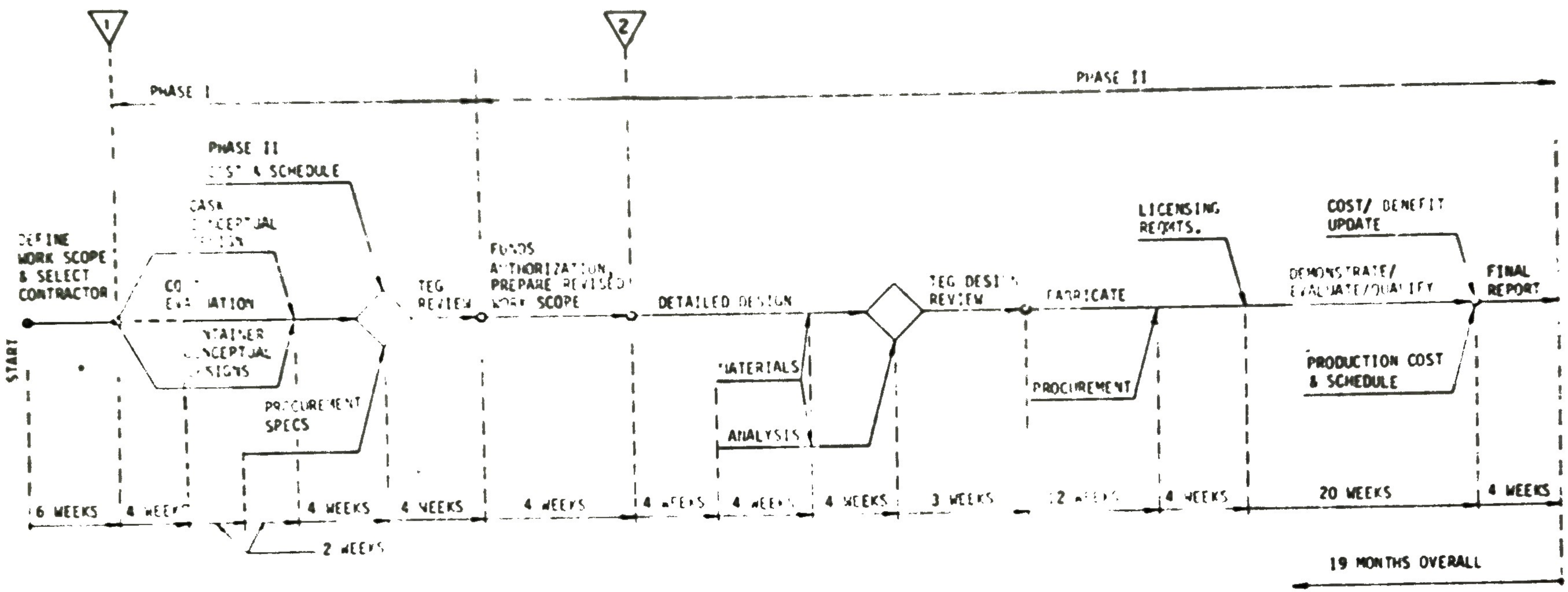
PRIORITY

Medium - Improved shipping efficiency for evaporator bottoms is not essential to cleanup operations, but is advantageous for schedule and cost impact.

COST

Phase I - Low
Phase II - Medium

OPTIMIZED SHIPPING CONFIGURATIONS FOR EVAPORATOR BOTTOMS C-15



NOTES:

- BEGINNING OF MAJOR EVALUATION/ DECISION PERIOD IN PROGRAM
- FUNDING AUTHORIZATION
- SCHEDULE BASED ON CASK OPTION

CANDIDATE PROJECT DESCRIPTION

CP No. 16

TITLE

High Integrity Containers.

PURPOSE/GENERIC BENEFIT

This task is intended to develop an alternate approach to solidification for disposal of contaminated ion exchange media. Use of this concept would reduce exposure of personnel to radiation as compared to other methods of handling the waste and is consistent with the ALARA philosophy. The containers would provide immobilization of the waste for a time in excess of 300 years, which is enough time for the main contributors to radioactivity to essentially decay out (> 10 half lives). Use of overpack containers also eliminates the processing steps of sluicing or elution and solidification.

