DRAFT

ROCKY FLATS SOLAR POND PROJECT

COMPARATIVE ANALYSIS OF COSTS OF SOLIDIFICATION/FIXATION OF SIMILAR SUPERFUND REGULATED IMPOUNDMENTS

Performed by ICF Kaiser Engineers

Under Contract to EG&G Rocky Flats

January 12, 1993

DRAFT

Table of Contents

DRAFT

1.0 INTRODUCTION AND BACKGROUND

ICF Kaiser Engineers (ICFKE) under contract to EG&G Rocky Flats, Inc. (EG&G) has been tasked to provide and independent evaluation of the Halliburton-NUS Cost Comparison Study which compares the costs to date on the Solar Pond Remediation Program (SPRP) with a similar "industry standard" remediation effort. Particularly ICF KE is to

- Assess the reasonableness of all analogous costs
- Compare and contrast operating environments and
- Develop any correlations between "industry standard" remediation and those efforts (current and future especially) which have and will be expended on the SPRP.

The SOW specified the following deliverables: No later than December 31, 1992 deliver a written report evaluating, commenting on, and as appropriate developing conclusions about the HNUS Cost Comparison Study and analogous Superfund impoundments. The report will be delivered to the Contract Technical Representative (CTR), and neither an interim draft nor an EG&G review is required before issuing the final report.

This report satisfies the subtask associated with coordinating a cooperative analysis and preparing a matrix for analogous Superfund impoundments. Since the Halliburton-NUS Cost Comparison study Report has yet to be submitted to EG&G, the ICFKE evaluation of that report is deferred and that task remains open.

2.0 SUMMARY AND CONCLUSIONS

In conducting a comparative cost analysis of sites or projects comparable to the SPRP, the ICFKE Team first reviewed the major databases such as the EPA Superfund Program ROD Summary Reports, Pollution Abstracts, NTIS, the Superfund Innovative Technology Evaluation (SITE) program and others. This review identified approximately 50 sites or projects involving the solidification or fixation of hazardous wastes that appeared to be comparative to the SPRP.

A more detailed review of the waste stream process and the complete scope of the remediation process (in particular the proposed disposal method) reduced the list of comparable sites/projects to four: two at DOE facilities and two Superfund sites. The major technical reasons for the elimination of most of the candidates included:

- Type of wastes - The only radioactive mixed wastes were at DOE sites and the waste forms at many of the other sites were primarily organic rather than inorganic.
- Disposal criteria - None of the sites had disposal criteria comparable to the NTS (NVO-325, Draft). Rather, the disposal criteria was as promulgated by EPA (RCRA or CERCLA) or the states.
- Media - Many of the candidate sites/projects were for solidification of soils rather than sludges treatment.

DRAFT

- Disposal - A large number of the candidate sites/projects involved either insitu stabilization/solidification followed by RCRA capping or on-site solidification/stabilization followed by bulk disposal in an on site landfill.

Additionally, several of the candidate sites were eliminated because, while the waste streams were comparable, the remediation selection process had not progressed beyond the feasibility study stage. As a consequence, solidification was only one of the process options being considered, the preferred disposal alternative was unselected and cost estimates were either not available or very preliminary.

The four sites/projects evaluated in detail are:

- 100N Solar Pond Remediation, Hanford Reservation,
- K-25 Sludge Ponds Fixation Project, Oak Ridge Reservation,
- Cimarron Superfund site, New Mexico, and
- Soliditech Stabilization Process, Imperial Oil Company/Champion Chemical Company Superfund Site, NJ.

The comparison of those sites to the regulatory, operational, and other factors that have major impact on the costs of the SPRP are presented in Table 1. Detailed discussion of each project/site are presented in Section 4.0

The basic conclusions from this cost comparison include:

1) There are no comparable sites or projects to the SPRP because none of the others used NTS disposal criteria as a basis for process design/operation.

2) All of the stabilization/solidification projects conducted thus far at DOE sites have been unsuccessful to date with respect to producing a stabilized waste that meets disposal criteria:

   - The Oak Ridge project created 42,000 drums of "cemented" sludges some of which are leaking or bulging.
   - The Hanford project created 7911 drums of stabilized sludges but some drums are bulging indicative of continuing chemical reactions and others are leaking indicative of matrix failure.

   This indicates that the waste stream and full range of chemical reactions associated with the process were not understood.

3) The costs for treatment/disposal of sludges at either Superfund or RCRA sites are significantly less than the costs of comparable projects at DOE sites because:

- Remedial actions at either Superfund or RCRA sites were not commenced unless and until the disposal option was selected, approved and confirmed. This eliminated any long term on site storage costs and double handling costs and also eliminated any reprocessing costs since the stabilized wastes were disposed in a landfill before either additional chemical reactions or matrix failure could occur.

- Remedial actions at Superfund sites generally can proceed with minimal constraints or impacts related to continuing facilities operations since most non-Federal Superfund sites are closed/abandoned business.

- Security at the most stringent Superfund site is still orders of magnitude less than that at DOE sites. Searches of oncoming/outgoing vehicles are minimal, badges are processed/issued faster and the only personnel screening is for health and safety. While some RCRA sites have more stringent security, it is still significantly less than found at DOE sites.

4) Costs for stabilization and disposal of waste sludges (and associated liquids at Superfund sites) ranges from $100/ton ($80/cu. yd.) to over $300/ton ($240/cu. yd.) of processed waste depending extensively on the volume of waste and the disposal option. This cost <u>does not</u> include the cost of the RI/FS and RD nor for any permitting and other regulatory interactions.

5) Cost for stabilization and disposal of sludges/sediments at DOE sites range from $__ /ton to $__/ton ($__/cu. yd. to $__/cu. yd.). One half of these costs are associated with on site storage, reprocessing and final disposal.

6) The costs for storage of stabilized wastes pending ultimate disposal varies widely based on varying regulatory or local operational requirements. At Oak Ridge, for example, the drums of stabilized wastes were stored in the open on a pad while the drums at Hanford are stored within a building.

7) Work factors associated with work within protected areas add significantly to the costs <u>if</u> uncleared staff are used. Coincidentally, the costs of getting/maintaining clearances for M & O or A/E-Constructor contract staff do not appear to be added to the project costs.

3.0 TECHNICAL APPROACH

ICFKE prepared a format for the data desired for each candidate site (Att. A) and then used that format as a screening device to identify candidate sites. Sites originally considered included:

- 183H Solar Pond Remediation, Hanford Reservation,

- K-25 Sludge Ponds Fixation Project (ORNL),

- Savannah River Plant (SRP) Seepage Basin Closure,

- Rocky Mountain Arsenal (RMA) Basin F,
- Weldon Springs,
- Other Superfund sites.

Searches were conducted of the following databases using key words such as solidification, fixation, stabilization, radioactive waste, inorganic sludges, etc.

