Y/ER-179

Phase 2 Focused Feasibility Study Report for the Reduction of Mercury in Plant Effluent Project at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

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Energy Systems Environmental Restoration Program
Y-12 Environmental Restoration Program

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Environmental Restoration and Waste Management Programs
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831-7101
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
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under contract DE-AC05-84OR21400

DRAFT

CONTENTS

DISCLAIMER

ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPCF	Central Pollution Control Facility
DOE	U.S. Department of Energy
EFPC	East Fork Poplar Creek
ER	Environmental Restoration
FS	feasibility study
GAC	granular activated carbon
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OU	operable unit
PRTF	Plating Rinsate Treatment Facility
TDEC	Tennessee Department of Environment and Conservation
WETF	West-End Treatment Facility

EXECUTIVE SUMMARY

The purpose of this focused feasibility study (FS) is to review the alternatives that have been evaluated under the Reduction of Mercury in Plant Effluent scoping efforts and provide justification for the recommended alternative. The chosen option from this study will be executed to meet the mercury-specific requirements of the recently negotiated National Pollutant Discharge Elimination System (NPDES) Permit for the Oak Ridge Y-12 Plant.

Past U.S. Department of Energy (DOE) operations at the Oak Ridge Reservation have led to propagation of mercury contamination in the environment through discharges to East Fork Poplar Creek (EFPC). Four previous "mercury use" buildings at the Y-12 Plant have been identified as primary contributors to these discharges and are scheduled to undergo upgrades to mitigate them as sources. They are 9201-2, 9201-4, 9201-5, and 9204-4. These buildings contain mercury-contaminated pipes and sumps that discharge to EFPC. Some pipes contain deposits of elemental mercury, which are subject to wash out during high flow periods and continually solubilize during normal flow. Many basement sumps collect mercury-contaminated groundwater, and, as the sumps are pumped, this contaminated water is discharged into EFPC. Discharges from the four buildings contribute to ~15 to 20 g of mercury per day, resulting in an instream concentration of ~1 ppb.

The current requirements for limiting mercury discharges to EFPC are defined in the draft Y-12 Plant NPDES Permit, which is expected to become effective in July 1994. The main requirement related to mercury in the permit is to reduce the downstream mercury concentration to 5 g/day or less. This equates to an instream concentration of ~0.2 ppb with a creek flow of 6 million gal/day, which assumes the flow of EFPC will be increased by pumping water from the Clinch River. The increased flow is detailed under the Flow Management Project augmentation and included as part of the NPDES Permit.

Three basic options are considered and estimated in this study, including treatment at the building sources with local units (~$3800K); a combination of local treatment and centralized treatment at the Central Pollution Control Facility (~$6600K–$8900K); and hydraulic control of the groundwater and/or in situ soil treatment (~$120,000K). As negotiated under the NPDES Permit, an "interim" local unit, utilizing carbon adsorption, is being placed in operation in the 9201-2 building by July 1994. Since the major uncertainties associated with meeting the NPDES permit discharge requirements for mercury are flow rates and treatment efficiency, the 9201-2 unit will provide within 6 months the data necessary to optimize a treatment design.

Based upon the NPDES Permit requirements and the uncertainties associated with flow rates and mercury removal efficiency, the following recommendations are made:

- Continue installation of 9201-2 local unit and operate for ~3 to 6 months, varying flow rate and mercury concentration under a design optimization plan.
- Use results obtained from the 9201-2 local unit design optimization plan to characterize process efficiency, considering flow rate, contaminant concentration, and operational

requirements. Use these data to determine the best overall treatment design and minimize uncertainties.

- Use the $8900K water treatment option as the baseline for funding prioritization until results of the design optimization plan are reviewed and approved by Martin Marietta Energy Systems, Inc., and DOE.
- In consideration of technical, cost, and schedule uncertainties, defer hydraulic control and/or in situ soil treatment until the Comprehensive Environmental Response, Compensation, and Liability Act process for the Y-12 Plant is implemented.
- Submit this focused FS to the Tennessee Department of Environment and Conservation and state Water Quality personnel to meet the July 1, 1994, NPDES Permit requirement for submittal of a development plan for a permanent treatment system.

