WHC-EP-0873
Revision 0

Engineering Evaluation of Alternatives:

Managing the Assumed Leak from Single-Shell Tank 241-T-101

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Westinghouse
Hanford Company Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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C. H. Brevick

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ENGINEERING EVALUATION OF ALTERNATIVES MANAGING THE ASSUMED LEAK FROM SINGLE-SHELL TANK 241-T-101

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for

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

ENGINEERING EVALUATION OF ALTERNATIVES - MANAGING THE ASSUMED LEAK FROM SINGLE-SHELL TANK 241-T-101

1.0 STATEMENT OF PROBLEM

The management program for interim stabilization of single-shell tanks (SST) containing high-level radioactive waste is being reassessed because significant changes have occurred since the last U.S. Department of Energy (DOE) Record of Decision in the 1988 Hanford Defense Waste - Environmental Impact Statement (HDW-EIS) (HDW-EIS 1988). These changes involve new issues in safety, waste disposal technologies and facilities, and DOE direction. Resolutions of issues in these areas are interdependent, therefore, technical plans for interim stabilization of SSTs need to be reexamined and rebaselined.

Decisions to mitigate leakage from SSTs were made by Energy Research and Development Administration (ERDA 1538) in 1975, and by the DOE in 1988. The DOE's decision was documented in the HDW-EIS Record of Decision (Federal Register, Vol 53, No. 72, April 14, 1988) and the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement, May 1989). These documents provide the following objectives:

- Removal of liquids from SSTs to reduce the potential for future tank leaks
- Continued storage of residual wastes in SSTs after liquid removal
- Development and evaluation of methods for retrieving, processing, and disposing waste
- Minimization of worker exposure
- Limitation of environmental releases
- Protection of public health.

Selection of disposal technologies for individual SSTs in support of the 1988 and 1989 objectives was delayed, because of the lack of waste characterization information. As more waste characterization information was developed in the 1990s, waste-related safety issues were identified. Therefore, some SSTs were placed on safety watch lists, or an unreviewed safety question list (criticality issue) to ensure safe waste management during resolution of safety issues. In addition, facility and equipment-related technical issues have arisen, i.e., transfer line integrity (the need for double-encased transfer lines), and long-term effects on retrieval from interim stabilization actions (accelerated tank corrosion and waste heating and hardening).

While these waste safety and technical issues were being identified for SSTs, the appropriateness of the disposal technologies selected for double-shell tanks (DSTs) in the 1988 Record of Decision were challenged. The B-Plant (Hanford's waste pretreatment facility) was shut down, because it failed to meet regulatory requirements. The grout disposal method for low-level radionuclide and hazardous waste is being reassessed.

In response to safety and technical issues, and challenges to the 1988 Record of Decision, the DOE directed that a new strategy and a new baseline for disposal of tank waste be developed by March 31, 1993. Plans were to include storage, retrieval, transportation, processing, and disposal of all DST and SST waste. A new EIS would be prepared in lieu of a supplemental EIS to the HDW-EIS. This waste retrieval system EIS would address the retrieval and disposal of DST and SST wastes.

Because criticality safety and watch list safety issues were not reviewed, the 1988 interim waste management program was delayed, and is currently being reassessed. Therefore, Tri-Party Agreement milestones M-05-03 (interim stabilization of four tanks during fiscal year 1991), and M-05-04 (interim stabilization of nine tanks during fiscal year 1992) have not been met.

Alternative SST waste management plans are evaluated and ranked because of the interim stabilization program status, and events, that have occurred since 1988. Alternatives span the full range of technologies available for managing tank wastes. This report is focused on Tank 241-T-101, because this tank may have recently leaked. Possible alternatives to pumping liquids from an assumed SST leaker are identified, evaluated, and screened using safety, compliance, and socioeconomic criteria.

2.0 NEED FOR ACTION

One hundred forty-nine SSTs were constructed between 1943 and 1964 to store high-level radioactive wastes. These SSTs, monitoring instrumentation, ventilation, pipelines, and support equipment do not meet current standards and operating requirements. Sixty-seven of the SSTs are believed to have leaked a total of 600,000 to 900,000 gal of waste into the soil since operations began. Single-shell tanks are projected to fail and began leaking at the rate of one per year.

In response to the Record of Decision and Tri-Party Agreement, a program has been established to interim stabilize all SSTs. Interim stabilization of an SST is achieved by reducing the liquid content to less than 50,000 gal of drainable interstitial liquid, less than 5,000 gal of supernatant, or a jet-pumped flow rate of 0.05 g/min has been achieved. This requirement is accomplished either by crystallizing or solidifying the liquid contents or by transferring the liquid to DSTs. Interim stabilization has been accomplished on all tanks except 44 SSTs. Tank 241-T-101 is among the remaining SSTs and contains approximately 133,000 gal of waste of which more than 30,000 gal is pumpable liquid.

At mid-year 1992, the liquid level gage for Tank 241-T-101 indicated that 6,000 to 9,000 gal had leaked. Because of the liquid level anomaly, tank 241-T-101 was declared an assumed leaker on October 4, 1992. SSTs liquid level gages have been historically unreliable. False readings can occur because of instrument failures, floating salt cake, and salt encrustation. Gages frequently self-correct and tanks show no indication of leak. Tank levels cannot be visually inspected and verified because of high radiation fields. High radiation causes frequent failure of television cameras and electrical equipment and increases the difficulty in obtaining photographs. Manual tapes can be used, but their accuracy level does not allow detection of small volume leaks. These measurement uncertainties and the lack of adequate DST space often delay recovery actions for an assumed leaker SST until accuracy and dependability of the gage can be determined.

The gage in Tank 241-T-101 has largely corrected itself since the mid-year 1992 reading. Therefore, doubt exists that a leak has occurred, or that the magnitude of the leak poses any immediate environmental threat. While reluctance exists to use valuable DST space unnecessarily, there is a large safety and economic incentive to prevent or mitigate release of tank liquid waste into the surrounding environment.

During the assessment of the significance of the Tank 241-T-101 liquid level gage readings, Washington State Department of Ecology determined that Westinghouse Hanford Company (WHC) was not in compliance with regulatory requirements, and directed transfer of the Tank 241-T-101 liquid contents into a DST. Meanwhile, DOE directed WHC to examine reasonable alternatives/options for safe interim management of Tank 241-T-101 wastes before taking action. The findings of these examinations are reported in this study.

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3.0 DESCRIPTION OF ALTERNATIVES

The five alternatives that could be used to manage waste from a leaking SST are: (1) No-Action, (2) In-Tank Stabilization, (3) External Tank Stabilization, (4) Liquid Retrieval, and (5) Total Retrieval. The alternatives span the full spectrum of recovery actions that could be used to manage SSTs containing liquid and solid wastes. Each alternative contains a number of options that could be used. Detailed descriptions are provided for those options thought to be the most viable, given our current knowledge of the physiochemical properties/parameters associated with SSTs and their wastes. In narrowing the scope of this engineering evaluation, some viable options may have been inadvertently overlooked or eliminated. More in-depth and focused evaluations should rectify that shortcoming. The evaluation is focused on Tank 241-T-101 which is a presumed leaker (1992 event). The alternatives are also applicable to 44 SSTs containing appreciable liquids that have not been interim stabilized.

3.1 NO-ACTION ALTERNATIVE

The No-Action alternative is defined as taking no action in response to a possible leaking SST. Normal maintenance and monitoring activities are continued. Nothing is done to mitigate, control, or stop the leakage nor is the waste retrieved in any fashion.

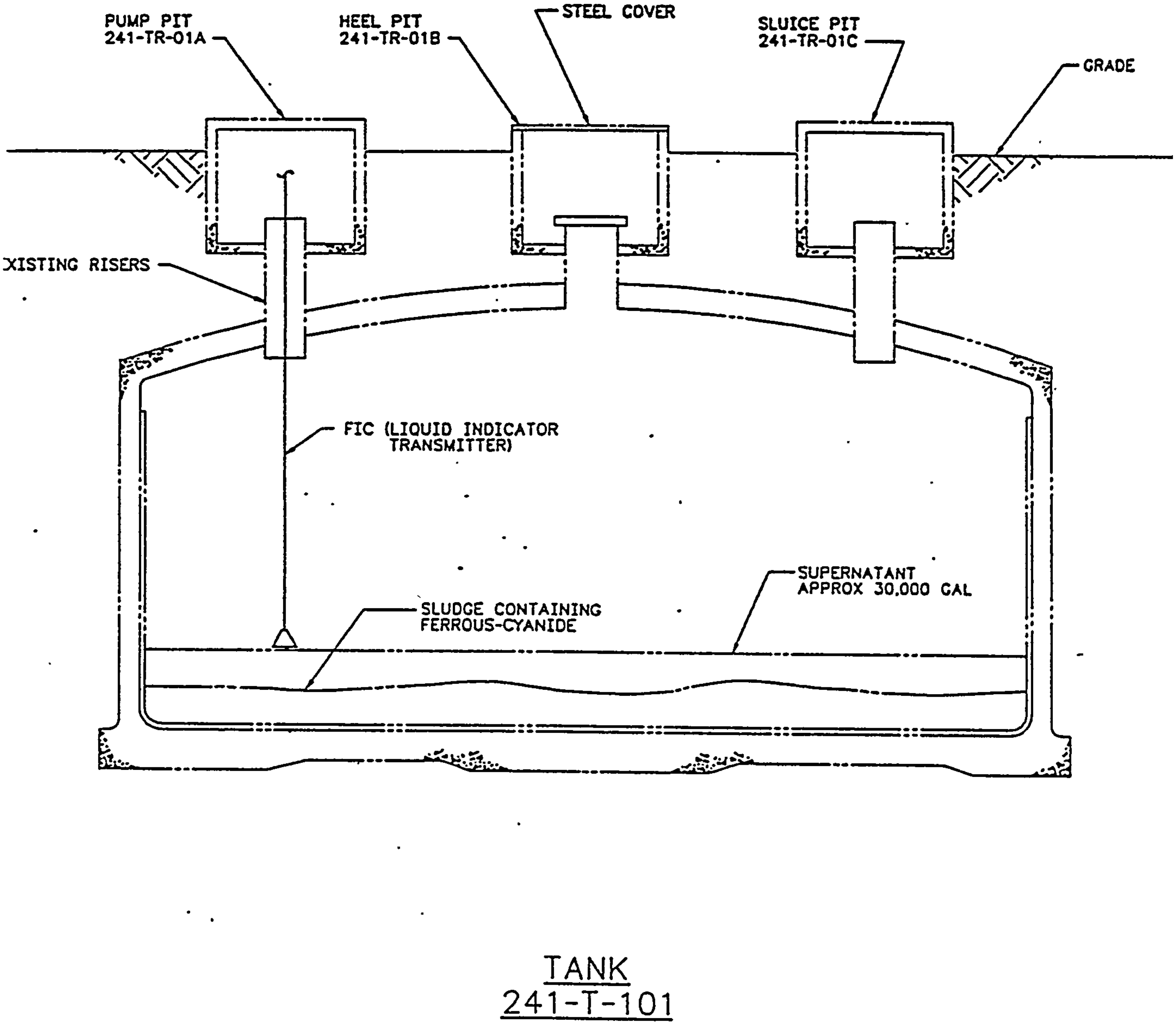
3.1.1 Existing SST Option

Radioactive mixed waste is stored in 149 underground SSTs at Hanford. Sixty-seven of these SSTs are assumed to have leaked. To date, 104 SSTs have been interim stabilized, i.e., the liquid partially pumped out.

Tank 241-T-101, as shown in Figure 3-1, was constructed between 1943 and 1944 and placed in service in December 1944. It is a domed, reinforced concrete structure that has a mild steel liner (1/4 in. side wall; 5/16 in. knuckle area and bottom). A 3/8 in. layer of mastic separates the steel liner from the concrete shell. The tank is 75 ft in diameter with a storage capacity of approximately 500,000 gal. Currently, it contains approximately 133,000 gal of waste of which approximately 30,000 gal are liquid. Recent liquid level measurements (1992) indicate that the tank may be leaking, although gamma logging in adjacent dry wells has not shown increased radioactivity. Since monitoring instruments frequently give false readings, there is currently great uncertainty as to the status of leakage in Tank 241-T-101.

3.1.1.1 Instrumentation/Monitoring. Tank liquid level has been determined by three different methods: Food Instrument Corporation (FIC) gauge, manual tape, and zip cord. The FIC gauge consists of wire-tank wall conductivity measurement excited by a 60 cycle, 24 Vac transformer system. Depth is determined by automatically lowering the tape and bob until contact is indicated by deflection of a current meter (current flows). A calibrated measuring wheel determines the amount of tape unrolled. The manual tape is similar to the FIC design (wire-tank wall), but is manually reeled out (length markings directly on the side of the tape). A direct current (DC) source of excitation with an ohmmeter is used to indicate contact. Depth must be

Figure 3-1. Tank 241-T-101.
(ER3415/TMBM8).



indexed to some fixed point on the riser. The zip cord is an indexed 2-wire cord that is manually lowered until the exposed ends contact liquid to close the circuit. An ohmmeter is used to detect the loss of resistance (current flows) similar to the manual tape system. A complimentary visual observation of the tank surface does not take place when the tapes are lowered to the surface.