SCOPE OF WORK

Phase I -

1. Determine draft criteria for overpack disposal including:

   a. minimum immobilization time,
   b. environmental conditions (internal & external),
   c. pressurization/venting requirements if any,
   d. dimensional constraints,
   e. weight constraints,
   f. material constraints,
   g. heat disposal requirements,
   h. stress requirements,
   i. shipping/shielding requirements,
   j. final closure requirements, and
   k. accident evaluation.

2. Coordinate approval of draft criteria from the NRC, DOE, Waste Disposal site (Site management and responsible state and local government agencies) and the TIO.

3. Prepare procurement specifications which will ensure compliance with criteria.

4. Prepare conceptual designs for large commercial liners for storage only concepts.

5. Prepare conceptual design from shielded shipping/storage overpack container for liners assuming source strength of:

   a. 2000 R/h
   b. 500 R/h
   c. 100 R/h
   d. 20 R/h

6. Perform preliminary shielding, stress, and heat transfer analyses for each container concept as applicable, and estimate personnel exposure from utilizing each overpack concept.

7. Provide recommendations for Phase II effort including concepts to be pursued, and estimated schedule, material and labor requirements. Also supply a list of potential contractors to perform Phase II, and provide cost/benefit evaluation for this approach.

Deliverable items from the Phase I effort will include:

1. the criteria,

2. specifications,

3. conceptual design report including summaries of all support analyses for each container concept, and

4. recommendations for Phase II effort as identified in item 7 of the Phase I scope of work.

Phase II -

The Phase II effort will consist of:

1. detailed design of the identified overpack concepts including:

    a. drawing preparation,
    b. supporting analyses,
    c. materials evaluation and selection, and
    d. identification of unusual fabrication requirements.

2. fabricate 2 copies of each design,

3. demonstrate/evaluate container adequacy to meet design criteria,

4. update cost/benefit evaluation from Phase I,

5. qualify overpacks for NRC licensing, and

6. estimate production unit costs for quantities appropriate for a large decontamination effort.

Phase II deliverables will consist of the fabricated hardware identified above and a design report which will include all the analyses and evaluations performed as well as justification of the design as built.

ADVANTAGES

1. Reduces steps in waste handling and thus reduces personnel exposure in keeping with the ALARA philosophy of radiation exposure.

2. Eliminates concern about leaching and chemical stability associated with solidification of waste.

3. Eliminates capital costs associated with solidification concept.

4. Established precedent for "state-of-the-art" disposal of large quantities of intermediate lived waste generated by an accident.

DISADVANTAGES

1. Results in larger waste volume than volume reduction concept.

2. Requires licensing approval of the concept and individual container designs.

3. Requires assurance that containers won't fail due to gas buildup resulting from chemical processes occuring over the storage life-time of the contents.

SCHEDULE

See network diagram.