1. INTRODUCTION

1.1 PURPOSE

This report evaluates selected alternatives for reducing the mercury contamination in the effluent of four buildings at the Oak Ridge Y-12 Plant. Assessment of the alternatives is based on Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria, which provides consistency in technical approach with other Y-12 Plant Environmental Restoration (ER) activities. The intent of this study is to provide timely evaluation for a cost-effective treatment process that will meet the upcoming National Pollutant Discharge Elimination System (NPDES) Permit requirements and provide necessary flexibility for process improvement if needed.

1.2 BACKGROUND

Past U. S. Department of Energy (DOE) operations at the Oak Ridge Reservation have led to propagation of mercury contamination in the environment through discharges to East Fork Poplar Creek (EFPC). Four previous "mercury use" buildings at the Y-12 Plant have been identified as primary contributors to these discharges and are scheduled to undergo upgrades to mitigate them as sources. They are 9201-2, 9201-4, 9201-5, and 9204-4. These buildings contain mercury-contaminated pipes and sumps, which discharge to EFPC. Some pipes contain deposits of elemental mercury which solubilizes into the water as it passes or washes out during high flow periods. Many basement sumps receive mercury-contaminated shallow groundwater, and, as the sumps are pumped, this contaminated water is discharged into EFPC.

In August 1993, DOE-Headquarters sponsored a workshop to review the Integrated Mercury Strategy document, mercury contamination in Upper EFPC, remedial activity schedules, and roles and responsibilities. This workshop developed a project plan outline that defined the objectives for Phase 2 of the Reduction of Mercury in Plant Effluent project as (1) mitigation of mercury sources in buildings; (2) continued characterization and verification of mercury sources; (3) continued effective communication with and reporting to Y-12 Plant staff and regulatory agencies; and (4) provision of permanent wastewater treatment at the Y-12 Plant.

Baseline planning had identified two elements to reduce the contaminated effluent:

- **Source elimination.** This activity, which is already well under way, involves installing new pipe to parallel and bypass contaminated pipe. The old pipe is then unhooked and abandoned for disposal in the future. Some clean water flow (e.g., steam condensate and process drains) that was draining into the contaminated groundwater sumps is also being rerouted to prevent its contamination.

- **Source treatment.** Baseline planning for this element called for modifying the Central Pollution Control Facility (CPCF) to enable treatment of flow from contaminated basement sumps of the four identified buildings. These buildings would be tied into

CPCF via a common header running between them. Modifications to CPCF called for adding a precipitation/flocculation process, carbon columns, and possibly an add-on structure to house the new equipment. With operation of this CPCF modification scheduled for January 1, 1998, it was decided to put an interim unit in 9201-2 to provide a test bed for proving the selected carbon adsorption treatment technology and to treat the building's contaminated sump discharge.

After cost estimates for this baseline approach came in higher than expected, a task team was formed to reevaluate the project needs, methods, technical scope, and cost. The team brainstormed options, evaluated each according to the appropriate CERCLA criteria, and selected basic options for evaluation. The results are shown in this report.

The actions and alternatives evaluated have been identified to meet requirements of the upcoming NPDES Permit. The goal is to reduce loading of mercury to EFPC to 5 g/day, thus achieving an instream concentration of ~0.2 ppb. This limit must be met by December 31, 1998.

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 REMEDIAL ACTION OBJECTIVES

It is assumed that all the alternatives that have been developed will be designed for and will meet the effluent limits provided by the NPDES Permit. A limit of 5 g/day by December 31, 1998, is the assumed permit requirement. The measurement will be taken downstream at Station 17. At an EFPC flow of 6 million gal/day, the effluent mercury concentrations are estimated to be ~0.2 ppb. These limits can be met either by treating the collected wastewater or by avoiding contamination. Both of these options were considered in the identification of technologies and development of alternatives.

2.2 TECHNOLOGY SCREENING

This section presents the results of a brainstorming session held to identify potential technologies that could be incorporated into alternatives for treating mercury-contaminated water. Alternate treatment technologies identified in the Y-12 Technology Logic Diagram and technologies that are part of the existing design for expanding the CPCF are also among the potential technologies. Table 1 presents the suggested technologies and the results of further evaluation. The evaluation of technologies was based on both a consideration of technical applicability (the first step of CERCLA technology screening) and a comparison of implementability, effectiveness, and cost between like technologies (the second step of CERCLA technology screening). Effectiveness considerations took into account whether the technology was a pre- or post-treatment technology and whether it was intended to be the primary treatment technology and therefore needed to achieve the permit limits.