Without a complimentary visual observation, reproducible placement of the conductivity gauge cannot take place at the air/solution/solid interface. Both liquid and moist salt are conductive for this type of measurement. For instance, if the surface of the tank solution contains both salt and liquid, a finite conductivity measurement would be recorded when the tapes contacted a chunk of floating salt or stationary salt that may be several inches above the liquid level. Uncertainty of depth of 1 in. for a tank 75 ft in diameter would represent a 2,750-gal uncertainty in the volume. The depth measurement, as presently constituted, can give a very uncertain liquid level measurement if salt bergs and/or salt encrustations are forming in a tank.

Another monitoring system is known as liquid observation well (LOW). A LOW is a closed-ended tube inserted to the bottom of the tank. Neutron and gamma-logging permits an indication of the liquid and pore water levels in the waste. Experimental observation has shown that the radiation levels are higher in the liquid than the salt cake. Since liquid seeks a constant level, this method is promising because it discerns both pore water and liquid levels independent of floating salt bergs or salt crust. Unfortunately, liquid level sensitivity is 1.2 in. because the data is logged ten times per foot. The LOW method has not been applied to Tank 241-T-101 because the closed-end tube has not been installed.

3.1.1.2 Steel Liner Corrosion Potential. There have been no efforts to retrieve liner steel plate samples from Hanford SSTs with leaks and conduct corrosion failure analyses of the steel samples. This has not been practical because retrieval and evaluation of radioactive contaminated plate samples are major tasks. Special equipment and procedures would have to be developed. Samples would have to be taken at random and many samples would have to be taken to obtain a sample that coincided with a tank leak.

At the Savannah River Site (SRS), corrosion failure analyses were conducted for primary steel tank samples retrieved from observed leak locations (E.I. du Pont de Nemours and Company). The steel samples were taken from nonstress-relieved SRS DSTs that developed multiple leaks very soon after filling the caustic waste that included nitrates and nitrites. The failure analyses indicated that stress corrosion cracking (SCC) caused the SRS primary tank leaks. Waste chemistry is one of three basic conditions necessary to cause SCC in waste tank steel plate. The SRS laboratory SCC studies determined the waste chemistry variables that promote or inhibit SCC. High pH levels and nitrite concentrations were found to inhibit SCC. The other two necessary conditions for SCC occurrence are elevated temperature and high tensile stress.

The Hanford SST steel liners are nonstress-relieved. Therefore, based on the SRS study and the waste temperatures and chemistry that exist in Hanford SSTs, SCC in the liners is a hypothesized cause for SST leaks.

The SRS failure analyses for waste tank steel samples did not confirm uniform, pitting, or crevice corrosion. Photographs have been taken inside Hanford SSTs that show the inside surface of the steel liner above the waste surface. Some of these photographs indicate that there could be through-wall corrosion at the waterline, therefore, remedial actions involving the use of liquids in SSTs are likely to cause leaks into the environment from those cracks.

3.1.1.3 Leak Self Healing. The SRS has observed large barnacles and stalactites of salt crystals adjacent to stress corrosion cracks that have breached the tank wall in the annular space of their DSTs. The SRS believes that the slow seepage followed by evaporation and reaction of the alkaline liquid with the surrounding air causes precipitation of a salt cake that closes off the leak (see E.I. du Pont de Nemours and Company).

There has been no observation of a similar plugging phenomenon at Hanford because there is no directly visible annular space in SSTs. There is an asphaltic mastic layer between the steel and concrete, and the concrete is in contact with the backfill. The SRS healing mechanism seems unlikely to be at work in SSTs since it would require contact with the air and evaporation of the liquid. Hanford SSTs in contact with concrete/backfill would have a much slower rate of water mass transport, preventing dry-out and salt precipitation. Hanford tanks that leak and later appear to stop may be more indicative of the liquid level falling below the level of the crack.

3.1.2 Enhanced SST Option

The enhanced SST option refers to improving the leak monitoring instrumentation for the SST. Otherwise, the definition is the same for no-action (see Section 3.1).

3.1.2.1 Instrumentation/Monitoring. There are new methods of measuring depth by a tape that are being studied; the improved FIC system method and the displacer method. The improved FIC method uses modern electronics to repeatedly raise and lower the conductivity probe to search for a constant depth. The displacer uses a weight on a wire which is raised and lowered by modern electronic controllers that will break through a salt crust if it exists. Load on the wire is monitored to determine when the weight has reached the liquid level. Both methods suffer from the same problems mentioned earlier, namely, the need for a confirming visual observation that the sensing heads are in the correct location. Both devices will fit through 4-in. risers.

The most interesting new liquid-level measurement technique is a radar detector that continuously sweeps the surface to determine liquid depth in real time. A visual observation is required to confirm that the detector is focused on the liquid rather than on a salt berg or salt layer. A 30.5-cm (12-in.) diameter riser is required for entry into a tank. Recent experience in Tank 101-SY has been inconclusive using the radar detector, but this could be because the dynamic nature of the interface (hydrogen bubbling lifts the liquid) and/or salt bergs moving in and out of the radar window.

There are other liquid level measurement systems being evaluated such as acoustic/ultrasonics, gamma probes attuned to 106 Ru decay, neutron probes, etc. Ongoing investigations have not yet clearly singled out one measurement system over another because of the diverse and complex waste chemical and radiation environments existing in SSTs.

Liquid-level measurements normally require a visual check to confirm the instrument reading. This cannot routinely be done because radiation prevents visual inspection and interferes with electrical systems such as television cameras. It is important to note that a tank without a free-standing phase of liquid (salt cake sludge fully filled with pore fluid to the top) can still leak. Thus, a surface level measurement may give a false sense of confidence. The LOW method might show the most promise if the sensitivity could be improved by an order of magnitude.

3.1.2.2 Leak Detection Systems. External dry wells exist around the tanks; Tank 241-T-101 does not have a lateral dry well under the tank as some SSTs do. Existing dry wells can be used to introduce neutron and gamma detecting equipment into the ground. Plumes of leaking waste will carry radioactive contaminants that can be identified by gamma-ray analysis. However, it has not been too successful because leaks from other tanks have raised the background radiation levels. New leaks do not significantly increase the measured radiation levels; consequently, there is usually not adequate sensitivity for monitoring new leak activity.

3.2 IN-TANK STABILIZATION ALTERNATIVE

This alternative refers to internal tank methods used to prevent liquid from leaking waste into the environment. These methods include preventing the leaks in the first place, trapping the liquid by some method, removing the liquid by drying, or plugging the leaks as they occur.

3.2.1 Tank Corrosion Inhibition Options

Corrosion inhibitors may be added to a tank to prevent or inhibit further tank-wall corrosion. The SSTs contain a mixture of solids and liquids which complicates the chemistry of liquid tank wastes and may make the addition of inhibition chemicals difficult to control. Analysis of the tank contents is required to determine what specific chemicals would be needed to add to the liquid waste to inhibit corrosion.

3.2.1.1 Tank Stress Corrosion Cracking Inhibitors. An SRS series of laboratory tests determined the waste chemistry variables which effect SCC of carbon steel plates used for waste tanks. The caustic and nitrite concentrations are the most important and can be added to control SCC. Accordingly, SRS controls these concentrations in their waste storage tanks for protection from SCC.

It is unlikely that Hanford SST waste chemistry controls for SCC protection similar to those enforced for SRS tanks could be beneficial or practical. The reasons include:

- It would be too late. Historically, at SRS, nonstress-relieved primary tanks experienced multiple SCC leaks very soon after filling (without the current chemistry control).

- The wastes stored in Hanford SSTs currently are combinations of solids and some liquid. The chemistry variables have ranges of uncertainty. Therefore, it may be difficult to add this type of chemistry control and effectively inhibit SCC.

Historically, nonstress-relieved tanks failed very quickly in the high pH waste at SRS. Tank 241-T-101 should be thoroughly stress corrosion cracked by this time since it has all the predetermining factors. The SRS observed hundreds of cracks in their early nonstress-relieved tanks. It is probably too late to gather any benefit from modifying the chemistry in Tank 241-T-101 (assuming, first, that we know what the chemistry is, and secondly, that we can mix the waste).

Advantages

- Prevents further tank wall/floor degradation
- Stops new leaks to the environment.

Disadvantages

- Tank contents must be mixed to properly distribute the inhibitor
- No known means of mixing solids and liquids in SSTs
- Does not stop existing leaks.

Application. The waste in the tank would be analyzed to determine its chemical makeup. The proper chemicals to inhibit corrosion would then be determined. These chemicals would be added to the tank and mixed to ensure uniform distribution. The tank contents would still be monitored to ensure that the waste is maintaining its desired properties. If it has changed, chemicals would be added to restore the desired inhibition properties.

3.2.1.2 Liquid Surface Inhibitors. The SRS (David Hobbs) has recognized that the waste/air interface of their high pH wastes will continuously absorb carbon dioxide from the air. This means that the hydroxide ions will react with carbon dioxide to make carbonates; thereby, tying up the hydroxide and lowering the pH and making the steel vulnerable to SCC at that location. The SRS periodically analyzes the surface (grab sample by bottle on a string) for pH, nitrite, and nitrate. When needed (surface chemistry has dropped below their specifications), sodium hydroxide (sometimes accompanied with sodium nitrite) is sprayed onto the waste surface to inhibit SCC (E.I. du Pont de Nemours and Company).

The value of this process for Tank 241-T-101 requires knowing whether the failure process leading to leakage is because of ongoing SCC at the waste/air interface or old SCC cracks in the metal that intersect with ongoing cracking in the concrete. A conservative approach would assume that SCC of the metal is still ongoing. Implementation of the method would require analyses of the surface chemistry to establish a baseline.

3.2.2 Liquid Absorption Options

Liquid absorption can be used to trap the liquid in the tank by immobilizing it. Diatomaceous earth (DE) and portland cement have been tried at

Hanford with little success. They are included in this study to demonstrate the application of various options and their impact on the selection criteria.

3.2.2.1 Diatomaceous Earth. Diatomaceous earth acts like a sponge when it is added to liquids. Once absorbed, the liquid cannot be removed without adding heat to dry the DE. Solids are more difficult to retrieve from SSTs than liquids. While DE can aid in preventing or mitigating a leak, its use complicates waste retrieval, increases volume solids, and makes waste more difficult to process using existing and planned waste handling and treatment facilities.

Diatomaceous earth has been added to the following six SSTs at Hanford (WHC-EP-0338 draft).

Tank	Amount	Date diatomaceous earth added
241-BX-102	95 tons	January 1972
241-SX-113	41 tons	April 1972
241-TX-116	95 tons	November 1972
241-TX-117	41 tons	January 1971
241-TY-106	27 tons	February 1972
241-U-104	55 tons	May 1972

Liquids were first pumped from the tanks before the DE was added. This minimized the amount of DE required to absorb liquids. This same approach would likely be used for any future DE additions. If DE were added to a tank, such as Tank 241-T-101, prior to interim stabilization, the large quantity needed to absorb all the excess liquid would add enormously to the volume to be retrieved and make processing much more difficult.

Advantages

- Easy to distribute if free liquids have been removed
- Soaks up small pools of liquid well
- Easy to add to the waste.

Disadvantages

- Salt well jet pump not likely to work for retrieval due to 0.127 cm (0.05 in.) openings in the salt well screen
- May contribute to corrosion of the carbon steel wall by removing liquid by dioxides and nitrites
- Existing equipment can only transport liquids
- No existing or planned systems to process DE solids

- Experience with hot-cell samples from DSTs indicates that if wastes dry out, they are much more difficult to dissolve for transporting and processing. Additions of DE will contribute to this phenomena by removing cooling capability associated with evaporating liquids

- There have been no efforts to date to retrieve DE stabilized tanks. It is not known to what extent DE will complicate future waste retrieval and processing operations

- Overall increase in the volume of waste to be retrieved and disposed.

Application. The DE was injected into the liquid waste using air pressure. One problem encountered during injection was that the DE tended to clump as it became wet, making it difficult to spread evenly through the liquid waste.

Sufficient quantities of DE must be injected into the waste to ensure absorption of the free liquid. As discussed previously, this dry material causes a problem for future retrieval and processing. Present equipment can only handle liquid wastes. Any dry waste would have to be redissolved prior to retrieval. The present vacuum-evaporator crystallizer would have problems processing the retrieved DE wastes to reduce excess liquids. Solids created by adding DE are likely to complicate retrieval/transport and processing operations. This would greatly increase the volume of waste to be handled, processed, and disposed. The dissolving of DE solids produces gels that are hard to transport. Diatomaceous earth is heavy in silicates, which are difficult to process through existing and planned pretreatment facilities.

3.2.2.2 Portland Cement. Portland cement can be added to a tank to absorb some of the liquid waste and form a grout barrier. The cement could be placed where the tank wall and the liquid interface to prevent liquids from leaking out of the tank.

This method has been used in only Tank 241-BY-105 (WHC-EP-0338 1990). Fifty-seven tons of portland cement were added as part of a demonstration program. The cement did not mix well. After injecting the portland cement, some of the remaining liquid was pumped out. The mixture blocked the underground transfer lines.

Advantages

- Relatively inexpensive and readily available for use.