- EPA Superfund ROD Summaries,
- Superfund Innovative Technology Evaluation (SITE) Program,
- Engineering Index,
- Pollution Abstracts,
- Enviroline,
- NTIS,
- Environmental Bibliography.

The search of the EPA Superfund database generated a list of 27 Superfund sites where the ROD specified some form of solidification. Details about the 27 sites are summarized in Appendix A. Review of those 27 sites resulted in the identification of several candidate Superfund sites including:

- Independent Nail, SC,
- NL Industries, NJ,
- Cimarron Mining Site, New Mexico.

Searches of the SITE database found fixation/solidification process that appeared to be comparable to the SPRP processing approach including:

- Hazcon Solidification Process
- Chemfix Technologies, Inc. Solidification/Stabilization Process,
- Soliditech, Inc. Solidification/Stabilization Process.

The remaining databases yielded 38 candidates publications but no comparable sites. (Appendix B)

The principle reason that so very few Superfund or SITE projects were found that were comparable to SPRP included:

- Radioactive Mixed Wastes - None of the Superfund or SITE projects involved radioactive mixed wastes.
- Organics - Many of the Superfund or SITE projects were for highly organic sludges that were not comparable to SPRP sludges.

- Media - Many of the Superfund or SITE projects were for contaminated soils rather than sludges thereby negating their comparability.

- Disposal - Numerous of the stabilization/solidification projects reviewed involved stabilization/solidification in place and/or on site disposal which is not considered comparable to the SPRP approach.

Of the previously identified DOE and DOD sites, three were eliminated:

- The SRP Seepage Basins were closed by removing (evaporating) the water and placing a cap over any residual sludge. It is not a comparable project.

- At Basin F on Rocky Mountain Arsenal, the liquid contents were incinerated but the sludges are the subject of an ongoing feasibility study for sludge treatment/disposal (of which solidification is one option.) No firm cost data is available.

- The Weldon Springs site does include waste ponds comparable to the solar ponds, but DOE is still in the process of determining the remediation approach (fixation vs. vitrification.) No firm cost data is available.

In analyzing the similarities and dissimilarities, ICF KE especially focused on technical and cost issues and prepared a matrix of all those inorganically contaminated impoundments which are similar to the SPRP. The matrix compares costs, operating environments, regulatory drivers, physical and site specific parameters and any other factors which warrant comparison. The matrix is "backed-up" by appropriate reference or developmental data. This matrix, presented in Table 1, provided the basis for determining which of the final sites were considered comparable to the SPRP.

The eight sites identified in the screening process were then investigated further though discussions with the EPA site managers, the sponsoring companies, A/E's and others. The results of those inquiries are presented in Section 4.0.

4.0 RESULTS OF COST COMPARISONS

Further review of the details of the eight projects selected for comparative cost analysis resulted in the elimination of four of the candidate sites:

- Independent Nail, SC - The waste forms were very comparable (heavy metal sludges) but the remedial action only consisted of solidification/stabilization of the contaminated sites and on-site disposal.

- Hazcon - While effective in immobilizing heavy metals, the process is better suited to waste streams high in organics, stabilized wastes have large volume increases (>100%), solidified blocks do not weather well.

- ChemFix - Stabilized waste forms had unacceptable failure rate of

DRAFT

TCLP (30%). Also multiple extraction procedures (MEP) analysis showed exceedance of EP toxitiy standards for heavy metals (lead) in first extract.

- NL Industries, NJ - The volume of liquids and sludges at the site are roughly comparable (1.5 million gallon) as are the waste characteristics. However, the remedial action adopted, transport the liquids off-site to a RCRA permitted treatment facility and transport the sludges (w/o fixation) to an off-site RCRA disposal facility, is not comparable to SPRP. Fixation and on-site disposal was proposed for about 10,000 cu. yd. of waste (slag, dust, etc.) in four piles on the site at a cost of about $164/cu.yd.

This left only four sites that were considered comparable:

- 183H Solar Ponds, Hanford Reservation,
- K-25 Sludge Ponds, Oak Ridge Reservation,
- Cimarron Mining Superfund Site, New Mexico, and
- Imperial Oil Superfund Site, New Jersey, (Soliditech Process).

Each site is synopsized at the end of this section and a summary of the essential factors for each is presented in Table 1.

The major differences in the costs per units of wastes between the DOE sites and non-DOE Superfund sites appears to be the fact that the remedial action at the non-DOE Superfund sites did not begin until and unless the waste disposal option was available. At DOE sites, because of the uncertainties related to the final disposal of radioactive wastes, either on or off-site, the end point of the DOE waste stabilization projects was on-site "temporary" storage that has, in all cases, stretched into years. This significant difference caused major cost growth in the DOE projects for:

1) Storage - i.e., additional structures, monitoring costs, reporting costs, permit regulations, etc.
2) Reprocessing - in every case the stored stabilized wastes have failed and will or are being reprocessed at a cost equal to or greater than the first stabilization effort and
3) Disposal - in the 5 - 7 years since these "stabilized" wastes have been in storage at DOE sites, the disposal costs have more than doubled.

Table 1
COMPARATIVE ANALYSIS OF ANALOGOUS SITES/PROJECTS TO SPRP

Evaluation Factors Project/Site	Waste Volume/Form	Hazardous Constituents	Regulatory Driver	Disposal Option (Plan)	Work Force	Site Constraints	Ambient Operating Conditions	Technology	COSTS • Total To Date • Engineering • On site storage • Disposal • Construction • $/unit measure-Stab. • O & M • $/unit measure-Storage • $/unit measure-Disposal
SPRP			RCRA	MTS					
183-H Ponds Hanford	250,000 Gal-liquids 220,000 Gal-Sludge (15,519 drums of waste)	Heavy Metals Uranium Nitrites Chromium	RCRA	On site Landfill or NTS	M & O Staff	Q or L Required Existing Utilities Used	Warm Weather Impacted by Summer Heat (early work shift)	Solidification of liquid with Sorbond LFC-II Diatomaceous earth added to sludges	• $ 31.3M • $ 2.1M/yr. • $ 924k • $34.9M • $ 1.6M • $37/Gal-Stab. • $ 25.6M • $ 2.50/Gal-Storage • $41/Gal-Disposal
K-25 Ponds Oak Ridge									
Cimarron Superfund Site	570 cu. yds. sediment and sludges (700 cu. yds. of stab. waste)	heavy metals	CERCLA	On-site landfill or RCRA TSDF	Contract (non-Union)	None	Warm weather	Fixation using Portland cement Bulk disposal	Off site Disposal Option • $220k • No cost • $ 65k • $114k • $ 41k • $ 72/cu. yd. - stab. • $ 10k • $200/cu.yd. - disposal
Imperial Superfund Site	3800 cu. yds. contaminated soils, waste filter, cake & oily sludge (5700 cu. yds. of stab. waste)	Organics, heavy metals	CERCLA	On-site	Union ?	None	Above freezing ambient temperature	Pozzolan fixation cast in 1 cu. yd. monoliths	• • No cost • $ 35k • $ 11.4M • $132k • $ 152/cu.yd. - stab. • $453k • $2000/cu.yd. - disposal

Additionally, the absence of radioactive contaminates (and the associated spectra of nuclear weapons) facilitated the selections, acceptance and implementation of a remedial action by both the public and the regulators. Another major difference is in the site access and constraints. Most private Superfund sites are closed or abandoned facilities so while there may be space constraints there are no constraints associated with working around ongoing operations such as at Rocky Flats. Planning for a remedial action in the midst of an operating DOE facility requires review and approval by the facility operators, health and safety, etc. to assure that the process train, work areas, access ways, storage areas, etc. are situated and operated in such a way so as not to impede site evacuation or emergency response. Such considerations are much less complex for Superfund sites and the associated cost of coordination and approval of the remedial actions operating plan is consequently less.