As indicated in Table 1, those technologies that are not applicable or not as effective as another, given the cost, were not developed into alternatives. Several treatment technologies were not developed into alternatives yet may remain viable. These include reverse osmosis, ion exchange, electrochemical treatment, ultrafiltration, and aeration. They will be reconsidered during design of the treatment plant, if a treatment plant is selected. It was felt that using carbon adsorption to represent these technologies was appropriate given the level of effort for this feasibility study (FS).

Further details of treatment technologies considered are presented in the Y-12 Technology Logic Diagram prepared for DOE.

Table 1. Technology screening

Response action	Technology	Process option	Description	Result of evaluation
No action		As is	Continue to pump sumps and direct discharge	Not acceptable. Exceeds permit limits
		Stop pumping	Abandon building, relocate, stop pumping sumps, allow basements to flood	Not acceptable. Buildings in use. As buildings are no longer used, option could be reevaluated
Contaminated water removal	Collection	Raise level for pumping	Raise the pump intake level, allowing slightly higher water levels in building	To be considered during final design if collection is part of alternative
		Allow flooding	Maintain normal pumping during high flows, allowing flooding of basement	To be considered during final design if collection is part of alternative
Diversion	Hydraulic control	Wells/drains	Used to lower water table or assist in diverting groundwater flow away from buildings	Potentially viable. Expensive and may still collect contaminated groundwater. There is some question about reliability. Subsurface barriers represented by hydraulic control. Retained
	Subsurface barriers	Slurry walls	Trench excavated and filled with slurry. Tied into bedrock	Not considered as effective as lowering the water table by reversing the gradient. Not retained
		Grout curtains	Grout pressure-injected along contamination boundaries in overlapping drilled holes	Not considered as effective as lowering the water table by reversing the gradient. Not retained
		Sheet piling	Steel sheet piles driven along boundaries.	Excessive leaking although less expensive. Not retained
Treatment	Location	Central at CPCF	Water piped to and consolidated at CPCF. Existing facility expanded	CPCF closest and easiest to expand. Retained for consideration
		Central at WETF	Water piped to and consolidated at WETF. Existing facility expanded	CPCF closer and easier to expand. Not retained

Table 1 (continued)

Response action	Technology	Process option	Description	Result of evaluation
Treatment (continued)	Location (continued)	Central at Alpha 4	Water piped and consolidated at Alpha 4. New facility built	CPCF closer and easier to expand. Not retained
		Local at buildings	Water treated close to source. Not consolidated	Retained for consideration
		North–South pipe	Water collected from North–South pipe for treatment	Excessive flows. Low mercury concentrations already at limits for treatment technology. Not retained
	In situ	Stabilization	Stabilization of soil underneath buildings immobilizes mercury so it does not leach as water passes through	Retained for further evaluation
		At sump	Add iron, zinc, GAC to insolubilize mercury	Hard to control and maintain. Not as effective or reliable as ex situ treatment. Not retained
	Physicochemical	Ion exchange	Contaminated water passed through a bed of resin material where exchange of ions occurs between the bed and the water	May be effective with selective resin. May need further evaluation at design stage
		Reverse osmosis	Semipermeable membrane using osmotic pressure to force water through while leaving contaminants behind	Effective. May need further evaluation at design stage
		Adsorbents	Contaminated liquid or gas stream passes over adsorbent that removes contaminants	Effective and easy to implement. Will be representative treatment technology
		Sulfur-impregnated carbon	Carbon adsorbent impregnated with sulfide ions to enhance mercury removal	No improved effectiveness over GAC. Not retained
		Chemical reduction	Use of reductant such as borohydride to form less soluble, more stable forms	Not sufficiently effective at low levels

Table 1 (continued)

Response action	Technology	Process option	Description	Result of evaluation
Treatment (continued)	Physicochemical (continued)	Chemical fixation	Chemical reaction followed by filtration or other separation technique	Insufficiently developed for further consideration
		Ultrafiltration	Ultrafine filter used to remove large ions. Needs pretreatment to remove suspended solids to prevent fouling	Effective. May need further evaluation at design stage
		Electrochemical	Changes oxidation state of ions to more treatable state through the application of direct current through submerged electrodes	Effective. May need further evaluation at design stage
		Inorganic microporous filter	Extension of filtration with the advantages of use in severe environments, readily cleaned, reused indefinitely	Insufficiently developed for further consideration
		Forager sponge	Porous, open-cell sponge containing specialized polymers with selective affinity to certain dissolved species such as mercury	May need further evaluation at design stage
		Empore	3M process with ethers attached to silica particles in a membrane. Ethers remove the mercury	Insufficiently developed for further consideration
	Biological treatment	Biosorbents	Adsorption on biomedia tailored for specific contaminants. Can use algal biomass on a permeable packed matrix	May need further evaluation at design stage
		Artificial wetlands	Uptake of contaminants into wetland plants. Plants harvested and disposed. Some contaminants precipitate into sediment	Difficult to implement and control. Effectiveness limited. May promote development of methyl mercury. Not retained