Disadvantages

- Will plug liquid waste transfer lines

- Does not inhibit tank corrosion

- No existing Hanford equipment for retrieval of solids generated

- No existing Hanford equipment for processing solids generated

- No reliable method exists to mix portland cement with liquid waste in the tank
- Any cement added to the tanks will have to be broken up and removed during solids retrieval
- Potential for explosive gas and/or exothermic reactions to be generated during mixing of liquid waste.

Application. Field personnel indicate that when the portland cement was injected onto a pool of liquid waste, the cement powder simply spread out across the surface of the waste without mixing. The cement powder never mixed well with the liquid to form the desired grout barrier. In trying to remove residual liquid from the tank, the main underground transfer line became blocked by cement. The underground line had to be abandoned and the liquid transported by adding overland transfer lines. Assuming a method is found to mix the liquid waste with portland cement, a method for retrieval and processing the solid waste would be required. The solids would need to be broken into small enough pieces (while still in the tank) to permit retrieval and processing. Otherwise, the solids will be in such large pieces (potentially, many cubic feet in volume) that they cannot be removed through any existing tank openings.

The portland cement option could be developed to allow filling of an entire tank without future retrieval. In this option, the entire tank contents would be mixed and solidified and the tank filled with grout and abandoned in-place. The waste would then be considered disposed. A concrete vault could be built around the tank and the environment monitored. This option would eliminate waste retrieval and processing.

3.2.2.3 Desiccants/Gels.

Desiccants. Desiccants placed in a tank could remove the free liquids in the waste. Since a desiccant does not have to physically contact the liquids to remove moisture, it has an advantage over an absorbent that must contact the liquid to absorb it. The desiccant would need to be isolated from the outside atmosphere to ensure that it only collects tank moisture. Whether the desiccant would work well to remove the interstitial liquids under and in the salt cake sludge is unknown. The tank contents may need to be mixed to ensure these liquids are exposed to the desiccant. No desiccants have been placed in waste tanks.

Advantages

- May remove moisture without contacting the waste
- Won't heat waste while removing moisture.

Disadvantages

- If desiccant is suspended above the waste, ensuring that it does not drop into the waste as moisture is absorbed it would require an internal support structure suspended within the tank
- Handling the desiccant when removed from the tank

- Redissolving any solidified waste for retrieval and processing. Experience with hot cell samples from DSTs indicates that if the samples dry out, they are much more difficult to dissolve
- Ensuring there are no isolated pools of free liquid in the waste to leak out
- Potential explosive gas generation when mixing the waste.

Application. If the desiccant is suspended above the liquid level, precautions must be taken to ensure that the moisture picked up in the desiccant does not cause the desiccant to drop into the liquid. Equipment and experience exist that should enable desiccant to be added safety into the tank. Exposure of trapped liquids in the solid waste to the desiccant is an unsolved problem. Waste retrieval would not be directly affected by the desiccant. As waste dries out, however, it becomes more difficult to retrieve. Either new methods of solid-waste retrieval and processing need to be developed or liquid would have to be reintroduced to dissolve the waste for retrieval and processing.

If the desiccant were placed directly in the waste, all of the above would still apply. However, the chemical properties of the desiccant would have to be evaluated to determine what effect they might have on process chemistry and equipment.

Gels. Pacific Northwest Laboratory is currently working on a proposal to develop a media that could be added to the liquid waste to turn it into a gel that would return to a liquid state when mixed, stirred, or pumped. The title of the proposal is "Non-leaking Hydraulic Retrieval: Development and Demonstration of Non-leaking Dissolution and Slurrying Media for Retrieval of Waste from Leaking Tanks." The purpose of this study is to "develop a nonleaking fluid for retrieval of SST waste. It will have a low viscosity when stirred and pumped, but forms a nonflowing gel when left undisturbed." One of the candidate fluids has exhibited the desired thixotropic behavior when mixed with a simulated SST salt cake. Colloidal silica forms a gel when mixed with salts or salt solutions, due to ion exchange between the salt cation and the silinol hydrogen. The strength of the gels were controllable by adjusting the silica solids content, salt concentration and pH. The gelling process was found to be reversible by lowering the pH below 6.

No gel material has been added to any Hanford waste tanks, although some laboratory testing has been done to demonstrate its feasibility. Numerous activities and issues must be resolved before implementation can take place. The time frame in the milestone summary indicates that development will not be complete until September 30, 1995. If the technology is successful, it will allow hydraulic retrieval of waste which provides a larger cost savings over mechanical retrieval.

Advantages

- Liquid waste will gel to ensure no leakage from tank even though new wall defects develop
- Retrieval virtually the same as if no media added to waste

- Processing only slightly more difficult with gel.

Disadvantages

- Tank contents must be mixed to ensure even media distribution throughout the waste
- The increased silicate loading complicates processing
- Under development, with a minimum 2- to 3-year time frame before practical full-scale application
- May enhance corrosion by removing hydroxide and nitrite inhibitors
- Potential for explosive gas generation when mixing liquid waste.

Application. Gel media could be added to the waste using similar technology to that developed for DE and portland cement. A method of mixing must be developed that ensures uniform distribution throughout the waste. If the gel works as described, retrieval would be virtually the same as pumping liquids for interim stabilization. The waste would liquify under the shear introduced by the pump. Processing of waste should remain the same as presently planned, except, there are additional silicates from the gelling media. Operating personnel indicate that silicates are difficult to process through the vacuum evaporator crystallizer.

3.2.3 Drying Options

Drying offers a method for physical removal of tank liquids without changing chemistry or providing external transport to a DST. The methods investigated include heat exchangers, microwave systems, and air drying. All these methods evaporate liquids and leave the waste solid.

3.2.3.1 Heat Exchangers. The referenced report contains information on a model system for underground waste storage tanks and a circulator-concentrator (Dunn 1986). The circulator-concentrator system consisted of a 400 gal stainless steel vessel equipped with a circulator of 3-in. internal standard schedule 40 pipe that is 32 in. long. It is vertically suspended 6 in. above the bottom of the tank. Evenly spaced within this circulator are six tubular hairpin 1,500 watt, 240 V immersion heaters.

In a recent test, these heaters were immersed in simulated waste of Tank 101-BY for 407 hours. Measurements of flowrate velocity of the waste did not reveal any significant changes in the circulation rate as the quantity of solids increased. However, there were difficulties as the concentration increased. Small holes in the air distributor, used for circulation, became plugged from crystal growth. Steam sparging and lancing were required to keep the ports open (total of 14 times during the test).

At 112 hours, the solution reached a concentration sufficient to allow crusting over the surface. As it formed, the crust broke up and sank to the bottom. The salt cake on the circulator top was 8 in. thick when the test ended. The final specific gravity (sg) was 1.670 at 68 °C. When it cooled to room temperature, the apparent solids content was 96% with a sg of 1.495 and a viscosity of 21 centipoise at 33 °C.

All measurements and observations indicate that no insurmountable process difficulties would be encountered in plant operations for the circulator-concentrators unless extended periods of shutdown are required. There was a localization of the remaining liquid after concentration that should simplify addition of cementing agents for any remaining liquid. Ultimate disposal of these final liquids would take place in containers filled with cementing agents.

Per discussions with field personnel, this method of waste stabilization was dismissed in the 1975 to 1976 time frame because the vacuum-evaporator crystallizer worked better. In addition, the waste needed to be heated to approximately 240 °F to boil off the moisture since the process took place at atmospheric pressure rather than at the reduced pressure of the evaporator crystallizer.

Advantages

- Removes most of the moisture to virtually eliminate leakage
- Waste is mostly crystalline when complete
- Little residual liquid to be disposed.

Disadvantages

- Waste must be heated to approximately 115.6°C (240 °F) to boil off liquids (maximum allowable temperature of ferrocyanide tank is 200 °C [392 °F])
- Increased moisture load on heating, ventilating, and air-conditioning (HVAC) equipment
- Drying waste makes it much more difficult to retrieve and process
- Existing retrieval and processing equipment cannot handle solids
- Not an efficient method of evaporation. (Vacuum evaporator/crystallizer works at 65.5 °C)
- May increase corrosion by removing inhibitors (hydroxides and nitrites)
- Potential explosive gas generation from additional heat to tank waste
- Design for application in the final storage container.

3.2.3.2 Microwave. Microwave heating shows promise of being capable of completely and finally stabilizing pumped and unpumped tanks to less than 4% total moisture. The economic incentive for portable microwave use thus can be even greater than wiped film evaporation for interstitial liquors because existing piping would not be required, and salt well pumping, transfers or double-shell storage would not be required (Berry 1990). The proposed microwave system need not become contaminated; thus, it should be much easier to move from tank to tank. It does, however, require a portable exhauster and would require the same size chiller-condenser-deionizer planned for the wiped film evaporation (E.I. du Pont de Memours and Company 1982).

Oak Ridge worked on simulated waste with a 1/3 scale proprietary microwave system. The intent was to evaporate the free water in the waste followed by melting of the salt residues. The cooled melt forms a solid monolith. The final waste volume is much less than the original because the water is removed and the salts are melted residues. They can produce final waste with no free particulates or liquids (White 1990).

The microwave energy heats the waste directly because the oscillating electric fields directly couple to the molecular bonds of the chemicals in the waste, causing frictional heating. The microwave process contains no moving parts and is designed to heat the liquid waste in the final storage container. The direct heating of the microwave energy must be carefully controlled to avoid process upsets such as splattering, arcing, and thermal runaway.

During testing, boiloff liquid occurred at approximately 120 °C (248 °F). The residual salt melted when the temperature rose to 360 °C (680 °F).

Advantages

- Can produce a very dry waste product
- One microwave assembly can be used in numerous tanks
- Microwave unit does not contact the waste and is not contaminated.

Disadvantages

- Solidified waste is difficult to redissolve for processing
- Waste will need to be heated to approximately 360 °C to melt the salt residue if the tank is chosen for final storage. (This exceeds the maximum allowable temperature [200 °C] for a ferrocyanide tank.)
- In-tank mixing may be required
- Tank contents must be heated to approximately 120 °C. Hot spots easily develop
- A new/modified ventilation system must be developed to condense all the excess moisture vapor developed while boiling the liquid
- Still in development stage. May be years before practical application
- No existing equipment for retrieval or processing solids
- Potential explosive gas generation when heating the waste
- High temperatures may structurally damage the concrete tank.

3.2.3.3 Air Drying. Circulating air through the air space above the liquid waste will remove moisture through evaporation. The moisture-laden air is passed through a condenser to remove the excess moisture and prevent damage to the high-efficiency particulate air (HEPA) filters. Air drying works much slower and at lower temperatures than the other drying techniques.

The air-drying method may require mixing of the tank contents to maximize the removal of moisture. Circulating the air is not likely to remove the moisture entrained in the salt cake. Air circulation has been used to cool tanks. Cooling dried the waste surface as it removed the heat. The waste surface has been described as desert like. How much the circulating air dried the waste underneath the surface is unknown.

Advantages

- Method has been used in the past and results in waste surface that looks like a "desert"
- Ventilation system can be readily connected to tank
- Ventilation system does not contact waste
- No requirement for new technology.

Disadvantages

- No existing equipment to retrieve or process solids
- Tank contents require mixing to get maximum drying
- Isolated pockets of liquid likely to exist even if thorough mixing is done
- This method may enhance corrosion of the tank wall by eliminating the liquid corrosion inhibitors
- Modified ventilation system needed to remove moisture from the air
- Through-wall defect below dried waste may result in leak to the environment
- Once the waste dries, it is difficult to redissolve according to WHC tank operations personnel.

3.2.4 Stop-Leak Option

A material similar to that used in a leaking automobile radiator has been proposed for stopping flow from a leaker tank. Stop-leak materials will need to be mixed into the liquid waste, this way it can flow to the liner defect and plug it.

Typical ingredients in commercially available products are sodium silicate, polysaccharide, colloidal clay, smedtite clay, borax, wood flour, bentonite clay, sodium metasilicate, defoamer, corrosion inhibitors, and water.

Advantages

- Safe for environment and personnel
- Proven process, it works in automobile radiators
- Commercially available, therefore, relatively inexpensive
- Easy to inject
- Quick response to a leaking tank
- Corrosion inhibitor added at the same time as stop leak.

Disadvantages

- Increased silicate loading
- Requires mixing the waste
- Potential explosive gas generation when mixing heated waste
- Waste must be heated
- Unknown how much media to add and how evenly it will be distributed
- Effects on future processing are unknown.

Application. Injection of the stop-leak media can be done using existing technology. But, a means of thoroughly mixing it in the liquid layer is required to ensure the media gets quickly to the tank defect. Stop-leak does not solidify or thicken the waste and should not affect liquid retrieval methods. But the silicate loading that comes from the media may make processing more difficult. Processing silicates through the evaporator is difficult.

3.3 EXTERNAL TANK STABILIZATION ALTERNATIVE

External tank stabilization can retain contaminates at the waste site to significantly lessen the environmental impact of leaking tanks. Stabilization of the soil surrounding the tank with subsurface barriers, without stressing the tank, can prevent migration of the plume to lessen the amount of contaminated soil--an important goal of interim stabilization. A number of innovative in-situ technologies have emerged in recent years for hazardous waste containment. They include grouting, freezing (cryogenic barriers), deep soil mixing, sheet metal piling, and geomembrane walls.