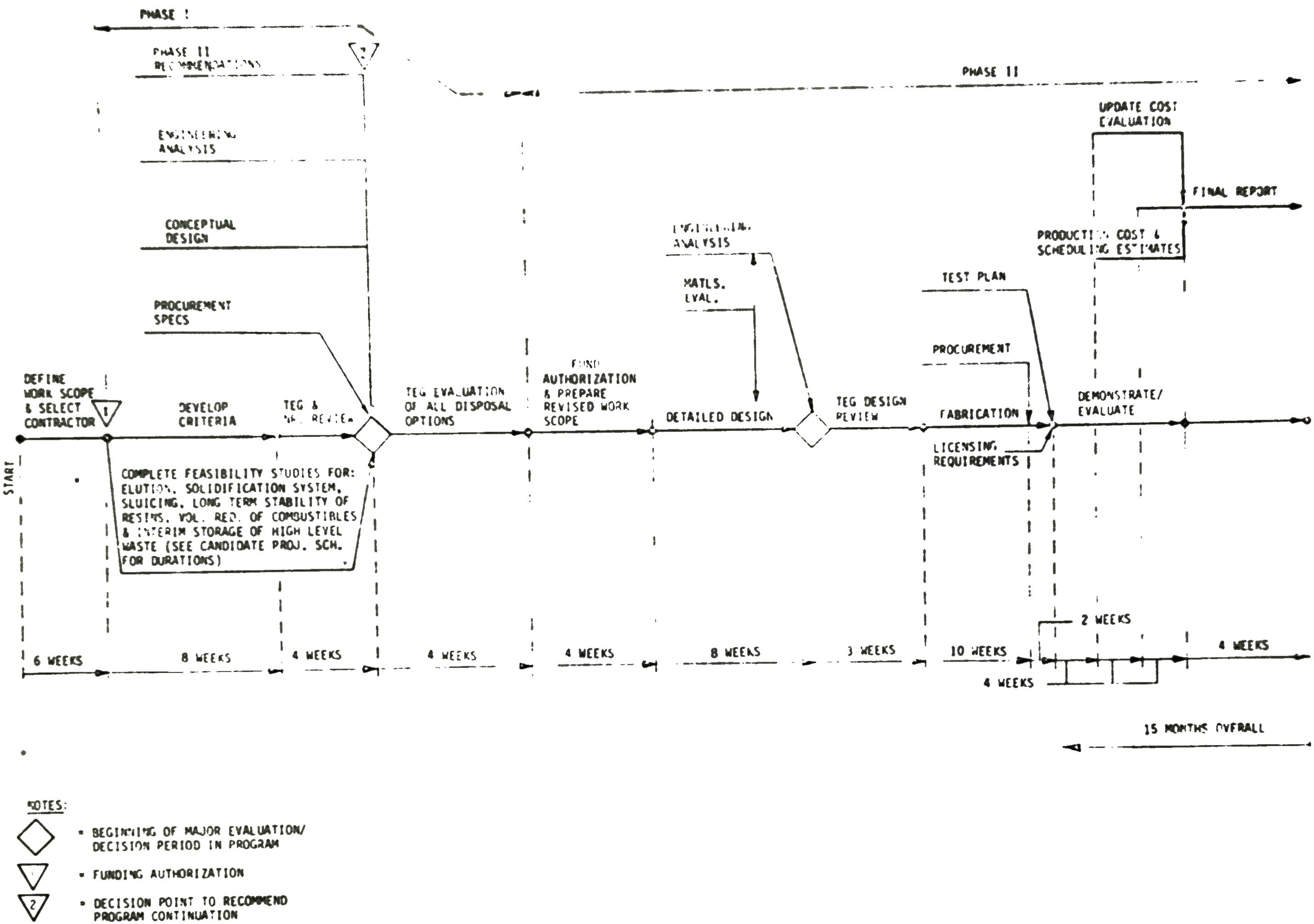
PRIORITY

High: The high priority is assigned because of the impact of the concept on the ALARA philosophy i.e. the elimination of sluicing will significantly reduce the exposure of personnel to radiation

COST

Phase I - Low
Phase II - Medium

HIGH INTEGRITY CONTAINERS CP-16



CANDIDATE PROJECT DESCRIPTION

CP No. 17

TITLE

Ion Exchange Media in AFR. Canisters.

PURPOSE/GENERIC BENEFIT

This task is to evaluate the option of encapsulating ion exchange media and storing it in an "Away From Reactor" (AFR) pool until the time the waste can be processed. This option is viable only if the waste classification is determined to be high level waste. If the ion exchange waste is classified as high level waste it will have to be processed prior to permanent storage. Since there are currently no facilities that are processing commerical waste, it will be necessary to store the waste in a fuel type pool or a canal until reprocessing can occur.

SCOPE OF WORK

Phase I -

1. Identify possible waste classifications for ion exchange media - much of the ion exchange media does not appropriately fit within the current waste categories. Before the disposal of this waste can be properly addressed it will be necessary to classify the waste and have appropriate disposal criteria for the applicable waste categories. The NRC has given some indication high activity resins, filters, etc. waste cannot be classified as low-level waste. In view of this confused state, the first item of work will be to get the waste category defined even if a new category of waste must be generated to achieve this goal. Of course, the NRC and possibly DOE and DOT must be parties to the classification of the waste.

2. Determine storage criteria. Once the waste category has been established storage criteria can be addressed. If interim storage pending processing is the indicated procedure then the following must be addressed:

   a) Can an existing facility be utilized as is?

   b) If an existing facility cannot be utilized as is, can it be made acceptable by modification?

   c) What, if any. geometry restrictions will be imposed?

   d) What, if any, are the quantity limitations?

   e) What are the material restrictions?

   f) How long can the material remain in the interim storage facility?