Table 1 (continued)

Response action	Technology	Process option	Description	Result of evaluation
Treatment (continued)	Pretreatment (continued)	Filtration	Fine solid particles removed from liquid stream by filter medium. Common media are sand, diatomite, coal, natural or synthetic fabric, and wire cloth	Effective and can be inexpensive. Retained for consideration in design
	Pretreatment	Sulfide precipitation	Chemical equilibria of metals altered to reduce solubility through the addition of sulfide	Effective. May be needed for higher total mercury levels. Retained
		Aeration	Volatilize elemental mercury and capture on GAC	Effective and can be inexpensive. Retained for consideration in design

CPCF = Central Pollution Control Facility
GAC = granular activated carbon
WETF = West-End Treatment Facility

3. DEVELOPMENT OF ALTERNATIVES

Alternatives were developed from the technologies remaining after screening. A range of alternatives was developed that varied from improving the existing design for the CPCF through remediating the mercury in the soils beneath the buildings. Assumptions concerning influent conditions included the following:

- Only sump groundwater will be treated. Water from steam condensate, roof drains, and process drain lines would not be included.
- Other future wastewater streams such as those resulting from decontamination and decommissioning and other ER activities are not specifically included.
- The design influent mercury concentration level is assumed to be 80 to 100 ppb.
- Maximum flow rates at individual buildings are assumed to be 65–110 gal/min at 9201-2, 15 gal/min at 9201-4, 16 gal/min at 9201-5, and 0.04 gal/min at 9204-4.
- There are no specific provisions for removal of other contaminants, although it is recognized that the selected treatment technology may do so.
- All alternatives evaluated will require Tennessee Department of Environment and Conservation (TDEC) approval and a renegotiation/modification to the NPDES Permit.

Much like the identification of technologies, the alternatives were developed in a meeting using brainstorming techniques. Those alternatives deemed not to be applicable as developed were either modified or deleted from consideration. Three basic alternatives were developed: (1) develop local treatment facilities at 9201-4 and 9201-5, make permanent the 9201-2 interim local unit, and use a portable polytank for collection at 9204-4; (2) modify the existing design of the central treatment facility to make it cost-effective, make permanent the 9201-2 interim local treatment unit, and use a portable polytank for collection at 9204-4; and (3) remediate the source instead of treating the water. The source remediation alternative is a final alternative for the mercury in the soils beneath the buildings. The water treatment alternatives are interim activities until the soils and groundwater in this area undergo final CERCLA remediation.

Several elements are common to more than one of the developed alternatives. All developed alternatives include an effort to minimize the influent flow. Process and cooling-water drain lines need to be rerouted to the storm sewer. Sump levels would be raised to reduce the amount of flow pumped, and equipment that could be damaged by temporary basement flooding would be raised. All surface water flow would be rerouted away from the buildings. The two water treatment alternatives also include making the interim treatment unit at 9201-2 permanent and installing a collection tank at 9204-4. The collected water would be transported to one of the treatment systems periodically.

Several uncertainties are associated with the treatment plant alternatives. Uncertainties center on the need for pretreatment [e.g., is pH adjustment useful? is precipitation/flocculation needed? what are the operation and maintenance (O&M) requirements of these processes?] and the potential for other currently unidentified waste streams that will also require mercury treatment. These uncertainties are addressed in the detailed analysis of the alternatives. A more detailed description of each alternative is presented below.