Ground-freezing and ground-cooling technologies can be used to immobilize contaminates around a leaking container. They can act as a barrier to plume migration to prevent further contamination of a site. Geomembrane walls are similar to sheet piling (subsurface barriers) except that the barrier permeabilities are significantly lower. Membrane and hazardous waste compatibility is important in achieving closure status after remediation. Factors that influence the selection of an appropriate technology include waste characteristics, soil characteristics, and hydroecology. Site-related information and data requirements for a given stabilization technology may be found in the documents referenced.

3.3.1 Subsurface Barrier Options

Subsurface barriers can be used to isolate and/or immobilize the waste once outside the tanks. Isolation is achieved by placing a wall or membrane of low permeability between the waste and the environment. Immobilization is a process where leaked waste is converted to a less mobile, more chemically stable form. Subsurface barriers can be grout barriers, slurry walls, or sheet piles depending on waste and soil properties and characteristics of the site. Surface encapsulation is one of a broad spectrum of technologies that involve subsurface installation of barriers. It does not treat waste directly but serves to immobilize contaminates. Surface encapsulation involves chemicals that may influence future options for site closure. Surface encapsulation is not addressed in this summary because regulatory guidelines are not formulated to permit their use.

3.3.1.1 Grout Barriers. In the grouting process, fluid additives are injected into soil to form a barrier that reduces the movement of water/contaminates through the site, or increases the strength of a site's natural barriers (see Figure 3-2). Grouting has been frequently used in remedial actions at radioactive waste sites. A drawback to grout barriers is that they are not capable of truly achieving low permeabilities in unconsolidated materials as surrounds the Tank 241-T-101 site. Leaks can occur between pours. Both the grout formulation and the techniques for placement are important factors in whether the grout will perform properly to mitigate migration of contaminants. Theoretically, placement of grout around and underneath the contaminated sites (bottom sealing) is possible; in practice, this has proven to be very difficult and expensive to accomplish. The subsoil strata at tank sites is a mixture of coarse and fine grained sand. Rainfall is low. This suggests that low viscosity grouts placed by injection or jet grouting may be reasonably effective in reducing permeabilities and in preventing migration of contaminants.

Grouts are typically injected with pumps and mixers. Proposals for grouting involve shallow low-pressure injection to seal the voids in the soil and create a barrier to lateral or vertical migration of contaminates. Materials used can be silicates, acrylate, urethane, and portland cement. Jet grouting is a wide array of techniques to washout cavities in the subsurface soils (see Figure 3-3). With directional drilling, jet grouting can be used to install barriers to prevent vertical migration. Jet grouting uses high-pressure water or air jets to create cavities in the soil. The cavities are then refilled with bentonite clay or portland cement mixtures.

Chemicals or cements used in injection and jet grouting can effectively be used to produce an impermeable barrier. Presently, no technique is available to detect any discontinuities between pours/injections. The grout masses can leave gaps through which contaminates may pass. Jet grouting was proven effective in a wide variety of geologic media (such as fine sand or mixture of silt and sand) where waste/grout interactions are not significant problems. Jet grouting requires specialized equipment that is not normally available locally. It requires significantly more time to set up and cleanup than injection grouting.

Advantages

- Forms high strength barrier
- Effective in preventing horizontal migration of contaminants
- Adaptable to use in preventing vertical migration

Figure 3-2. Grout Barriers.

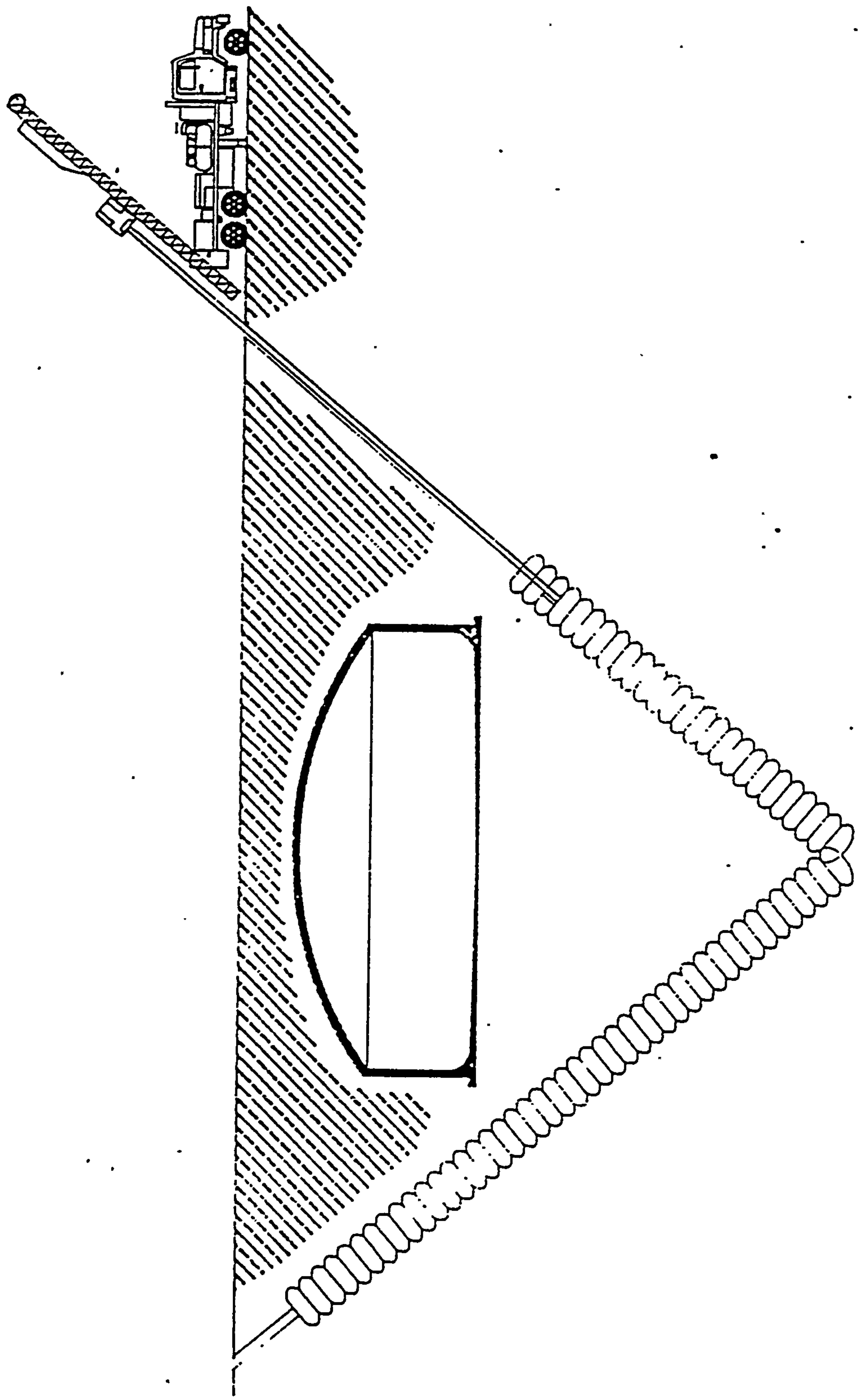
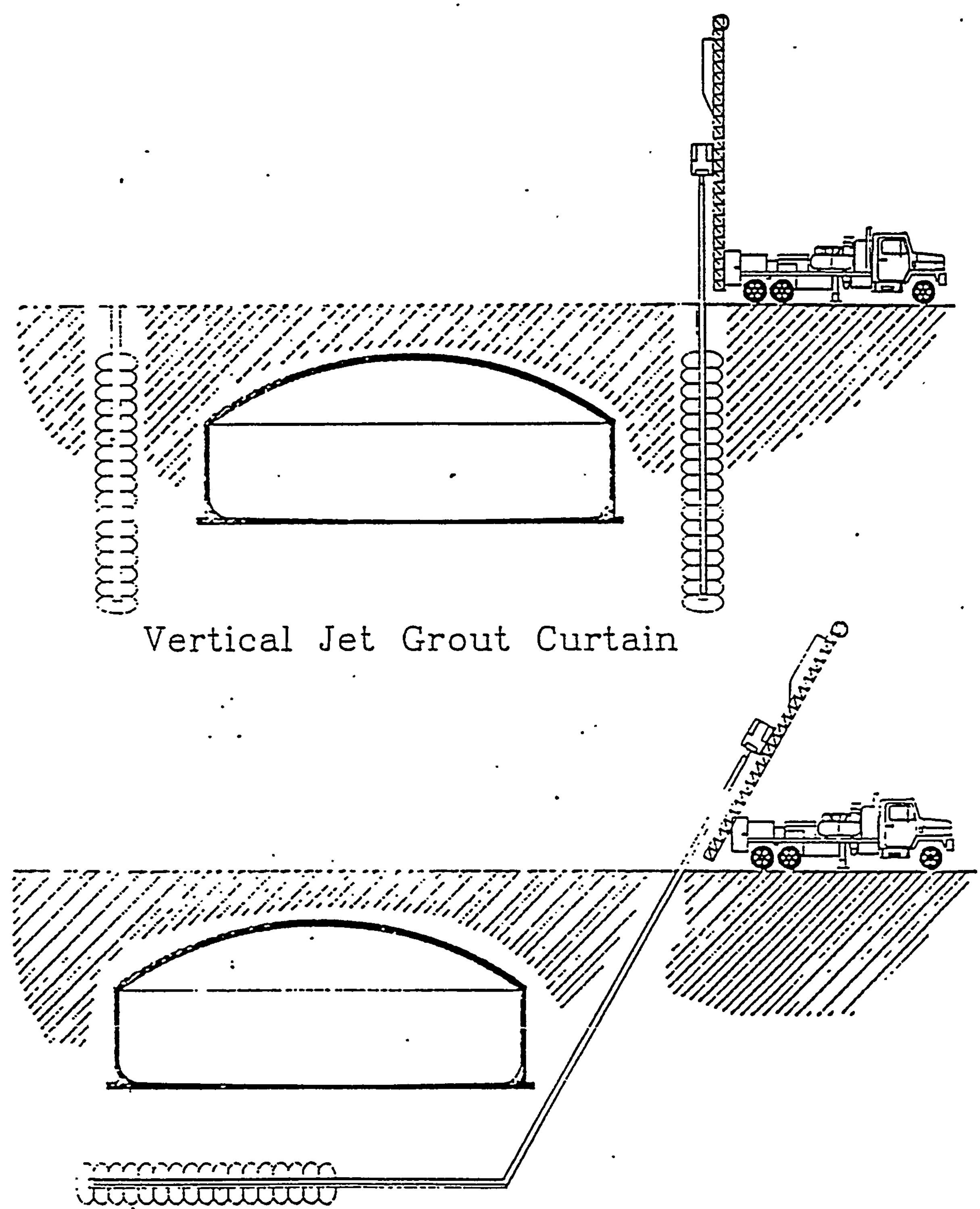


Figure 3-3. Jet Grout Curtain.



Vertical Jet Grout Curtain

Horizontal Jet Grout Curtain

- Uses low cost, readily available, ecologically acceptable materials for construction

- Commercially available technique frequently used to prevent migration of radioactive materials

- No hazardous materials associated with technology

- Retrievable if necessary for final disposal and site restoration.

Disadvantages

- Leak paths may develop between pours

- Leak paths may develop if used in unconsolidated soils and rock

- Grout placement around and beneath contaminated site is difficult and expensive