Of the four sites, the two DOE sites are the most comparable yet still have some significant differences. For instance, the first round of fixation at both Hanford and Oak Ridge, as well as Rocky Flats, involved the design construction and operation of full-scale permanent fixation plants. While the current plans for reprocessing and necessary for ultimate disposal are for permanent installation at Hanford (the WRAP facility) and temporary installations at both Oak Ridge and Rocky Flats. Similarly, the security requirements are different between the three sets with the Rocky Flats SPRP being the most stringent. While the project at both Oak Ridge and Hanford were in controlled areas, Q's were not required for site access.

4.1 SYNPOSIS OF HANFORD/183-H SOLAR PONDS PROJECT

Site/ Project Name:

Hanford/183-H Solar Evaporation Basins Closure

Location (city/ State):

The Hanford Site for the Department of Energy-Richland Operations Office (DOE-RL), Richland, Washington.

Dates of Operations:

1949-1965, these basins were used as part of the filter plant providing reactor process water for the 105-H Reactor.

1965-1973 the basins were not used after the Reactor was shut down.

1973-1985, these 4 basins were redesignated for use as solar evaporation basins for liquid chemical waste from the 300 Area (N Reactor) fuel fabrication facilities.

November 1985, Part B Permit Application was filed which initiated the "interim status" closure process.

DRAFT

As part of the closure a new liner was installed in basin 2 in 1986, and a new liner in basin 3 was installed in 1987.

All sludge was removed during the period of 1985 to 1988.

All liquid was removed and solidified between 6/89 and 11/89.

Crystallized salts remaining on the bottom of basins 2 & 3 were removed during the period 3/90 to 12/90.

Initial attempts to decontaminate the basins showed that at least 3/8 inch of concrete would have to be removed from the contaminated surfaces. This effort was halted pending RCRA/CERCLA closure considerations.(1)

Negotiations are in progress between the U.S.Department of Energy, Richland Field Office, the U.S. Environmental Protection Agency, Region X, and the Washington State Department of Ecology.

Closure of the basins has not been completed pending negotiations on whether to close as a clean closure, a landfill closure or a Hybrid closure.

Volumes of Waste (liquid - gal. & solids - cu. yds. or tons):

At the start of remediation the contents of the basins consisted of 250,000 gallons of liquid and 220,000 gallons of sludge.

- The contents were separated into 5 waste streams:(2)

- Liquid Waste generated 2,728 drums of solidified waste.

- Sludge Waste is contained in 7911 drums.

  7646 ft^3 sludge removed in 1985 from basin 1, 8955 ft^3 from basin 2 in 1986; 1300 ft^3 sludge from basin 3 in 1987 and 6259 ft^3 of sludge from basin 4 in 1988.

- Crystallized Salt Waste is contained in 2516 drums.(3)

- Sandblast Grit Waste generated 1980 drums.

- Solid Waste (misc) is contained in 384 drums.

- Also contributing was the cleanup of two associated trenches. Trench T05 cleanup generated 3297 drums and trench T24 183-H generated 3128 drums.

Hazardous Constituents (look for high salt and nitrates):

The routine waste stream consisted of spent acid etch solutions (primarily nitric, sulfuric, hydrofluoric, and chromic acid) generated by the nuclear fuel fabrication process. Typically these acidic solutions were reacted (neutralized) with excess sodium hydroxide before being transported to the 183-H Basins. Metal constituents in the waste included copper, silicon, zirconium, aluminum, chromium, manganese, nickel, and uranium. Following reaction with sodium hydroxide, these metals were present primarily in the form of precipitates and discharged into the 183-H Basins.

On several occasions, nonroutine wastes (both listed and nonlisted) were discharged to the basin. The nonroutine wastes consisted of unused chemicals and spent solutions from miscellaneous processes, development tests, and laboratories.

Chemical analysis of the wastes showed the major constituents of the solids phase to be sodium, copper, water of hydration, fluoride, nitrate, and sulphate ions.

Surface Area of Impoundments (acres):

The Basins cover an area 140 ft. X 230 ft. The proposed cover for a hybrid closure, which is still being designed is 140 ft. x 230 ft. X 7 ft. deep with edges having a 3H:1V slope. However, the current plan is to remove all mixed waste and close as a contaminated landfill (i.e.no cover).

Description of treatment Technology, (process train and process criteria; major pieces of equipment):

The liquid waste was solidified into a solid, freestanding monolithic form inside polyethylene-lined U.S. Department of Transportation Specification 17-H steel drums. The drums were then transported to the 200 West Area Central Waste Complex, Retrievable Waste Storage facility.

The solidification agent for the liquids removal was Sorbond LPC-II (Sorbond LPC-II is a trademark of American Colloid Company.). Selection of this material was the result of an 11-month test and evaluation effort in which 13 different solidification agents were investigated. Samples of each material were obtained and tested in the laboratory using a 40 percent sodium nitrate saturated solution. Various ratios of material to liquid were determined, and a full-scale field test of three candidate materials was conducted within the confines of basin 3.

The use of Sorbond LPC-II material provided a high-packaging efficiency with less than a 30 percent volumetric increase. the initial Sorbond test resulted in solidifying 36 gal of liquid waste in a 55-gal drum by adding 261.4 lb. of Sorbond LPC-II. This mixing proportion resulted in a liquid content per drum of 40 gal, with a corresponding increase of solidifying agent to 290.4 lb. This proportion resulted in approximately 2 to 3 in. of freeboard in each drum. Once mixed in the solution, the initial gel occurred quickly (less than 1 hour after the mixing action was terminated). Continued mixing extended the setup time, with full cure requiring 3 days. After full cure the free space in each drum was filled with an absorbent material to absorb any condensation that might accumulate after bolting the lid in place.

To expedite the liquid solidification process, equipment was procured for mixing quantities of 320 gal of liquid in each batch (eight drums per batch). All equipment used for the liquid solidification process was installed within the confines of the 183-H Basins.