3.1 ALTERNATIVE 1: LOCAL UNITS AT 9201-2, 9201-4, AND 9201-5; POLYTANK AT 9204-4

This alternative involves two primary actions. First, the final configuration of the interim local unit at 9201-2 would be converted into a permanent system capable of long-term operation at that facility, and 9204-4 discharges would be pumped into a portable polytank for transport to a treatment facility. Preliminary cost evaluations for running pipe from 9201-2 (because of its long distance) and 9204-4 (because of its low flow) to another treatment facility appear to indicate that this alternative would be more expensive to implement than the other alternatives suggested. A future value engineering study will need to verify these recommendations. The configuration of the 9201-2 permanent unit would be finalized when operational experience is gained, after the interim unit comes on line in June 1994. Converting the interim system for long-term, permanent operation would require modifications based on several considerations, including conduct of operations, access control, upset condition operation, off-shift operation and maintenance, etc. Until information about the operation of the interim unit is collected, it is assumed that pH adjustment and additional carbon columns would be required to make the local unit at 9201-2 a permanent treatment facility.

Second, the permanent local unit at 9201-2 would be duplicated at 9201-4 and 9201-5. This would require installation of similar systems modified as site-specific conditions dictate. Because of higher mercury levels at 9201-4 and 9201-5, additional equipment may be required to provide pretreatment before the final treatment process. The site-specific requirements to get sump waters to the treatment units, provide an NPDES discharge point from the units, and supply electrical power and alarming of the systems would have to be considered for each unit.

3.2 ALTERNATIVE 2: LOCAL UNIT AT 9201-2; MODIFICATION OF CPCF; POLYTANK AT 9204-4

Alternative 2A is a modification of the original design submitted for a central mercury treatment system at the CPCF. It also involves two primary actions. First, the final configuration of the interim local unit at 9201-2 would be converted into a permanent system capable of local long-term operation at that facility and 9204-4 discharges would be pumped into a portable polytank.

Second, the Plating Rinsate Treatment Facility (PRTF) equipment at CPCF would be modified to be a central mercury treatment system. Existing equipment would be used to the greatest extent possible. Piping from 9201-4 and 9201-5 to the new system would be added. The existing PRTF equipment would be modified by changing the piping, adding new acid pumps for the carbon inlet pH adjuster, adding new carbon columns, adding cartridge filters, and adding an NPDES discharge point. Also included in this alternative is the addition of influent overflow/recycle tanks in existing catch basins.

Alternative 2B is an option that would be designed but might not be added until a need is demonstrated. In addition to utilizing carbon adsorption technology, it also includes a chemical precipitation/flocculation system with new acid pumps for floc inlet pH adjusters and hookup of a filter press.

3.3 *ALTERNATIVE 3: SOURCE REMEDIATION*

The source remediation alternative consists of both flow-reduction activities and in situ soil and water treatment to immobilize the mercury. To limit groundwater flow into the sumps while in situ soil treatment is implemented, wells would be placed around the buildings (estimated at six per building) to lower the local water table level. The groundwater itself could be contaminated with mercury or other constituents, which would require further treatment.

To reduce mercury concentrations in water that may leak into buildings from contaminated groundwater during high flow conditions, french drains would be installed around the buildings with an immobilizing compound such as zinc sulfide placed within the drain. While treatability studies are required to assess the optimum compound, the goal is to immobilize dissolved mercury in the groundwater within the trench. Modeling of flow direction would be needed to assess where trenches would be effective. Where hydraulically applicable, the trench would be designed to act as a filter for suspended particles containing mercury. Periodic maintenance to replace the trench materials may be needed. Further investigations would be needed to assess whether area groundwater is contaminated with mercury from a variety of sources and would therefore require in situ groundwater treatment for the long term. Soils immediately adjacent to and below the buildings may be the only mercury source. In this case, further operation of the in situ groundwater treatment system should not be needed once the soil is stabilized.

The final action under this alternative is soil stabilization. Although the actual material to stabilize the soil has yet to be identified, the intent of the material would be primarily to bind mercury to the soils chemically. It is anticipated that perhaps a zinc sulfide grout could be injected through the basement floors and around the foundation of the buildings.

Final source mitigation is a complex problem, which will require further research and assessment. Additional information about the nature and extent of soil contamination, results from treatability studies, and an implementability assessment will be needed before this action can be carefully evaluated.