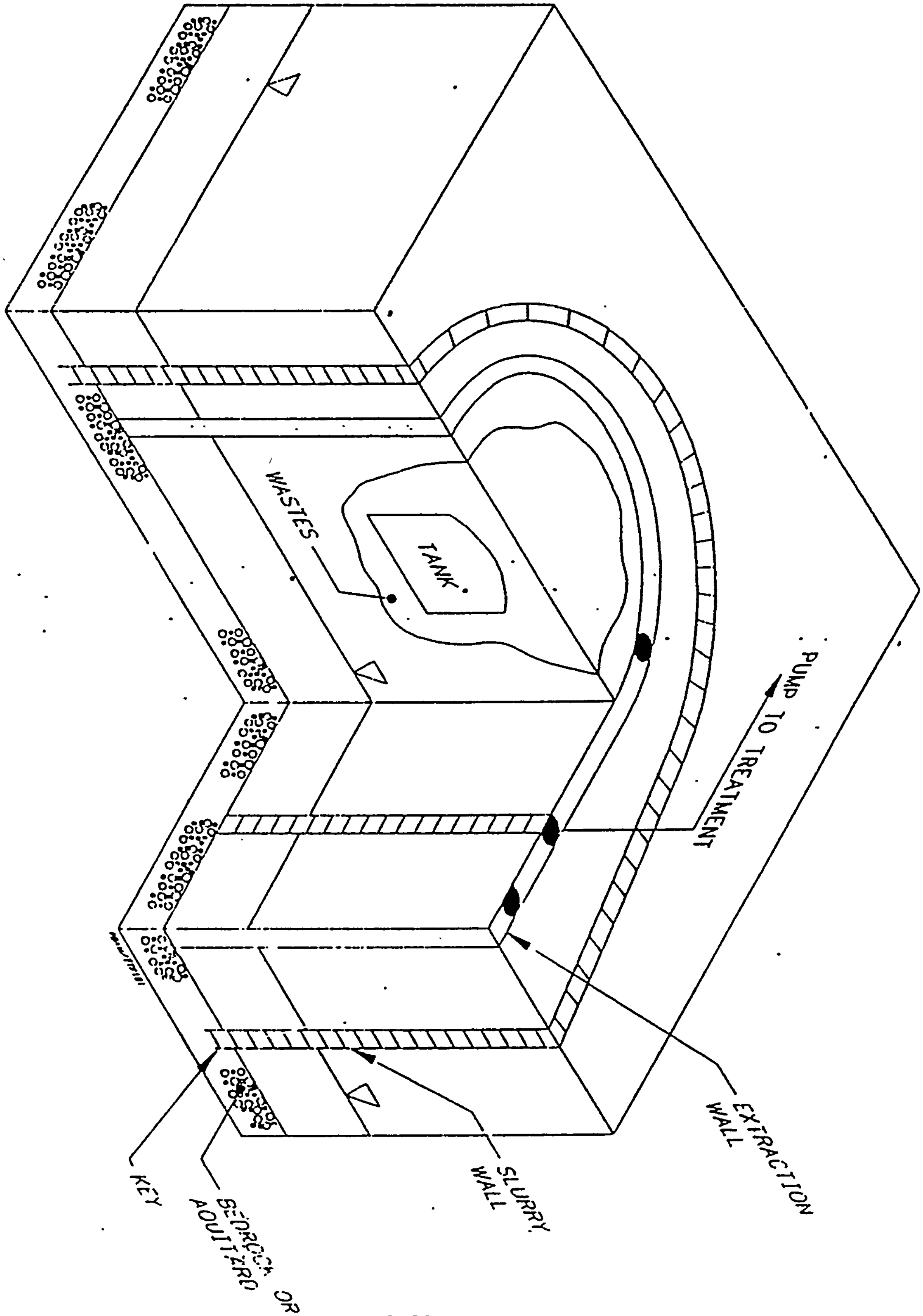
- Significantly increases the amount of contaminated soil requiring treatment.

3.3.1.2 Slurry Walls. Slurry walls (see Figure 3-4) are used to contain waste or contamination and reduce the potential of future migration of contaminants. Slurry walls are constructed in vertical trenches that are excavated while being filled with slurry. The slurry provides a shoring for the trench and forms a barrier preventing fluid losses to the environment. Slurry walls are differentiated by the type of materials used in the slurry mix. Most commonly, an engineered soil mixture is blended with a bentonite clay slurry to form a soil-bentonite slurry wall. Portland cement, bentonite, and water are also frequently blended to form a cement-bentonite slurry wall.

Of the major types, soil bentonite walls offer the lowest installation costs, and the broadest range of chemical compatibilities, with relatively low permeability. Cement-bentonite walls offer high strength, low permeability and are suited to restricted areas, such as around tank sites. Large spaces are needed to mix soil-bentonite. Cement-bentonite barriers have higher permeability than soil-bentonite, but are subject to cracking and chemical attack. Soil-bentonite slurry walls are generally favored by regulators because of extremely low permeabilities and a high degree of compatibility with hazardous chemicals.

Slurry walls are mainly employed as a vertical barrier. Bottom sealing is rarely feasible. Deep excavation is usually required to maintain contaminant control. Excess soil has to be disposed. It is important that the walls be extended and sealed to a natural barrier confining layer under the contaminated site to prevent seepage underneath the wall. At the Tank 241-T-101 site, the applicability of slurry walls is limited, because of the long distance to a confining layer, and the close proximity of the tanks to each other. However, slurry walls used in conjunction with jet grouting may offer a viable, cost-effective option to mitigate tank leakage during waste retrieval operations.

Figure 3-4. Wall and Bio-Polymer Slurry Trench.



Advantages

- Forms relatively high strength, low permeability barrier
- Low installation and material costs
- Compatible with hazardous chemicals--no hazardous materials associated with technology
- Effective in wide variety of geologic media
- Retrievable if necessary for final disposal and site restoration.

Disadvantages

- Barrier permeability sensitive to construction materials used
- Not applicable to stopping vertical migration of contaminants
- Specialized equipment and significant setup and cleanup time required
- Significantly increases the amount of contaminated soil requiring treatment
- Excavation activities disturb any contaminated soil present
- Large excavation requirement preclude its use in close proximity to other tanks.

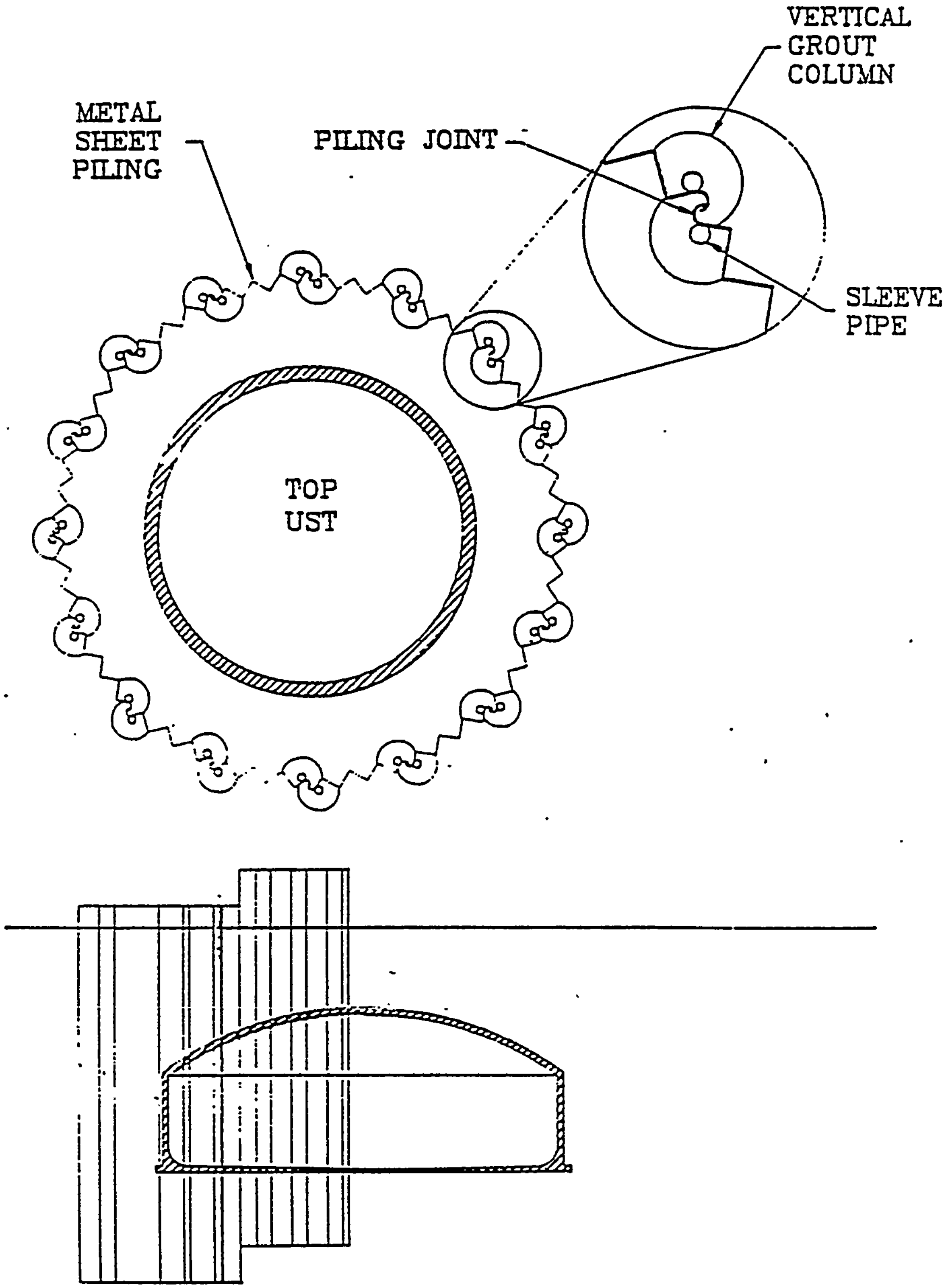
3.3.1.3 **Sheet Piles.** Sheet piles (see Figure 3-5) are routinely used in the construction industry to prevent intrusion of ground water. Sheet piles are interlocked sheets of steel or concrete panels, driven into the subsurface by hydraulic or pneumatic pile drivers. They provide a continuous barrier. The piles that stabilize the sheets are driven into the ground via a jetting shoe, vibratory hammer, or static emplacement. Steel sheet piles are cost-effective, but only a temporary method of retaining the contaminates. They can be installed close to the tanks.

A drawback of sheet piling is the installation problem caused by rocky soils as found in the Hanford tank farms. Damage to or deflection of the piles during installation usually renders the barrier ineffective. Bottom sealing of the containment area is not feasible using this technique.

Advantages

- A developed commercial technology
- May be installed in close proximity to leaking tank
- Barriers easily removed
- Low material costs.

Figure 3-5. Sheet Metal Piling.



Disadvantages

- Sheet piles deflected by rocks, hardened soils, etc., during installation compromises barrier integrity
- Leaks in barrier frequently occur between sheet pilings
- Vibrations from pile driver in close proximity can damage existing piping, equipment, and tanks
- Not applicable to stopping vertical migration of contaminants
- Sheet piling is subject to corrosion
- Significantly increases the amount of contaminated soil requiring treatment.

3.3.2 Ground Freezing Option

Artificial ground freezing (see Figure 3-6) involves the installation of freezing loops in the ground and a self-contained refrigeration system that pumps coolant through the loops. By injecting coolant (e.g., ethylene glycol or liquid nitrogen) into the loops, the soil can be cooled below the freezing point. Ground freezing renders the soil practically impermeable. It has high operations and maintenance costs.

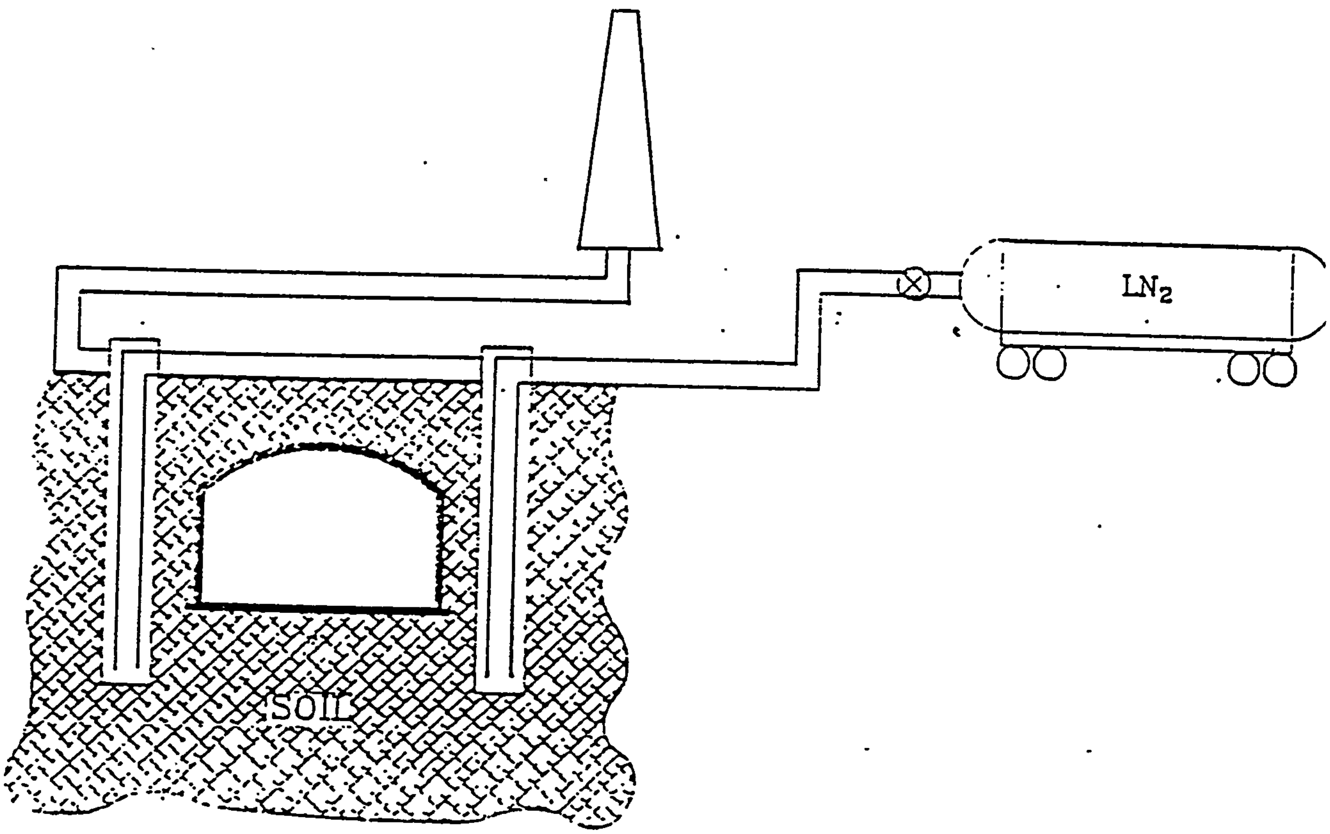
Two freezing methods have been used to date: (1) slow-rate freezing in closed-loop systems or (2) rapid-rate freezing in open-loop systems using liquid nitrogen. Open-loop systems are advantageous because they achieve much lower temperatures (-321 °F) than compressor-type closed-loop systems that achieve freezing temperatures of -4 °F.