3. Develop storage canister criteria. Based on facility restrictions, anticipated storage duration, internal and external environmental conditions establish criteria for canister design. If necessary, modify the criteria for the various applications to be compatible with waste form and activity level. Obtain criteria approval.

4. Identify storage requirements for the interim storage facility based on total volume of waste requiring such storage. Consider requirements for retrieval, shielding, transfer and cooling in identifying storage requirements. Protection requirements from the elements should also be identified.

5. Prepare canister specifications to reflect all the storage requirements and criteria. Keep in mind the need to hold down costs when preparing the specifications.

6. Prepare conceptual canister design assuming a field strength of 250 R/h ft^3.

7. Perform stress, heat transfer and materials analysis on the conceptual design based on expected internal and external environmental conditions.

8. Perform cost/benefit analysis for this approach. Cost should include development, production waste handling, waste shipping, waste storage and waste retrieval costs.

9. Provide recommendations and estimates for Phase II effort. These should include.

    a) List of recommended contractors.
    b) Recommended approach and alternative approaches.
    c) Estimated cost and schedule for Phase II effort based on the the recommended approach.

Deliverable items from the Phase I effort will be:

1. All requirements and criteria.

2. Specifications.

3. Conceptual design report including supportive analysis.

4. Cost evaluation of approach.

5. All recommendations and estimated cost breakdown and schedule for Phase II.

Phase II -

The Phase II effort will include:

1. Detailed design effort.

2. Fabrication of test articles (2)

3. Demonstration, evaluation and qualification of the design to meet all requirements.

4. Update cost evaluation from Phase I.

Phase II deliverables will consist of a design report, test hardware, test report and cost evaluation for production.

ADVANTAGES

This may be the only viable method of waste storage if the waste is classified as high level waste, or if a new classification is issued for the accident waste which requires eventual chemical processing.

DISADVANTAGES

1. Doesn't permanently dispose of waste.

2. May require extensive retrievable waste storage space.

3. Requires more waste handling than other options, and consequently results in higher personnel exposure to radiation.

4. Requires new criteria and licensing.

SCHEDULE

See network diagram.