4. DETAILED EVALUATION

To simplify documentation of the evaluation of alternatives, only a comparative analysis is presented. The individual analysis was conducted as part of a meeting during the effort to compare relative benefits of each alternative. The comparative analysis is summarized in Table 2. Only the balancing criteria [criteria that balance issues (e.g., cost-effectiveness)] are presented in the table. Threshold criteria (those CERCLA criteria that must be met by every CERCLA action) are met for each alternative, and a description of how these criteria are met is included in Sect. 4.1. The modifying criteria [those criteria that allow input/acceptance from other stakeholders (e.g., state and community)] are not presented, as input regarding a selected method of achieving compliance has not yet been solicited from these stakeholders. Note that the NPDES Permit has undergone public notice, and stakeholder comments are currently being received.

4.1 THRESHOLD CRITERIA

4.1.1 Protection of Human Health and the Environment

The basis of existing permits and the new NPDES Permit is protection of human health and environment. Alternatives 1 and 2 meet this criteria by collecting and treating contaminated water in building sumps before storm sewer discharge. The treatment level achieved will meet the NPDES Permit requirements and therefore will be protective of human health and environment. The intent of Alternative 3 is to prevent contaminated water from entering the sumps through a combination of activities. In situ soil treatment binds the mercury to soil. minimizing the amount available to leach into water. Raising the level at which water is collected in the buildings, along with diverting water around the buildings is intended to prevent water from entering the storm sewer, thereby negating the need for treatment. However, remaining contaminated groundwater would be part of the groundwater operable unit (OU) in the area and any additional remediation needed to be protective of human health and environment would be conducted as part of that OU.

4.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

The primary applicable or relevant and appropriate requirements of concern are surface water quality criteria that guide the requirements of a state-issued permit. The remedial action objective is to meet the NPDES Permit requirements. Appropriate disposal requirements for waste residuals will also be met. No waivers are expected to be needed for any of the alternatives. While all developed alternatives would meet the objective, none entirely complies with the treatment method defined in the NPDES Permit. All would require some degree of permit renegotiation/modification.

4.2 BALANCING CRITERIA

A summary of the comparative analysis of the balancing criteria is presented in Table 2. Compared to the source remediation alternative (Alternative 3), there are no significant differences between the two treatment alternatives. The source remediation alternative is

Table 2. Comparative analysis

	A2 permanent/CPCF modification	Local treatment	Source remediation
Long-term effectiveness and permanence	Is the most reliable because of redundancy of systems and flexibility included in design. Can treat influent extremes and can accept other waste streams. Easily monitored to avoid noncompliance	Loss of precipitation/flocculation decreases reliability although design may still meet requirements under most conditions. May not be able to treat extreme influent conditions. Less amiable to accept other waste streams. Remote operations and maintenance require special consideration to avoid permit violations	Most permanent solution. Limited long-term O&M. Difficult to assess reliability of components
Short-term effectiveness	Somewhat longer to implement than treatment without precipitation/flocculation (though not significant). Minimal impact on environment	Quickest to implement (although two treatment alternatives similar). Minimal impact on environment	Longest to implement. Significant earth-moving activities could affect the environment through erosion or volatilization
Implementability	Compared to source remediation, implementability is easy. Space available in CPCF for implementation	Similar to CPCF modification although slightly more difficult to implement because no existing equipment would be used, and spaces in buildings not designed to be used for wastewater treatment. Permanent treatment systems may require modifications to building utilities and structure. Would be added administrative difficulty because of additional NPDES discharge points	Most difficult to implement since there is considerable subsurface work. Existing buildings and subsurface utilities complicate implementation
Reduction of toxicity, mobility, and volume through treatment	Precipitation/flocculation could reduce volume of contaminated solids	Similar to CPCF modification. There is the potential for generating more waste without pretreatment	Reduces mobility of contaminants, so no additional treatment is needed
Cost	~$6660K, medium O&M costs	~$3800K, medium O&M costs	~$8900K, very low O&M costs

NPDES = National Pollutant Discharge Elimination System
O&M = operation and maintenance
CPCF = Central Pollution Control Facility

much more permanent, requiring limited long-term maintenance. However, there is less certainty about its success, and it is much more difficult to implement. Source remediation reduces mobility of the contaminants, whereas water treatment reduces the volume of contamination. Source remediation is much more expensive.

Between the two treatment alternatives, primary differences are cost and potential long-term reliability. Both are designed to be effective under standard conditions; however, only the modified PRTF plant (Alternative 2) provides effective flexibility for treating the extremes of influent conditions or accepting other waste streams. Alternative 1 must allow either basement flooding, alternative storage for materials currently stored in the basements, or treatment bypass of the basements if additional treatment capacity is not added. Retreatment during high mercury influent conditions may also be needed if no exceedences are allowed. For the added reliability of Alternative 2, cost and time to implement are slightly increased. Operations would be simplified by centralizing the treatment, and flexibility for treating other waste streams or for effective treatment under abnormal conditions would be increased. Also, centralizing the treatment system limits the number of NPDES outfalls and related cost for maintaining compliance.