The primary advantage of the freezing technologies is that they require no chemicals or additives that may restrict future options. Ground freezing has been used in the construction industry to prevent groundwater intrusion. Both vertical and horizonal barriers are possible and the subsurface around the tank can also be included. Because operations and maintenance costs are high, this technique is considered short-term. Ground freezing may induce thermal stresses in tanks nearby and cause stress cracking in the concrete and metal lining. Frozen soils expand and could damage tank structures.

Advantages

- Isolates tank and prevents further leakage
- Impermeable barrier to horizontal and vertical migration of contaminants
- Commercially available technology
- Effective in all soil media
- Little impact on decontamination and site restoration activities.

Figure 3-6. Ground Freeze Barriers.



Disadvantages

- Expensive to install, operate, and maintain
- Freezing soils expand to stress and possibly damage tank structures and underground equipment
- Freezing and thawing soils induce soil heaving and cracking, which permits existing soil contaminants to migrate faster.

3.3.3 Deep Soil Mixing Option

In deep soil mixing, augers (3 to 5 ft diameter) are used in parallel to drill holes up to 75 ft deep. Grout is mixed with soil on the surface and returned to the hole. Excess spoils are disposed. The technology is widely used in Japan to remediate sites. Its use in the United States has been limited. Unresolved contaminant control and health safety issues would likely preclude its use for the Tank 241-T-101 site.

Advantages

- Relatively impermeable, long lasting barrier
- Barrier materials readily available at low cost
- Extensively used to immobilize existing contaminated soils in Japan
- Compatible with most hazardous chemicals.

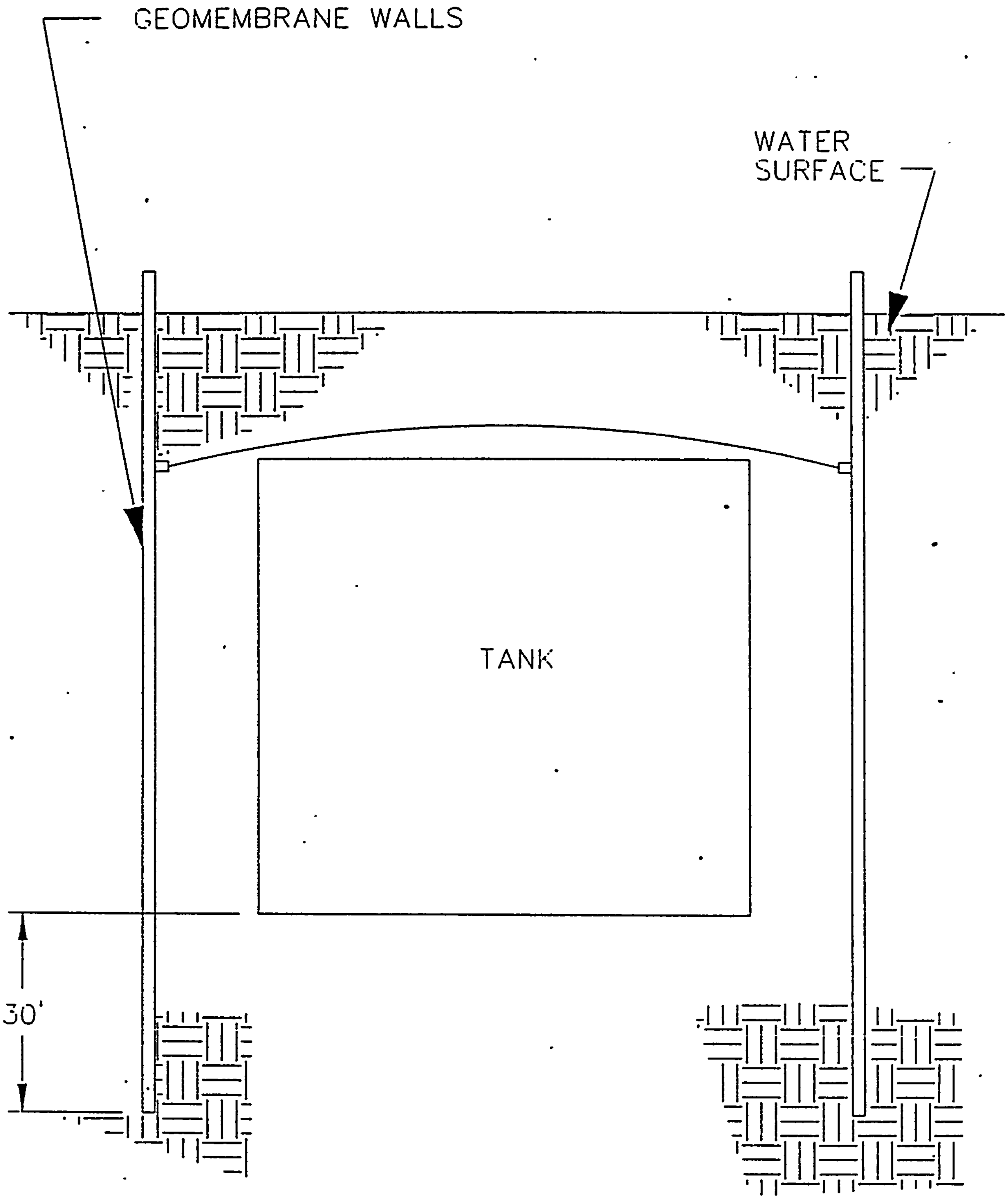
Disadvantages

- Large soil piles generated during excavation with a high potential for disturbing contaminated soils
- Area required for excavation and barrier construction may preclude or limit its use in existing tank farms
- Barrier integrity questionable--leaks possible between pours and excavation activities likely to disturb previous pour
- Unresolved technology and health and safety issues associated with this technology. Not approved for use in the U.S.A.
- Not applicable to stopping vertical migration of contaminants.

3.3.4 Geomembrane Walls Option

Geomembrane walls consists of high-density polyethylene sheets (80 mils or greater in thickness) that are interlocked and vibrated into place with a steel insertion plate, much like sheet piling (see Figure 3-7). The interlocks between the sheets incorporate a hydrotite seal made of chlorphene to ensure water tightness. Superior chemical resistance and compatibility with radioactive materials makes this a viable barrier system. High-density polyethylene (HDPE) liners are an acceptable means of containment for hazardous wastes because of their impermeability and environmental stress characteristics.

Figure 3-7. Gundle Vertical Barrier System.
(CAD FILE: FIG01)



The membrane can be installed either by unrolling it in a slurry trench or mounting it onto steel frames and lowering the frames into the slurry mixture. It is common to install panels in slurry walls, installations up to 35 ft deep have been vibrated into place with vibratory hammers. Sandy soil conditions at the tank may permit the panels to be installed to a lower depth.

Geomembrane walls are exclusively marketed by Gundle Lining System, Inc., as Gundwall Exterior Barrier Systems. As a in situ stabilization system, Gundwall is an emerging technology in the U.S. The system involves no additional chemicals to the soil and suitability is high for the arid environment. Stabilization by geomembrane walls involves no significant public or worker safety risks, except that it requires heavy equipment for installation. Because of the success of geomembrane liners as a barrier system for hazardous wastes, acceptability with regulators should be high and would help in eventual closure/postclosure of the Site. Though the system will prevent horizontal migration of contaminants, vertical movements are not restricted. The method imposes no constraints to waste retrieval, storage, or transfer of tank contents. Geomembrane walls coupled with vertical and horizontal jet grout curtains may deserve a large scale demonstration at this site.

Advantages

- Long lasting, impermeable barrier to horizontal migration of contaminants
- Compatible with hazardous chemicals and radionuclides
- Technology commercially available
- Installation flexible and relatively easy in sand soils
- Retrievable if necessary for final site closure.

Disadvantages

- Barrier susceptible to leaks between membranes if not carefully installed
- Heavy equipment required for installation
- Not applicable for stopping vertical migration of contaminants
- Technology relatively new in the U.S.A.
- Permits significant amounts of soils to potentially become contaminated and require treatment.

3.4 LIQUID RETRIEVAL ALTERNATIVE

The liquid retrieval alternative is defined as removal of tank supernate and pumpable interstitial liquids from solid wastes.

Supernates are typically removed by a submersible pump. Removal of the interstitial liquid contained in the waste solids is achieved by a process called salt well jet pumping. The residual liquid left in the tank after this process is largely held in the solids by physical and chemical forces. The amount available to drain through a breach in the tank, if the breach is below the remaining solids, is small.

The quickest way to emergency pump is by using a submersible pump followed by a jet pump. The submersible pump is capable of pumping 10 to 30 gal/min. The jet pump is capable of pumping between 0.05 and 4.0 gal/min. The submersible pump discharges the liquid in a short time. The pump can quickly reduce the driving force behind the leak to minimize the impact from liquids leaking into the environment. In some cases, jet pumping may be the only pumping option. This occurs when the liquid is interstitially dispersed within the solids.

The common process facilities and equipment needed for the pumping of Tank 241-T-101 are:

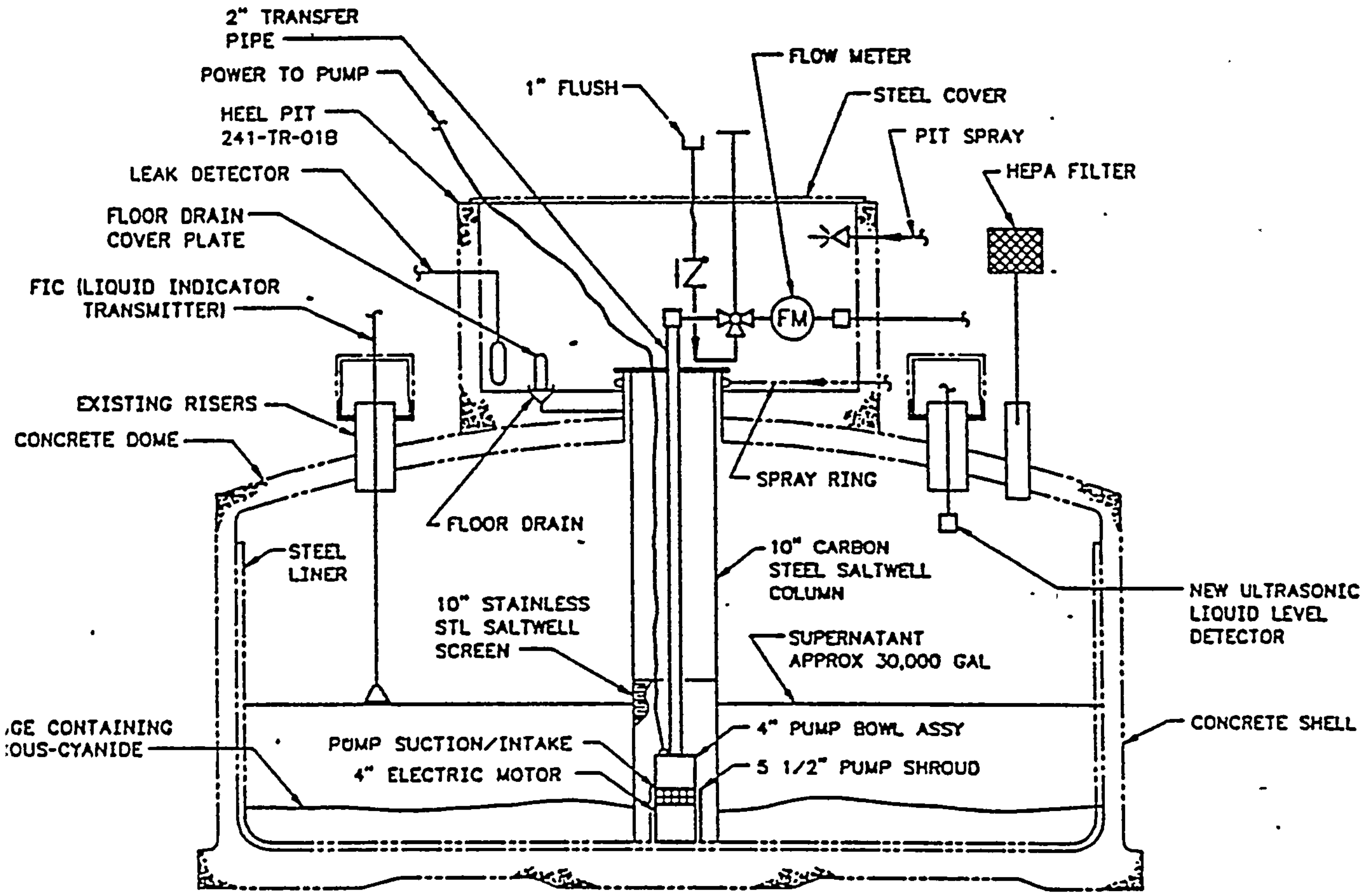
- Pump Pit, Salt Well, Screen, and Submersible/Jet Pump Assembly--The equipment and installations required for pumping are (1) a pump pit, (2) a salt well screen, (3) a submersible/jet pump assembly, (4) flushing assembly, (5) flex-hose jumpers, and (6) associated controls.