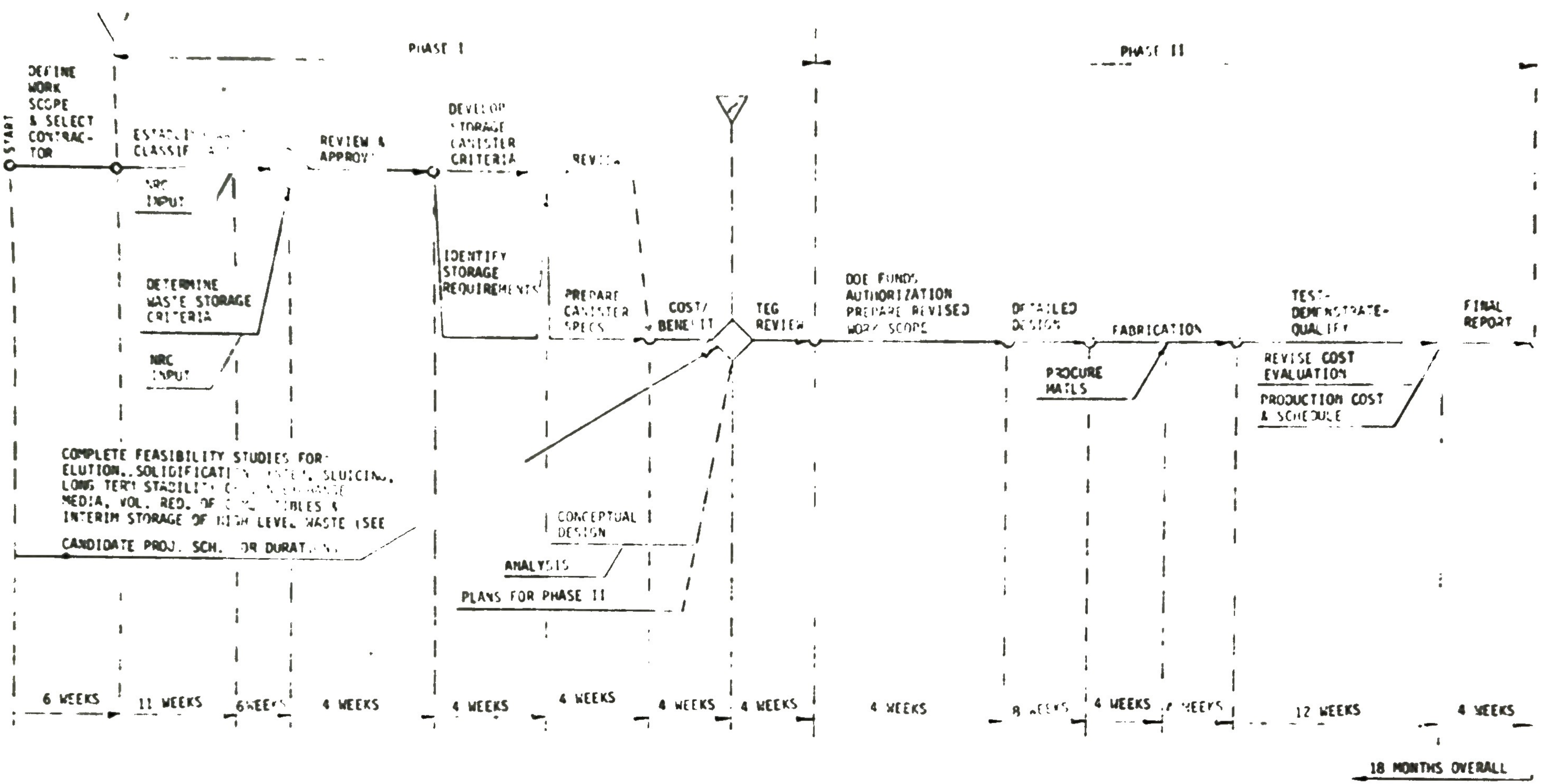
PRIORITY

Medium: This option is not desirable in terms of personnel exposure, cost, or final disposition of the waste. It cannot, however, be dismissed because of uncertainty over how the waste will ultimately be classified.

COST

Phase I -- Low
Phase II -- Low

ION EXCHANGE MEDIA IN AFR. CANISTERS CP-17



NOTES:

- BEGINNING OF MAJOR EVALUATION/ DECISION PERIOD IN PROGRAM
- FUNDING AUTHORIZATION
- ISSUE FINAL REPORT & RECOMMENDATIONS
- DECISION POINT TO RECOMMEND PROGRAM CONTINUATION

CANDIDATE PROJECT DESCRIPTION

CP No. 18

TITLE

Organic Resin Characterization.

PURPOSE/GENERIC BENEFIT

The organic resins from ion exchange processing of contaminated liquid accident wastes must be characterized by physical, chemical and radiochemical analyses in order to determine regulatory requirements for storage or further processing. Organic TMI-2 resins will be used as reference materials for this project.

The distribution of the activity within a large resin bed will provide resin suppliers and users with additional data related to techniques for designing resin cleanup systems for nuclear accidents. The technology for sampling and characterization of resins and the resulting information are a necessary part of other studies related to resin stability and interim storage of organic accident wastes.

SCOPE OF WORK

I. General Requirements

During normal operations nuclear power plants utilize ion exchange technology for the cleanup of reactor coolant water, for maintaining low activity levels in fuel storage basins and for providing plant demineralized water systems. Power plant operators are thus generally familiar with the use of organic resins in processing low level wastes followed by disposal of resin at commercial low level burial grounds.

The liquid wastes that result from the cleanup of a nuclear accident at a utility company may contain higher levels of radioactivity than are normally experienced in routine plant operations.

The radioactivity on the "loaded" resin used to process contaminated liquid should be principally cesium and strontium, but depending upon the accident circumstances other fission products or transuranic elements may be also present in trace quantities to macro amounts.