The mixing equipment consisted of a paddle-type batch mixer with a maximum capacity of 62.5 ft^3 (467 gal). A holding tank fitted with an overflow device to premeasure each batch of 320 gal was located above the batch mixer to permit gravity-feeding into the mixer for each batch. The Sorbond LPC-II material quantity of 2,323 lb was obtained in bulk Bags, each containing approximately 2,300 lb; the exact weight was stenciled on each bag. Each batch was charged with the contents of one bulk bag and topped off to produce exactly 2,323 lb. The makeup quantity was less than 50 lb for each batch. The exact weight of each bulk bag and the makeup quantity was recorded for each batch to control the mixing proportions. After mixing each batch (320 gal of liquid and 2,323 lb of Sorbond LPC-II), the mixed solution was drained from the mixer through a bottom discharge valve into polyethylene-lined 55-gal drums. Each drum was filled within 2 in. of the top then moved aside on individual dollies to permit continued filling of drums. One mixer batch filled eight drums, which were then stored on the opposite side of the basin until fully cured.

After a three-day cure period, each drum was hoisted out of the basin onto a lay down area immediately north of the basin on the other side of the chain link fence. The drums were radiologically surveyed to ensure they were clean and then relocated to a temporary storage area on the east side of the 183-H Basins.

The drummed waste from the 183-H Basins was removed from the temporary storage area within 90 days in order to comply with applicable regulations. The waste drums were shipped within the Hanford Site to the 200 West Area Central Waste Complex (CWC), Retrievable Waste Storage Facility, a distance of 17 miles, where the waste will be stored until it can be processed by the Waste Receiving and Processing facility (WRAP).[4,5]

The method of sludge removal consisted of manually shoveling and/or scooping the sludge with a 5-gal bucket. The sludge was placed into a 90-mil polyethylene 55 gal drum liner inside a U.S. Department of Transportation 17-H 55-gal drum. A 10-mil polyethylene bag was placed inside the drum liner. The exterior of the drum was protected by encasing the drum in a 10-mil polyethylene bag and taping the top to the drum top. The 10-mil bag inside the drum liner was folded over the top of the drum thus protecting all surfaces.

Approximately 1 ft^3 of diatomaceous was placed in the bottom of the liner. After 4.5 ft^3 of sludge was placed in the lined drum, the sludge was covered with 1.5 ft^3 of mixed diatomaceous earth adsorbents to ensure absorption of all free liquid. The 10-mil polyethylene bag was then closed, taped, and tucked inside and a 90-mil liner cover was installed over the liner and bolted tight. The drum was hoisted out of the basin where the outer 10-mil bag was removed and placed in a separate waste drum. The drum cover was the placed on the drum and the drums were palletized and placed in temporary storage to be sent to the central Waste Complex for storage awaiting the WRAP facility to come on line.

A simpler packaging method was later used consisting of a painted 17-H, 55-gal drum lined with two 10-mil polyethylene bags.

Design/Actual production Rates (Tons per hour):

The liquid waste was solidified in batches of 320 gallons of liquid mixed with 2323 lbs of solidification material. One batch resulted in 8 drums each containing 40 gallons of liquid and 10.85 gallons (1.45 ft^3) of solidicant.(1) The liquid solidification required 2728 drums and required 5 months of operation(6), that equates to 2728 X 40 gal/drum / 320 gal/batch = 341 batches. Assuming single shift operation this is roughly 2 batches per day.

Processing Schedule or Project Schedule (time started to time completed):

The closure started in 1985 and is still in process.

In 1985, the liquid waste was pumped out of basin 1 and 7646 ft^3 of sludge was removed.
In 1986 liquid was pumped out of basin 2 and 8955 ft^3 of sludge was removed and basin 2 was lined.

In 1987 liquid was pumped out of basin 3 and 1300 ft^3 of sludge was removed.

In 1988 liquid was pumped out of basin 4 and 6259 ft^3 of sludge was removed.

Liquid solidification was started in June 1989 and was completed in November 1989.

Crystallized salts were removed from basin 3 between 3/90 and 6/90 and from basin 2 between 5/90 and 12/90.

Site constraints (Access, escorts, space, difficulties of working conditions, security, utilities, self provided or use of site utilities):

All of the personnel used on this effort required Q or L clearances. No escorts were required. All of the basin cleanup personnel wore level B protective clothing (Two layers of whites, hoods, respirator and rubber hip boots.). This required operation to shift to an early work shift to avoid the summer heat. All utilities were available at the site.

Union/Non-Union

All of the clean-up technicians, operators and craft were WHC union forces.

Disposal

The drums of waste are stored at the Hanford, 200 West Area, Central Waste Complex, Retrievable Waste Storage facility. The drums will be held in storage until they can be processed through the WRAP Module 2 facility where they can be reprocessed if required to meet the acceptance criteria for offsite or possible onsite permanent disposal.

WRAP Module 2 has the primary function of treatment and certification of retrieved suspect TRU and newly generated TRU in boxes and "other" containers, retrieved and newly generated RH TRU, retrieved and newly generated low level hazardous and radioactive mixed waste (RMW), secondary solids from Hanford Liquid Effluent Treatment facilities (LETFs), and the decontamination of equipment items and shipping casks for beneficial reuse. Module 2 will provide handling, treatment, and repackaging for retrieved and newly generated contact handled (CH) and remote handled (RH) waste in containers other than 55 gallon drums, and certification and shipping for RH waste. All Module 2 CH waste will be repackaged into 55 gallon drums and transferred to Module 1 for LLW/TRU determination, certification, and shipping. All RH waste will be certified and shipped to disposal directly from Module 2.

Regulatory Driver

RCRA, WAC (Washington Administrative Code Dangerous Waste Regulations), CERCLA.

Delays

Those resulting from negotiations with regulatory agencies.

Ambient operating conditions(designed for year round conditions or part time)

Operations were primarily during summer months.

Description of project

The 183-H Solar Evaporation Basins compose the first hazardous waste site that is going through cleanup at the Hanford site. The project is now in the final stages of closure. The object for this project was: 1) to efficiently and safely bring the existing facility into compliance with Resource Conservation and Recovery Act (RCRA) regulations and 2) to initiate the closure of the basins in accordance with the RCRA.

Costs

The total project cost to date is $31.3 million. The cost to complete is budgeted for $7 million and is to be completed this fiscal year. (This is based on removal of all mixed waste and closing as a land fill with no long term monitoring.)

Waste Disposal = $12,817,600
Engineering = $924,200
Material & Services = $1,494,600
Construction(Capital Equipment) = $400,000
Construction Forces = $440,000
D & D Operations = $12,817,600
Ground Water Monitoring = $3,507,000

See the attached spread sheet for year to year "expense fund" cost breakdown. These costs are the totals which will be billed to the "Project". There will be additional costs for the storage and monitoring at the CWC (presently $133.34 per drum per year)[7] and the cost to process the waste through the WRAP facility (estimated to cost $2100 per drum based on max flow). Final burial costs (Aproximately $150 per drum for mixed waste)[8] must also be considered. There is a strong possibility that all of the wastes will be buried at Hanford.