- Pump Pit--The dome of an SST is built with several risers of different diameters, one of which protrudes into the pump pit. A pump pit is a concrete structure located above the tank dome near the center of the tank with a drain in the bottom that empties into the tank. The pumping system is housed within the pump pit with portions of it extending into the riser and tank.

- Salt Well Screen--The salt well system is a 10 in. diameter salt well casing consisting of a stainless steel salt well screen welded to a Schedule 40 carbon steel pipe (reference drawing H-2-38587). The casing and screen are to be inserted into the 30.5 cm (12-in.) tank riser located in the pump pit. The stainless steel screen portion of the system will extend through the tank waste to near the bottom of the tank. The salt well screen portion of the casing is a 10 ft length of 300 Series, 10 in. diameter, stainless steel pipe with screen openings (slots) of 0.050 in. Because the waste level is at less than 4 ft, the salt well screen will extend above the tank waste. Therefore, the salt well is open to the tank's atmosphere (see Figure 3-8). The function of the salt well screen is to allow liquids to flow in while minimizing the size and amount of solids impacting the pump.

- Submersible Jet Pump Assembly--The submersible pump is to be mounted to a 2 in. transfer pipe extending up through the tank and the adapter flange to the pump pit. From the adapter flange, the waste will be routed through a horizontal discharge flange. The discharge flange will be connected by a process jumper to the wall nozzle and, finally, to the waste transfer line. A flex-hose jumper will tie into the process jumper to provide flushing capabilities.

Figure 3-8. Tank 241-T-101 Salt Well System.



TANK 241-T-101

The submersible pump assembly needed to pump liquid from the salt well screen into the pump pit has a 5-horsepower motor driven by 480 volt, 3-phase power (reference drawing H-2-73896). The motor is located below the pump intake and is submersed in the liquid. The pump is rated at 40 gal/min at 39.624 m (130 ft) total dynamic head, for liquid with a specific gravity of 1.7. The pump motor is cooled by the liquid being pumped. To aid liquid flow past the motor, the pump has a flow director shroud (see Figure 3-8).

Important instrument and control systems include leak detection and submersible pump controls including safety interlocks. The interlocks that shut down the pumps include loss of pump outlet pressure, excess pressure in the flush leg, leak detection in the pump pit, area radiation detection, leak detection in the double-contained receiver tank (DCRT), and DCRT at maximum operating level. An additional interlock associated with the pump itself is a thermal overload device designed to shut off the pump in the event the pump temperature increases from pumping air or stoppage by excessive sludge.

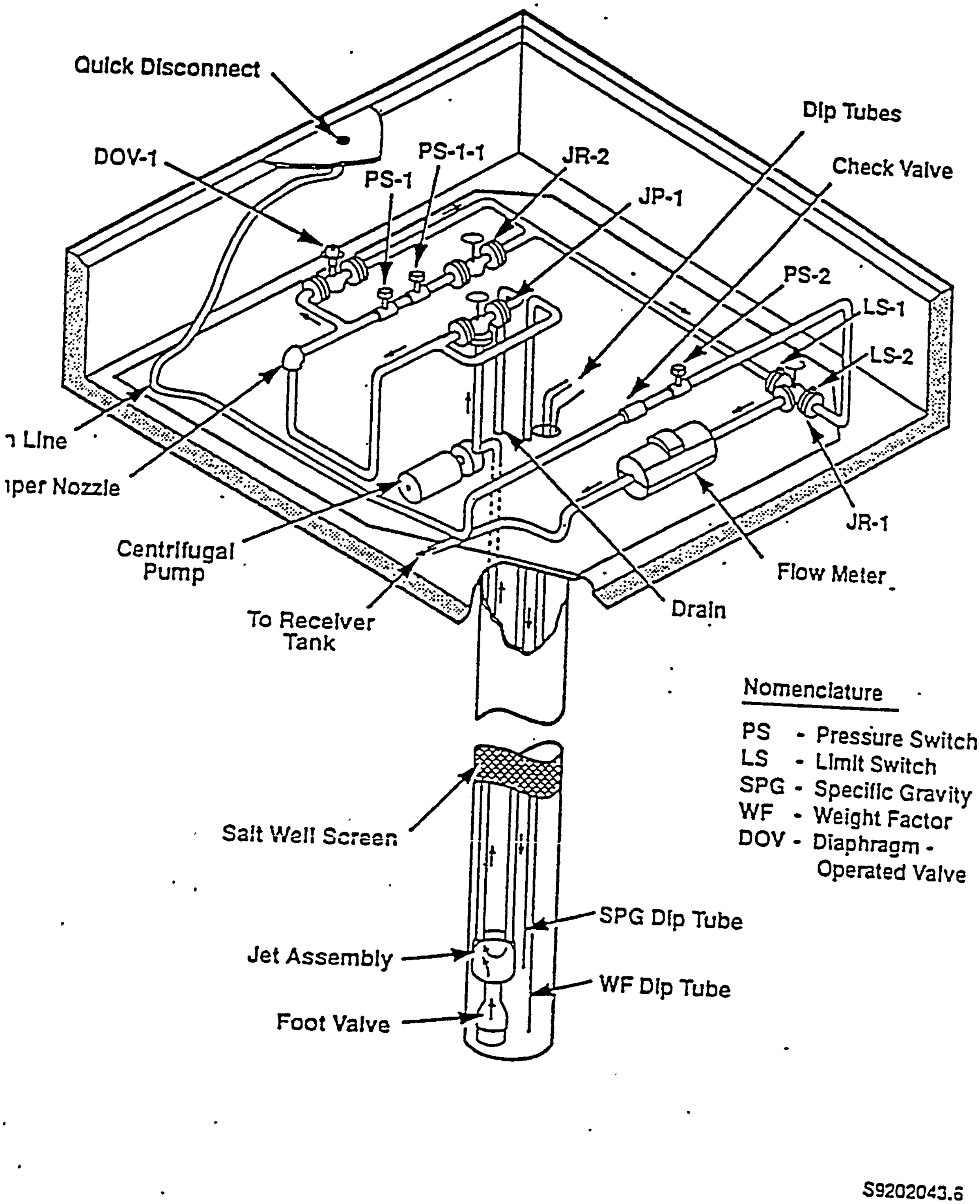
The jet pump system includes (1) a jet assembly with foot valve mounted to the base of two pipes that extend from the top of the well to near the bottom of the well casing inside the salt well screen, (2) a centrifugal pump to supply power fluid to the down-hole jet assembly, (3) flexible or rigid transfer jumpers, (4) a flush line, and (5) a flowmeter (see Figure 3-9). The jumpers contain piping, valves, and pressure and limit switches. Instrumentation and control devices are located within the pump pit.

The centrifugal pump and jet assembly are needed to pump the interstitial liquid from the salt well screen into the pump pit, nominally a 12.192 m (40 ft) elevation rise. The centrifugal pump, rated at approximately 30 gal/min at 30 psig, pressurizes power fluid to the jet assembly located in the salt well screen. The power fluid passes through a nozzle in the jet assembly and acts to convert fluid pressure head to velocity head, thereby reducing the pressure in the jet assembly chamber. The reduction in pressure allows the interstitial liquid to enter the jet assembly chamber and mix with the power fluid. Velocity head is converted to pressure head above the nozzle, lifting power fluid, and interstitial liquid to the pump pit. Pumping rates vary from 0.05 gal to about 4 gal/min. Reference drawing H-2-73990 depicts a jet pump system.

Raw water is used to fill the salt well jet pump system loop and prime the pump for operation. A recirculation loop permits the prime on the pump to be maintained at very low pumping rates. The energy produced by the pump's operation can heat the recirculated liquid about 30 °F above tank temperatures.

Jet pump system controls include limit switches and safety interlocks. The interlocks that shut down the pump include (1) loss of pump outlet pressure, (2) excess pressure in the flush leg, (3) high pressure in the circulation loop, (4) leak detection in the pump pit, (5) area radiation detection, (6) leak detection in the DCRT, and (7) DCRT at maximum operating level.

Figure 3-9. Salt Well Jet Pump.
(ER3415/TMBM4)



SALT WELL JET PUMP

- Double-Contained Receiver Tank (Tank 244-TX)--The salt well waste from Tank 241-T-101 will initially go to the DCRT underground Tank 244-TX. Tank 244-TX is a 25,000 gal cylindrical tank. The tank is positioned with its axis horizontal in the lower section of the reinforced concrete vault. Above the tank vault, and connected to it are a pump pit and a filter pit. An instrument enclosure is above the tank vault, but not connected to it.

  The pump pit contains transfer and agitator pumps and jumper connections with valves to the transfer lines. The filter pit contains a ventilation system equipped with HEPA filters. The tank vault contains the receiver tank and sump well. Associated instrumentation is contained in the instrument pit (see Figure 3-10).

  The ventilation system maintains the receiver vessel and annulus under negative pressure with respect to the atmosphere to prevent the release of radioactive materials in case of a tank breach. Supply air is taken into the tank annulus through a coarse filter and a HEPA filter. The exhaust system pulls air from the annulus intake and the inner tank through a coarse filter and two stages of HEPA filters.

  Safety considerations and controls on the ventilation system provide dampers and valves for regulation/isolation, measurement of differential pressure across the filters, continuous radioactive particulate monitoring and record sampling of exhaust air, and continuous flow measurement of exhaust air.

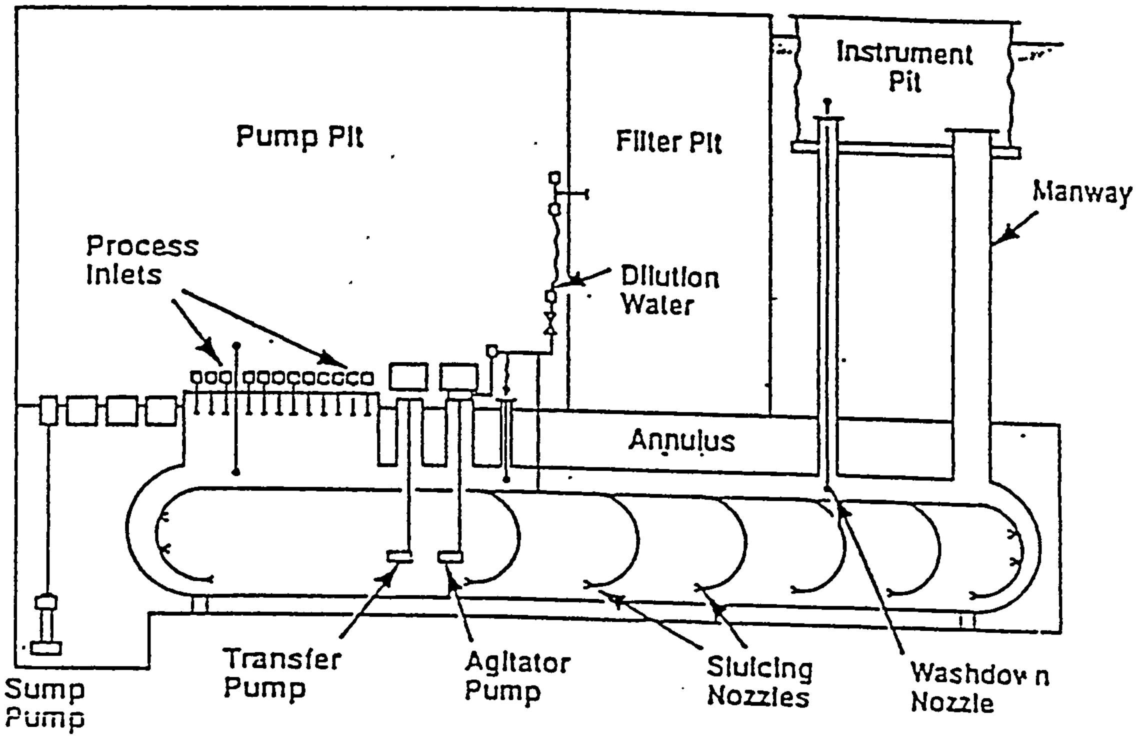
  The leak detectors in the DCRT sumps are interlocked with the primary pumps to shut down if there is a leak in the DCRT. Leak detectors are also installed in the filter pits or filter housing.

  To minimize the sedimentation of solids from liquor in the piping systems, the capability of water dilution is provided in the DCRT. In Tank 244-TX, rotating spray nozzles are installed inside the tank to aid in tank flushing. Also, sluice jets and flow from a pump agitator provide a way to resuspend solids, and keep them in slurry form.

- Double-Shell Waste Storage Tank--The transfer continues from Tank 244-TX to Tank 241-SY-102 after verification of compatibility by sampling and analyzing samples. Sample results from both sending and receiving tank after comparison to the Tank Farm Waste Compatibility Program, WHC-SD-WM-OCD-015, must show there is no compatibility problem. If sample analysis determines that Tank 241-T-101 in the 200 West Area contains complexed waste, a compatible receiver tank in that area may not be available.

- Associated Instrumentation and Controls--Leak detection is provided in each pump pit in the transfer system. Leak detection in each pit is interlocked to shut down the transfer pump. A flashing light and an audible alarm, located on top of the pump control station outside the pump pit area, alert tank farm operators of a shutdown condition.