The approval of regulatory agencies for interim storage or disposal of organic resins to shallow land burial will depend, among other criteria, upon the nature and quantities of the isotopes that are present. It is, therefore, necessary that samples of resin from accident radwaste processing be taken and the complete spectrum of activity be analyzed. This characterization information is also required in order to determine the nature of any further processing that might be required. Following an accident, the prompt recovery and containment of contaminated liquid wastes must be performed, sometimes under emergency conditions. The organic resins may be placed in temporary storage pending a determination of further processing, or pending the classification of the resins in respect to storage or to the waste disposal method to be employed. Organic resins are subject to decomposition or degradation under prolonged storage, depending upon the level of radiation to which they are exposed and the chemical and physical environment of the resins while in storage, including whether the resins are stored wet or dry. Such degradation of the resin may:

1. Generate gases (H_2, N_2, SO_2)

2. Create corrosive conditions for the liner (for example, due to absorption of SO_2 in water to form sulfurous or sulfuric acid)

3. Deteriorate the form of the individual resin bead.

4. Restrict the ability to elute the "loaded" isotopes due to physical or chemical changes in the resin

Therefore, in addition to performing chemical and radiochemical analyses, observations should be made to the effect that is practicable, to detect any evidence of resin degradation. Actual elution studies will not be undertaken within the Scope of Work of this project.

Two EPICOR-II liners of TMI "loaded" organic resins will be selected for characterization as typical samples of commercial systems under accident conditions. Drawings of the 4' x 4' liners will be provided. Each liner will contain approximately 40 Ci/ft^3 and approximately 1200 Ci per container. Shipment will be arranged f.o.b. Three Mile Island using approved Type B-2 truck casks. Resins will be dewatered of excess liquid but should still be in a damp to wet state. Vendor's facility must be able to handle a Type B-2 cask with a gross weight of 25 tons. Vendor should examine the liner drawings and direct his technical approach to the following problems:

1. Determining if gas evaluation is occurring and if so how he would propose to sample and analyze the components

2. Detecting whether corrosion may be occurring in the liner.

3. Undertaking to obtain a representative sample without upsetting or grossly disturbing the strata or layers that may be present.

4. Describing analytical and instrumentation facilities available for the determination of radionuclides and their individual concentrations.

   Since the radioactivity is known to be stratified in the liner, the sampling is important to determining the total nuclide loading in the liner as well as to the distribution of the activity among the different resin strata.

II. Detailed Requirements

A. Physical examination

Upon receipt of the EPICOR-II liners and related drawings at vendor's location, perform and record results of physical examination as follows:

1. Evidence of gas evaluation. If so, determine if it is feasible to analyze for H_2, SO_2, CO or CO_2. If gas analysis appears warrented advise EG&G Idaho of specific tests proposed (including estimated accuracy and precision) and cost to perform. EG&G will advise whether such tests are to be performed.

2. Examine container for visual evidence of corrosion.

3. Perform radiation scan (gamma) on container to make rough determination of the distribution of activity on resin from top to bottom of liner.

4. Determine presence of water in the liner and, if feasible, establish the pH. If pH measurement is made, qualitatively determine major anion present.

B. Chemical and Radiochemical Assay

Devise sampling system to remove representative core samples of resin from the resin liner. Conduct complete isotopic examination including cesium, strontium, transurances, and any other fission products present in more than trace quantities. Perform gas analysis as directed by EG&G.

III. Reserve residual resins in both liners until release for disposal is obtained from EG&G Idaho.

Deliverables

1. Submit details of plans for EG&G comments or approval. Allow maximum of 10 working days for approval to precede.

    a. Physical measurement and observations.

    b. Chemical and Radiochemical measurements.

2. Submit results and evaluations of measurements on each of above plans in final report.

ADVANTAGES

Regulatory decisions can be accelerated with a better knowledge of the character of organic radwastes. Process considerations are better designed with a knowledge of how the activity is distributed in a given resin bed. Storage criteria can be determined, and accident waste forms for storage can better be established.

DISADVANTAGES

The principal disadvantage is that ion exchange processing systems vary in details although not in principle. Also, very large waste containers of organic resin require specialized radiochemical facilities for handling.

SCHEDULE

Approximately three months from award of contract.

PRIORITY

High - this option is high priority since the data gained from it is necessary as an input for the final waste classification.

COST

Medium - estimated at $200,000 for Phase I. There is no anticipated Phase II cost.