Preliminary costs for the alternatives are shown in the Table 3. Along with cost, Table 3 lists the assumed components of each alternative. Recognizing the limited time to develop these costs, it is recommended that the scope of the selected alternative be more precisely defined in a value engineering session during Title I design. Additionally, the cost estimate of the selected alternative needs to be recalculated.

Table 3. Preliminary capital cost estimates

Treatment option	Preliminary estimate
Option 1	S3800K
A2—Local	
B4—Tank	
A4—Local	
A5—Local	
Option 2A	S6600K
A2—Local	
B4—Tank	
A4—CPCF "PRTF Base Modification"[a]	
A5—CPCF "PRTF Base Modification"[a]	
Option 2B	S8900K
A2—Local	
B4—Tank	
A4—CPCF "PRTF Full Modification"[b]	
A5—CPCF "PRTF Full Modification"[b]	

[a]CPCF "PRTF Base Modification": 9201-4 and 9201-5 piping to CPCF, carbon adsorption columns, 30,000-gal feed tank, carbon pH adjustment, cartridge filter, various CPCF PRTF piping modifications, NPDES discharge.

[b]CPCF "PRTF Full Modification": 9201-4 and 9201-5 piping to CPCF, carbon adsorption columns, 30,000-gal feed tank, carbon pH adjustment, cartridge filter, various CPCF PRTF piping modifications, NPDES discharge, 80,000-gal influent tanks, sulfide reactor, flocculent tank, flocculent pH adjustment, filter press.

5. SELECTED ALTERNATIVE

A water treatment alternative is recommended because water treatment would involve significantly less capital investment than permanent soil treatment alternatives, it is quicker to implement, and it has a greater probability of successfully meeting NPDES requirements. This selection will probably be maintained until the media in Upper EFPC OUs are remediated. Alternative 2 provides flexibility for treatment during atypical conditions and has a large advantage in being better able to accept wastewater streams from other ER activities. Alternative 1 has the potential to be less expensive in the short term, assuming that carbon without pretreatment will successfully remove mercury and that O&M costs are not excessive.

The following recommendations are made relative to selecting a treatment option:

- **Building 9201-2.** Convert the interim local unit presently being installed into a permanent system. Augment/modify the design as necessary to ensure its fitness to meet discharge criteria.
- **Building 9204-4.** Because of the extremely low flow from 9204-4, collect the effluent in a polytank for transport and treatment at another facility instead of piping it. This decision can be further validated after cost analyses are completed in a future value engineering study.
- **Buildings 9201-4 and 9201-5.** Implement a design optimization plan based upon operation of the 9201-2 local unit. This will allow determination of carbon adsorption effectiveness, the need for pretreatment (e.g., precipitation/flocculation), the degree of processing necessary if CPCF is selected (i.e., how much PRTF equipment must be used), O&M requirements for the local unit, and characteristics and disposal alternatives for spent carbon. These considerations could have a significant cost impact on the design chosen and thus need to be understood before a final design decision is made. The 3 to 6 months of design optimization have been built into the NPDES Mercury Treatment Plan schedule (Fig. 1) for reducing discharge to no more than 5 g/day by December 31, 1998. If CPCF is selected over local units, the schedule would also permit a design optimization period and still allow the NPDES requirement of having CPCF operational before January 1, 1998, to be met.

Primary recommendations, in addition to components of the selected alternative, include the following:

- Continue installation of 9201-2 local unit and operate for ~3 to 6 months, varying flow rate and mercury concentration under a design optimization plan.
- Use results obtained from the 9201-2 local unit design optimization plan to characterize process efficiency, considering flow rate, contaminant concentration, and operational requirements. Use these data to determine the best overall treatment design and minimize uncertainties.
- Use the $8900K water treatment option as the baseline for funding prioritization until results of the design optimization plan are reviewed and approved by Martin Marietta Energy Systems, Inc., and DOE.