REFERENCES:

(1) WHC-SA 0705-S, RCRA Closure Experience with Radioactive Mixed Waste 183 H Solar Evaporation Basins at the Hanford Site, paper presented at Waste Management '90, Tucson, Arizona, 3/1/90.

(2) TRAC-0347-VA, 183-H Solar Evaporation Basins Solidified Aqueous Waste Bulging drum Presentation, 12/92.

(3) Central Waste Complex inventory sheet totals 15,525 drums from 183-H Basins cleanup.

(4) SD-WO26-FDC-001, Waste Receiving and Processing (WRAP) Module 1.

155

(5) SD-W100-FDC-001, Waste Receiving and Processing (WRAP) Module 2.

(6) 183-H Project Summary Report for Basin #3.

(7) Costs provided by D. R Pyzel, Assistant Manager, Central Waste Storage, 1-4-93.

(8) Cost estimate provided by W. A. Holstein, KEH Project Manager WRAP.

4.2 SYNOPSIS OF K-25 POND STABILIZATION PROJECT - OAK RIDGE

4.3 SYNOPSIS OF THE CIMARRON MINING SUPERFUND SITE

Site/Project Name: Cimarron Mining (Operable Unit 02, Sierra Blanca Mill location).

Location (City/State): Carrizozo, Lincoln County, New Mexico

Dates of Operations: The Sierra Blanca facility is an inactive mill originally owned by Scott-Tex Inc. The mill temporarily shut down in the early 1970's. The town of Carrizozo eventually became owner of the site.

A 1975 U.S. Soil Conservation Service aerial photograph (USDA SCS,1983) shows that the site included only a single building and a few materials piles.

In 1979 the site was leased under the name "American Minerals Recovery Corporation". The facility operators were attempting to recover silver from various ore materials.

On 11/18/80 a New Mexico Environment Department (NMED) site inspection report stated that "this operation extracts whatever there is a market for - one week gold, the next silver, platinum and so on".

Between 1980 and 1984, discharge pits, process tanks, and more materials piles were added.

Volume of Wastes (liquids - gals. & solids - cu. yds. or tons): Wastes at the site consists of approximately 43 cubic yards of tank sediment, 182 cubic yards of material pile soil and rock, 345 cubic yards of discharge pit sediment.

Hazardous Constituents: The primary contaminants of concern affecting the soil, sediment, debris, and sludge are arsenic and lead. Other elements present at the site are barium, beryllium, copper, manganese, mercury, silver, sodium and zinc.

Surface Area of Impoundments (acres): 7.5 acres.

Description of Treatment Technology, (process train and process criteria; major pieces of equipment): The selected remedial action for the site includes excavating and treating on-site 225 cubic yards of contaminated material piles and tank sediment, including cinder block trench sediment which failed the TCLP test, using cement solidification and stabilization; excavating and disposing of 345 cubic yards of contaminated surficial soil and sludge that did not fail the TCLP test in an on-site discharge pit along with the solidified/stabilized waste; capping the discharge pit with an impermeable cover. (For comparison purposes, off site disposal has also been described under the project design and cost section.)

Treatment would be accomplished by a fixation process using Portland cement to stabilize the waste material.

Implementation would consist of leasing a standard portable cement mixer and setting it up on the site. The Portland cement type would be determined based on bench scale tests.

The contaminated material piles would be excavated and discharged into the cement mixer, where the material would be mixed with Portland cement, water, and any supplemental sand or aggregate required. The resulting concrete mixture would then be transported to the discharge pit and deposited.

Non-leachable contaminated discharge pits would be excavated and disposed directly without treatment.

An impermeable cover will be incorporated to restrict the infiltration of precipitation.

The discharge pit would then be covered with clean soils.

Two additional monitoring wells will also be installed as an extra precautionary measure to ensure protection of the ground water.

Design/Actual production Rates (tons per hour):

Processing Schedule or Project Schedule (time started to time completed):

Site Constraints (Access, escorts; Space, difficulties of working conditions; Security; Utilities, self provided or use of site utilities):

Union/Non-Union:

Disposal (Form of disposal i.e. boxes, drums, etc. and where - On/Site or Off/site): The waste would be treated with a Portland cement to solidify the leachable waste and disposal would be on-site. Disposal off-site has been listed also for comparison purposes.

Regulatory Driver (RCRA,CERCLA, Etc.): RCRA, CERCLA.

Delays (weather, labor, unusual delays):

Ambient operating conditions (designed for year round conditions or part time):

Description of Project (attach project summary): The selected remedial action for the site includes excavating and treating on-site 225 cubic yards of contaminated material piles and tank sediment, including cinder block trench sediment which failed the TCLP test, using cement solidification and stabilization; excavating and disposing of 345 cubic yards of contaminated surficial soil and sludge that did not fail the TCLP test in an on-site discharge pit along with the solidified/stabilized waste; capping the discharge pit with an impermeable cover.

Costs: Total $ and $/Ton or cu. yd. (Solids) or $/Gal (Liquids) Total costs for the project are estimated at $79,000 +50% or -30%. Actual costs cannot be determined until the project has been completed.

- Engineering (All costs associated with selection of preferred alt. and preparation of plans and specs.): Approximately $23,000

- Construction (Procurement/Setup/Shake Down of Projects Train): approximately $41,000.

- Operation and Maintenance: Approximately $10,000 to monitor the site after disposal.

- Feasibility Study costs (if available):

Description of Project (attach project summary): Treatment would be accomplished by a fixation process using Portland cement to stabilize the waste material. Implementation would consist of leasing a standard portable cement mixer and setting it up on the site. The Portland cement type would be determined based on bench scale tests. The contaminated material piles would be excavated and discharged into the cement mixer, where the material would be mixed with Portland cement, water, and any supplemental sand or aggregate required.

The resulting concrete mixture would be transported together with non-leachable wastes to a suitable off-site RCRA Subtitle D-compliant landfill for final disposal. One qualified off-site landfill which appears willing to accept the wastes is located 160 miles from the sierra Blanca site near Albuquerque. Transportation of the wastes would be accomplished in standard public highway approved bulk carrier trucks, of approximately 40,0000 pound capacity. After disposal of the wastes in the landfill, management of the wastes would become the responsibility of the landfill operator. For this reason, the operator has stated that the landfill would accept the wastes only if approved by the EPA and the state of New Mexico, and only if the wastes are certified as non-hazardous as per RCRA.

Costs: Total $ and $/Ton or cu. yd. (Solids) or $/Gal (Liquids). Total costs for the project are estimated at $220,000 +50% or -30%. Actual costs cannot be determined until the project has been completed.

- Engineering (All costs associated with selection of preferred alt. and preparation of plans and specs.): Approximately $65,000

- Construction (Procurement/Setup/Shake Down of Projects Train): Approximately $155,000

- Operation and Maintenance: This would be the responsibility of the municipal landfill accepting the waste.

- Feasibility Study costs (if available):

4.4 SYNOPSIS OF THE SOLIDITECH, INC. DEMONSTRATION: IMPERIAL OIL/CHAMPION CHEMICALS

Site/Project Name:

Superfund Innovative Technology Evaluation (SITE) Demonstration Program
Imperial Oil Company/Champion Chemical Company Superfund Site (IOC/CCC)

Location (City/State):

Morganville section of Marlboro Township, Monmouth County,New Jersey

Dates of Operations:

The Imperial Oil Company, Inc./Champion Chemical Company facility and associated land has been the site of numerous business operations since the original buildings were constructed in 1912. The first company to occupy the site produced tomato ketchup and tomato paste. The plant changed operations and possibly ownership around 1917. The Stratford Chemical Company took over the site and began producing arsenate and arsenic acid on-site. In the 1930's the Stratford Chemical Company changed its name to Brocker Chemical Company. The property was purchased by S. B. Penick and Company in 1945 from the bankrupt Brocker Chemical Company. S. B. Penick and Company produced flavors and essences until 1941.

The Champion Chemical Company purchased the property in 1950. The existing facilities were modified to support their oil reclamation operations. At this time, Eagle Asphalt Company was also utilizing the property. The process of oil reclamation involved washing the used oil with caustic material in vertical process tanks to remove the sludge and impurities. The washed oil was distilled to remove the heavy oil and then passed through a clarification process. This process involved mixing the oil with filter clay (diatomaceous earth) in large holding tanks. The filter clay was allowed to settle to the bottom and the oil was skimmed off the top. The filter clay was used to remove the heavy metals (tetraethyl lead, zinc, iron, etc.) present in the waste oil. The purified oil was passed through a filter press to remove any remaining earth.

The waste products of the reclamation process included wash water, waste oils and sludges and oily filter clay. Reportedly, the waste filter clay was piled near a settling tank for temporary storage. Wash water was discharged into a lagoon for settling. Excess oil floating to the top was recovered.

Imperial Oil Company, Inc. has leased the facility since 1969. The company conducts an oil blending operation which involves the mixing and repackaging of unused oil for delivery. Raw product (refined clean oils is delivered by truck and transferred to above ground storage tanks. Sludge material was removed from the oil/water separators and deposited near the filter clay pile.

The New Jersey Department of Environmental Protection(NJDEP), U.S. Environmental Protection Agency (EPA), Princeton Aqua Science (PAS), Fred C. Hart and Associates and the Monmouth County Health Department have conducted investigations at the site. Analyses of soil and filter cake waste pile samples revealed petroleum hydrocarbons, lead, barium, arsenic and polychlorinated biphenyls (PCBs) (aroclors). Off-site sediment samples also contained concentrations of lead, arsenic, PCB's and petroleum hydrocarbons. An EPA Record of Decision (ROD) was signed in September 1990.

In December 1988, the EPA initiated a SITE demonstration at the IOC/CCC site (the ROD indicates the demonstration took place in September 1987). A solidification/stabilization process, developed by Soliditech, Inc., was demonstrated sand, a combination of oily sludge and waste filter cake, and contaminated soil from off-site locations (downgradient wetland). An Applications Analysis Report (AAR) for the demonstration was published in September 1990.

Volume of Wastes (liquids - gals. & solids - cu. yds. or tons):

Approximately 3,700 cubic yards of contaminated soil was found in the off-site wetland location. The waste filter cake pile has an estimated volume of 1,000 to over 3,600 cubic feet (CAROL: CONVERT TO CUBIC YARDS). No estimate of the volume of oily sludge was presented in the ROD.

The Soliditech Inc. demonstration involved the use of a total of 9 cubic yards of contaminated soil and the combined oily sludge and waste filter cake.

Hazardous Constituents (look for high salt and nitrates):

The following contaminants of concern:

Volatile Organic Contaminants:

- benzene
- ethylbenzene
- toluene
- xylenes (o-, m-, p-)

Semi-Volatile Organic Contaminants:

- bis(2-ethylhexyl)phthalate
- butyl benzyl phthalate
- chrysene
- di-n-butyl phthalate
- fluoranthene
- phenanthrene
- 2-methylnaphthalene
- pyrene

Polychlorinated Biphenyls (PCBs):

- aroclors

Inorganic Contaminants:

- antimony
- arsenic
- beryllium
- chromium
- copper
- lead
- silver
- zinc

Surface Area of Impoundments (acres):

Wash water from Champion Chemical Company operations were deposited in a lagoon on-site. Lagoon dimensions were not given in the ROD. The Soliditech AAR does not indicate the use of lagoon materials during the demonstration.

Description of Treatment Technology, (process train and process criteria; major pieces of equipment):

Principal Treatment Operations:

The Soliditech, Inc. process blends waste material with pozzolanic material (such as fly ash), kiln dust, or cement; water; proprietary additives; and Urrichem, a proprietary reagent. A batch process was used to treat waste material. The operating capacity was governed by the size of the mixer, the amount of time required to load and discharge the mixer and the amount of mixing time required for the waste material and the reagents and additives. The two mixers used during the SITE demonstration had nominal capacities of 2 and 10 cubic yards. Materials were added while the mixer is operating to ensure thoroughly blended. Once all the materials were added to the mixer, they are thoroughly blended. The mixer worked by both circular rotation of the blades and end-to-end tilting. The mixing process continued until the operator or chemist determines that the materials were thoroughly homogenized (between 15 to 60 minutes per batch).

After treatment, the waste material was discharged to prevent hardening inside the mixer. The material was placed in forms for transport.

After treatment and discharge, any residual materials left in the mixer were blended with the next batch of waste to be treated. Alternately, the mixer could be decontaminated with a high-pressure steam cleaner. Wastewater and solid residual material from decontamination procedures could be used in treating the next batch of waste or can be collected and stored for treatment or disposal.

For every cubic yard of waste material processed during the demonstration, the following materials were used:

- 1,000 pounds cement
- 20 pounds Urrichem
- 30 pounds chemical additives

Water was used during processing and for decontamination at a rate of 5,000 gallons per day.

Capital and Auxiliary Equipment:

Capital equipment needs include the Soliditech mixer, storage bins of tanks for pozzolan, pumps for the liquid and associated piping and controls.

Auxiliary equipment items were divided into two categories, rental and purchased. Rental equipment included a site trailer, earth moving equipment (backhoe and loader), dump truck, fork lift, tank truck and truck scale. Purchased equipment included a dumpster, sludge pumps, plastic sheeting, 55 gallon drums, and personnel protective equipment.