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	IHgTF Testing	26.4w	6/15/94	12/15/94
2	Engineering Report	12w	12/16/94	3/9/95
5	AE Selection	10w	12/16/94	2/23/95
8	Design	42w	2/24/95	12/14/95
9	Title I&II	34w	2/24/95	10/19/95
13	CFC Pkg	40d	10/20/95	12/14/95
14	TDEC Rev & Approv Dsg	16w	12/15/95	4/4/96
15	Oper Readiness Review	20d	10/20/95	11/16/95
16	DB Review	2w	10/20/95	11/2/95
17	Construction	68w	12/15/95	4/3/97
22	Test and C/O Activities	30w	4/4/97	10/30/97
27	Operation	4w	10/31/97	11/27/97
28	TDEC Approve	4w	10/31/97	11/27/97
29	Begin Operation	0w	11/27/97	11/27/97
30	Post Operation Activities	12w	11/28/97	2/19/98

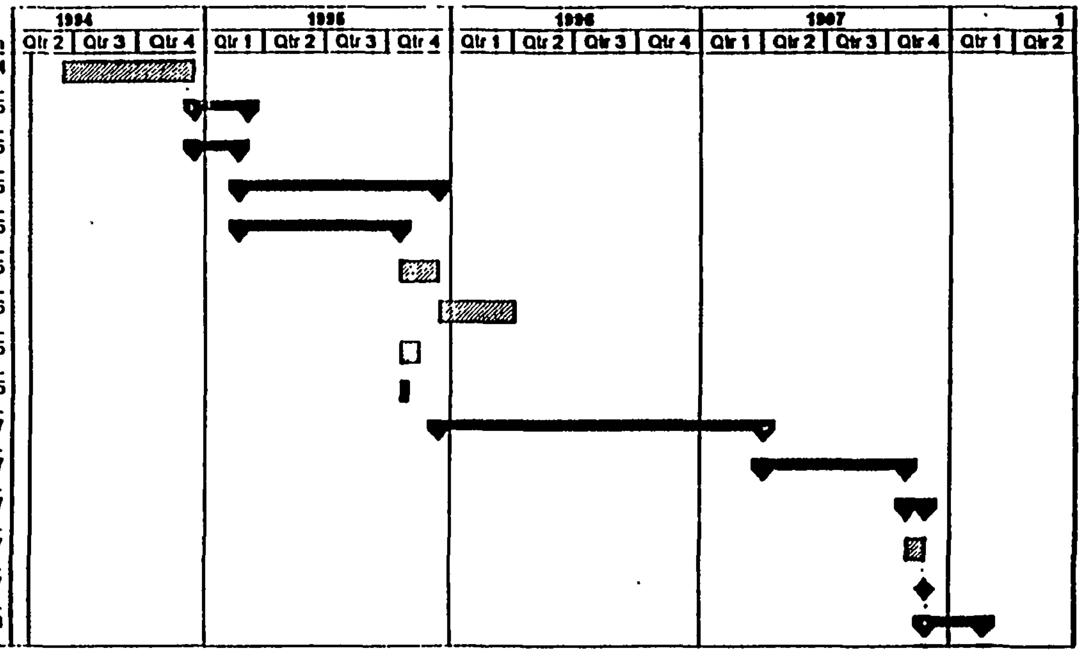

Fig. 1. NPDES Mercury Treatment Plan schedule.

- In consideration of technical, cost, and schedule uncertainties, defer hydraulic control and/or in situ soil treatment until implementation of the CERCLA process for the Y-12 Plant.
- Submit this focused FS document to TDEC and state Water Quality personnel to meet the July 1, 1994, NPDES Permit requirement for submittal of a development plan for a permanent treatment system.

Secondary recommendations include the following:

- Complete all source elimination (piping reroutes).
- Determine the groundwater level by using piezometers to identify groundwater, creek level, sump level interfaces. This recommendation is primarily applicable to 9201-2.
- Proceed with a value engineering study for selected alternative.
- Evaluate/correct surface water influx to buildings.
- Evaluate/implement raising sump pump levels.
- Evaluate the impact of 9201-2 basement flooding during high-flow conditions.
- Assess the effect that augmentation of the EFPC Flow Management Project would have on the groundwater level.
- Determine the need for or value of pH adjustment before treatment in carbon columns.
- Determine the characteristics of spent carbon. Is it Resource Conservation and Recovery Act waste?
- Compare the waste management costs for disposal of additional carbon to the cost for disposing of precipitation/flocculation sludge.