Pre-Treatment Processing:

The pre-treatment requirements of the process were minimal. Waste materials to be treated could contain no solids larger than approximately 1 foot in diameter. Larger particles could clog the discharge port of the mixer. Due to sampling constraints during the SITE demonstration, all solid wastes were screened through a steel screen with 4 inch by 4 inch square openings to remove large objects.

Waste materials containing more than 30 percent oil or water required pre-treatment to reduce the amount of free liquid. For the demonstration, the pre-treatment consisted of blending the waste oily sludge with contaminated filter cake to increase the solids content. This method allowed both the oily sludge and the contaminated filter cake to be treated together and conserved time and additives. Clean solids, contaminated solids or other additives could be used for this pre-treatment.

Waste materials with low moisture content were not considered to require special pre-treatment as water is normally added during the process.

If the waste material has a pH of greater than 12 or less than 2, neutralization is required prior to treatment. Ambient temperatures above freezing are normally required during the treatment process and the first 24 to 48 hours.

Residuals Handling:

Residuals from the Soliditech process included treated waste material; wash water and residuals from cleaning and decontamination of the mixer; any spilled treated or untreated waste material; any treated or untreated waste material used for on-site testing; any protective clothing, covering or lining material; and any personnel decontamination water.

Solidified waste material could be transferred directly to its ultimate on- or off-site storage location or it can be placed in drums, forms or other containers for temporary storage. Residual solids and liquids from treatment and decontamination could be treated immediately with the next batch of waste, drummed for later treatment, or drummed for off-site treatment or disposal. Contaminated clothing and other materials can be drummed for off-site disposal.

Effectiveness of Solidification/Stabilization Process:

Three distinct waste types were treated during the Soliditech demonstration - soil, used filter cake and filter cake/oily sludge mixture. These three wastes were sampled for chemical and leaching/extraction testing prior to treatment and again after a 28-day curing period following treatment. In addition, the reagent, additives, cement and water were mixed and sampled to check for possible chemical analyte contributions. Tests conducted on samples generated during the demonstration included the TCLP, EP Toxicity, ANS 16.1, BET, and WILT analytical procedures.

Structural Stability of Treated Waste Material:

The solidified waste from the demonstration was tested for unconfined compressive strength (UCS), wet/dry durability, freeze/thaw durability, bulk density, water content, loss on ignition and permeability. The morphology of the solidified materials were also examined both in the field and in the laboratory.

Placement of Treated Wastes:

After the treatment process, the treated wastes were allowed to cure at the site for the prescribed 28-day curing period. The chemical and physical nature of the treated material was not anticipated to change significantly past the curing period.

Samples of the solidified soil were allowed to cure on-site in a heated warehouse. The post-treatment solidified samples were used to determine the physical, chemical and leaching characteristics of the stabilized wastes.

The remainder of the treated waste was placed in 1 cubic yard plywood forms. The treated waste in the forms was allowed to cure for 28 days before the forms were uncrated and prepared for long-term storage. The treated waste monoliths were placed in a closely formed stack that was wrapped in 40-mil thick high-density polyehtylene (HDPE) film for protection. Periodically the monoliths were to be unwrapped and examined as part of the long-term monitoring.

Design/Actual production Rates (tons per hour):

A production rate of 10 cubic yards (1 cubic yard = 1 ton) per hour is estimated.

Processing Schedule or Project Schedule (time started to time completed):

The Soliditech SITE demonstration was conducted during the week of December 5, 1988. Soliditech estimates a the treatment process for 5,000 cubic yards of contaminated materials would require 13 weeks.

Site Constraints (Access, escorts; Space, difficulties of working conditions; Security; Utilities, self provided or use of site utilities):

Access:

Site access requirements for the Soliditech process are minimal. The site must be accessible to standard size and weight tractor trailer trucks. The roadbed must also be able to support the vehicles.

Escorts:

No information regarding escorts was provided in the Soliditech report.

Space:

The Soliditech process could be applied to small or large amounts of solids or sludge. The mixer is mounted on a trailer that is readily transported. A 30 by 100 foot area is required for the mixer and associated equipment.

Difficulties:

Because of lack of traction in the equipment mobilization area, Soliditech personnel were not able to erect the pozzolan storage hopper in the normal manner. A large tow truck with an extendable boom was required to help lift the hopper into position.

Security:

After hours security was employed by Soliditech.

Utilities:

Water for processing and decontamination was assumed by Solititech to cost $5 per thousand gallons. This included the service fees associated with connect/disconnect or water transfer activities at a cost of $125 per week. Fuel costs (at $0.90/gal, 15 gal/hr) came to a cost of $540 per week. Telephone costs were considered negligible.

A source of 30 amp, 120 volt electricity is required to power the blower used to transfer the cement or pozzolanic material from the storage hopper to the mixer. This same service is adequate to power the field-testing equipment and a portable steam cleaner. Costs of electricity were considered negligible by Soliditech.

Union/Non-Union:

Information concerning union or non-union labor agreements was not included in the Soliditech ARR.

Disposal (Form of disposal i.e. boxes, drums, etc. and where - On/Site or Off/site):

The treated waste monoliths were placed in a closely formed stack that was wrapped in 40 mil thick high-density polyethylene film for protection.

Regulatory Driver (RCRA,CERCLA, Etc.):

CERCLA, RCRA, TSCA, Clean Air Act, State of New Jersey primary and secondary ambient air quality requirements.

Delays (weather, labor, unusual delays):

A slight delay in the delivery of earthmoving equipment and thus the collection of waster material was experienced during treatment operations.

Ambient operating conditions (designed for year round conditions or part time):

Ambient temperatures above freezing are normally required during the treatment process and the first 24 to 48 hours.

Description of Project (attach project summary):

The Soliditech process mixes and chemically treats waste material with Urrichem (a proprietary reagent), additives, pozzolanic materials or cement and water in a 10 cubic yard concrete mixer to form a more stable material.

The Soliditech demonstration too place in December 1988 at the Imperial Oil Company/Champion Chemical Company Superfund sire in Morganville, New Jersey. Three types of contaminated waste material were chosen for the demonstration - contaminated soil, waster filter cake material and oily sludge. The wastes contained PCBs, various metals and petroleum hydrocarbons. Extensive sampling and analyses were performed on the waste materials both before and after treatment so that physical, chemical and leaching properties could be compared.

The Soliditech process was evaluated based on contaminant mobility, measured leaching and permeability tests; structural integrity of the solidified material, measured by physical, engineering and morphological tests; and economic analysis.

The conclusions drawn from these evaluations are that: (1) the Soliditech process can solidify waste materials containing high oil and grease concentrations; (2) heavy metals such as arsenic, cadmium, lead and zinc are successfully immobilized; (3) the short-term physical stability of the treated waste was good, with significant unconfined compressive strength and low permeability; (4) long-term testing of the waste indicates a potential for physical degradation; (5) treatment results in a volume increase of 0 to 59 percent (22 percent average) and a bulk density increase of 25 to 41 percent (a quantity of cement, reagent, additives and water approximately the weight of the waste was added during treatment; and (6) the process is economical.

Costs:

Total $ and $/Ton or cu. yd. (Solids) or $/Gal (Liquids)

Soliditech estimates the cost to treat 5,000 cubic yards of contaminated material using a 10 cubic yard capacity mixer to be $152 per cubic yard.

Itemized Costs:

Site Preparation Costs: Site preparation costs include site design, surveys, legal searches, access rights, preparation for support facilities and auxiliary equipment, and other costs. These preparation costs, exclusive of site development, are assumed to equal 500 staff hours at $50/hr (total cost: 25,000).

Permitting/Regulatory Costs: Typical permitting and regulatory costs are estimated by Soliditech to be $10,000.

Capital Equipment: A capital equipment cost of $11,417 is estimated to remediate a 5,000 cubic yard site using one cement mixer and associated equipment (listed in Description of Technology section).

Auxiliary Equipment: Auxiliary equipment costs include rented and purchased equipment.

Rented Equipment:	Site Trailer	$400/month
	Earthmoving equipment (backhoe and loader)	$5,325/month
	Dump Truck	$2,400/month
	Fork lift	$1,950/month
	Tank Truck	$2000/month
	Truck Scale	$1,200/month
Purchased Equipment:	Miscellaneous Equipment (Dumpster, sludge pumps, plastic sheets, 55 gallon drums)	$3,200/month
	Personnel Health and Safety Equipment (Disposable boots, gloves, protective clothing, etc.)	$4,000/month
	Decon Equipment (Steam cleaner, generator, fluids)	$6,500/month

Mobilization Cost: The start-up cost, including moving all equipment to the site, on-site mobilization, equipment setup and preliminary chemical and physical testing is estimated to be $21,000.

Labor: Nine people per day are required for the remediation. Labor costs are based on a 40 hour week and are assumed to be $40 per hour, including overhead and fringe benefits. In addition, seven of the nine people will be allocated a per diem of $55 per day to cover the costs of meals and lodging. This per diem will apply for 28 days each month. Each on-site person will also be allowed one weekend of paid "home leave" per month, at a cost of $500 in transportation per on-site person.

In addition to Soliditech personnel, after hours security service are employed. The cost is assumed to be $21 per hour for 60 hours per week.

Training is additional labor cost. Process and field support training is assumed to be 16 hours in duration per field staff at $40 per hour ($4,480).

Supplies and Consumables: The cost of materials is as follows:

•	Cement	$69/ton	2,500 tons at $172,500
•	Urrichem	$804/ton	50 tons at $40,200
•	Chemical additives	$1,340/ton	75 tons at $100,000
•	Consumables	$710	

Utilities: Utilities are fully discussed in the Site Constraints section. In summary, fuel costs include $540/week for 13 weeks ($7,020) and water costs are $125/week for 13 weeks ($1,625).

Effluent Treatment and Disposal: Soliditech assumed that one 55 gallon drum of equipment rinsate and decontamination solutions will be generated each week. This liquid is usable in the treatment process. A drum of disposable health and safety equipment will be generated each week. The cost of disposal, including all manifest and transportation charges is assumed to be $500 per drum for 13 weeks ($6,500).

Shipping, Handling and Transport of Residuals and Waste: On-site disposal is assumed by Soliditech. Off-site transportation and disposal of 7,500 tons of treated waste (5,000 tons of waste plus more than 2,500 tons of cement and additives) would significantly increase the cost.

Analytical Costs: Two types of sampling and analysis are involved in the Soliditech process. Environmental sampling is conducted as the waste is being excavated to assure that the waste removal is effective. Treated waste is also sampled to demonstrate both the effectiveness of the treatment as well as the structural integrity of the solidified waste. Costs for data tabulation and sampling personnel are included as labor costs.

The analysis assumes that one environmental sample will be collected every other day. Normally, a full scan for metals, volatile organic compounds and semi-volatile organic compounds costs approximately $1,200 per sample (2 samples at $1,200 per sample = $2,400). An alternative for site-specific hazardous constituents is assumed to be available at $300 per sample or $750 per week ($9,750). In addition, one QA/QC sample will be collected for each 20 environmental samples, and subjected to a full analysis, at a cost of $150 per week ($19,500). Two treated waste samples will be collected for both chemical and structural analysis. The cost for TCLP analysis is assumed to be $750 per sample for a total of $19,500. The cost for testing for unconfined compressive strength is assumed to be $50 per sample ($1,300).

Facility Modifications/Repair/Replacement: Maintenance costs are assumed to be 10 percent of annual capital equipment costs or $ 1,775 per project.

Site Demobilization: The cost for site demobilization is assumed to be $15,000. This figure includes final decontamination and removal of equipment, site cleanup and restoration, installation of a security fence, and run-on/run/off or erosion control measures.

- Engineering (All costs associated with selection of preferred alt. and preparation of plans and specs.): $35,000
- Construction (Procurement/Setup/Shake Down of Projects Train): $132,000
- Operation and Maintenance:- $455,000
- Feasibility Study costs (if available):

References:

EPA/ROD/R02-90/128, Superfund Record of Decision: Imperial Oil/Champion Chemicals, New Jersey. September 1990.

EPA/540/A5-89/005, Soliditech, Inc., Solidification/Stabilization Process, Applications Analysis Report. September 1990.

Attachment A

ROCKY FLATS
SOLAR POND CLEANUP PROJECT
COMPARATIVE ANALYSIS

Site/Project Name:

Location (City/State):

Dates of Operations:

Volume of Wastes (liquids - gals. & solids - cu. yds. or tons):

Hazardous Constituents (look for high salt and nitrates):

Surface Area of Impoundments (acres):

Description of Treatment Technology, (process train and process criteria; major pieces of equipment):

Design/Actual production Rates (tons per hour):

Processing Schedule or Project Schedule (time started to time completed):

Site Constraints (Access, escorts; Space, difficulties of working conditions; Security; Utilities, self provided or use of site utilities):

Union/Non-Union:

Disposal (Form of disposal i.e. boxes, drums, etc. and where - On/Site or Off/site):

Regulatory Driver (RCRA,CERCLA, Etc.):

Delays (weather, labor, unusual delays):

Ambient operating conditions (designed for year round conditions or part time):

Description of Project (attach project summary):

Costs: Total $ and $/Ton or cu. yd. (Solids) or $/Gal (Liquids)

- Engineering (All costs associated with selection of preferred alt. and preparation of plans and specs.):
- Construction (Procurement/Setup/Shake Down of Projects Train):
- Operation and Maintenance:
- Feasibility Study costs (if available):