Figure 3-10. 224-TX Tank Vault.
(ER3415/TMBM3)



244-TX TANK VAULT

Before pumping, the following existing or new devices would be required:

Tank 241-T-101

- New ultrasonic liquid level monitoring system (optional).
- New in-tank photography or a closed-circuit television (CCTV) system.
- New raw water supply for priming jet pump, flushing jumpers, and transfer lines.
- An available source of power shall be identified that is compatible with the pump to be used.
- Move the existing emergency pumping equipment trailer to the tank farm when the jet pump is used. The trailer is equipped with operational instrumentation, pump control station, power cable, air compressor and pump pit leak detection as described in WHC-SD-WM-AP-005, *SST Leak Emergency Pumping Guide*.

• Transfer Piping--The transfer piping options are listed in the following subsections.

3.4.1 Pump Out Option - Existing Pipeline

Tank 241-T-101 has several existing buried carbon steel pipelines ranging in size from 5.08 cm (2 in.) to 15 cm (6 in.) in diameter.

The 5.08 cm (2 in.) lines are direct buried (in soil) and were installed in 1980. The 8 cm (3 in.) and 15 cm (6 in.) lines are in concrete encasements that were installed in 1952.

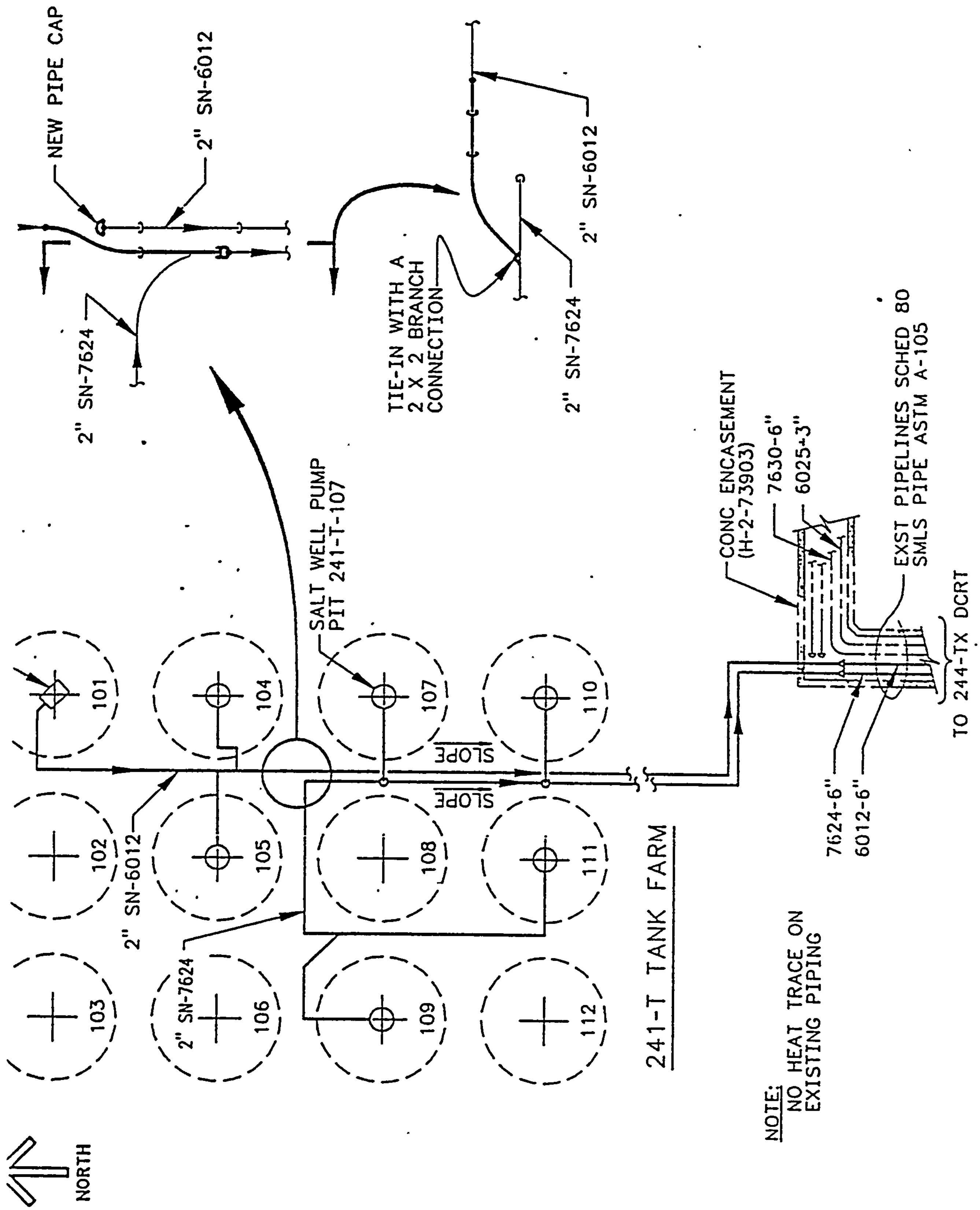
Leak detection is provided in each pit in the transfer system, and is interlocked to automatically shut down the pump upon leak detection. A flashing light and an audible alarm alert tank farm operators to the shutdown condition. This system is located on top of the pump control station outside the pump pit area.

These existing pipelines are not heat traced, and only the southern part that connects to Tank 244-TX is insulated. The pipelines are sloped downward in the direction of flow for drainage.

3.4.1.1 Pipeline SN-6012. This transfer route uses existing buried piping from Tanks 241-T-101 to 244-TX as shown in Figure 3-11.

The northern and southern part of the pipe route is 5.08 cm (2 in.) Schedule 40 carbon steel welded pipe direct buried with 1 m (3 ft) of ground cover to provide shielding, and was constructed in 1980. The middle portion is 15 cm (6 in.) Schedule 80 carbon steel pipe buried in a concrete encasement, and constructed in 1952.

Figure 3-11. Existing Transfer Routes.
(ER3415/TMBM5)



The design life of the salt well pumping transfer lines was 5 years. They are now more than 10 years old. The lines must be pressure tested before use, and every 6 month during use, to ensure against leaks. The pipeline integrity was verified in 1992 with a hydrostatic test pressure of 200 lb/in^2.

Since the transfer line is a three-pronged manifold system from the T-101, T-104, and T-105 pump pits to the joint transfer line (SN-6012) going to Tank 244-TX, leak detection is provided in each pump pit, T-101, T-104, T-105, and at Tank 244-TX (see Figure 3-11).

3.4.1.2 Combination of Pipeline Segments. This transfer route would be used if a section of pipeline 5.08 cm (2 in.) SN-6012 (reference subsection 3.4.1.1) failed.

This route requires pipeline 5.08 cm (2 in.) SN-6012 from Tank 241-T-101 be tied into line 5.08 cm (2 in.) SN-7624 that routes to Tank 244-TX as shown in Figure 3-11.

The northern and southern part of the pipe route is 5.08 cm (2 in.) Schedule 40 carbon steel pipe direct buried, and constructed in 1980. The middle portion is 15 cm (6 in.) Schedule 80 carbon steel pipe buried in a concrete encasement, and constructed in 1952.

The pipeline integrity was verified in 1980 by hydrostatic testing at 150 psig.

3.4.2 Pump Out Option - New Pipeline

When a tank is identified as an assumed leaker and a pipeline from the tank to a DCRT, or DST does not exist, or does exist, and has failed, a new pipeline with encasement is required.

The new line will be pressure-testable and equipped with a leak detection system. The new pipeline would be routed from Tank 241-T-101 heel pit TR-01B to the closest useable line in T-Tank Farm that is approximately 61 m (200 ft.) If a useable line does not exist, the new pipeline would be routed approximately 488 m (1,600 ft) to the 244-TX receiver vault as shown in Figure 3-12.

3.4.2.1 Pipeline Below Grade. A new pipeline would be installed below grade in an existing tank farm.

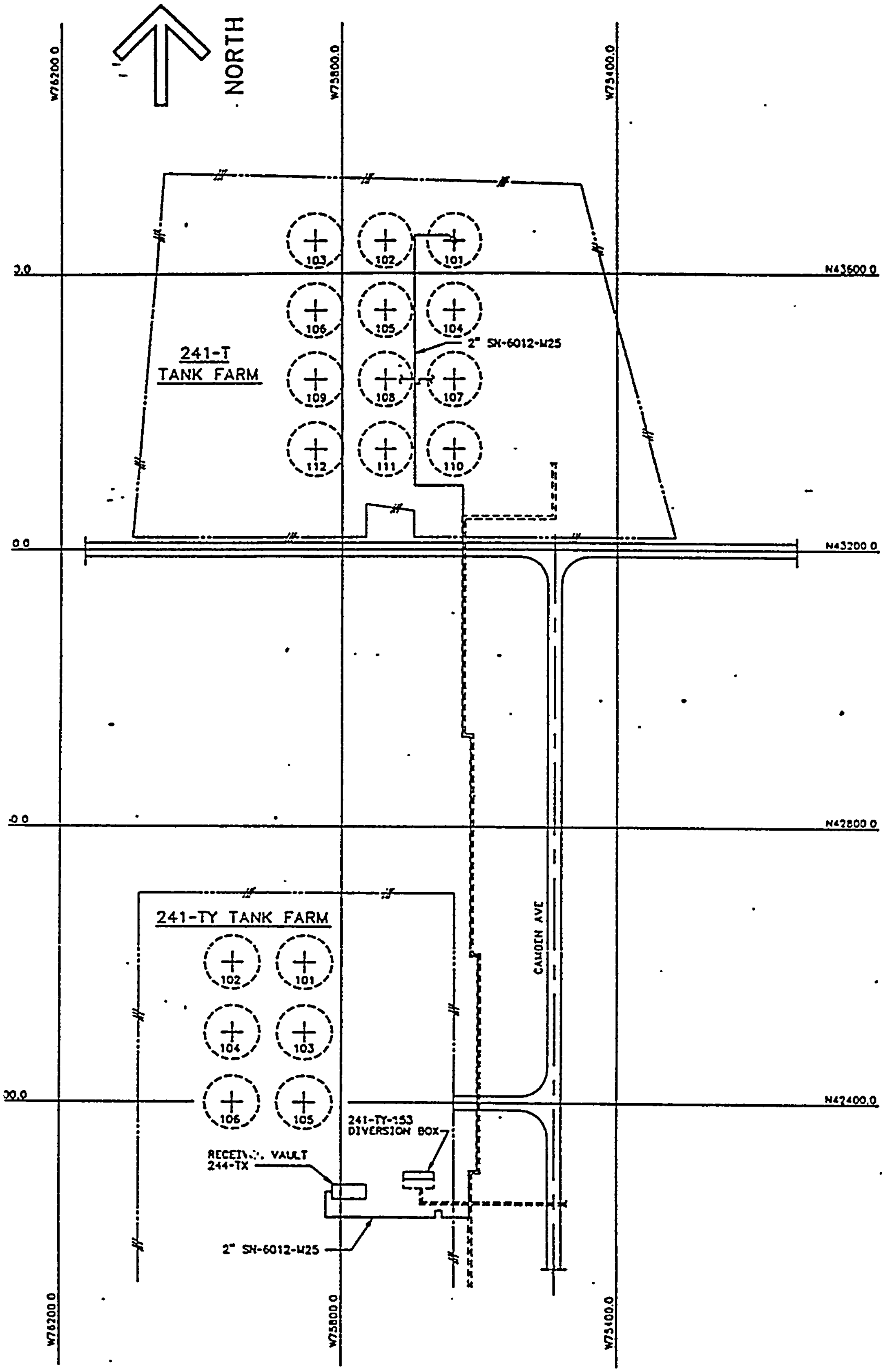
Advantages

- Earth cover provides shielding
- Does not impede accessibility of personnel or equipment
- Line can be sloped to drain in one direction
- Complies with past transfer methods
- Complies with laws/regulations.

Disadvantages

- Not conducive to emergency pumping time restraints (excessive time required for designing, procuring, fabricating, installing, and testing)

Figure 3-12. New/Existing Transfer Route.
(ER3415/TMBM7)



- Contaminated soil may be encountered during excavation
- Excavation will expose other buried obstacles that may affect the design
- Limited accessibility for inspection and/or repair.

3.4.2.2 Pipeline Above Grade. Install a new pipeline on grade and add an earth berm as required for shielding or install a temporary double-contained piping system above grade.

An addendum to safety analysis report (SAR) SD-WM-SAR-034 must be prepared to evaluate the aboveground transfer.

Advantages

- Requires less time to install than a below grade line
- Cost is less than a below grade line
- Reduced chance of encountering soil contamination
- Inspection and repair accessibility
- Complies with laws/regulations

Disadvantages

- Impedes access of equipment and personnel
- Line must be sloped to drain to both ends
- Leak detection required at both ends of the transfer line
- The transfer line will have a high point (air entrapment)

3.4.3 Pump Out Option - Tank Truck/Railcar

Pumping supernate and drainable interstitial liquid from solid wastes in Tank 241-T-101 into a tank truck, or tank railcar, would use the equipment listed for Tank 241-T-101, and Heel Pit 241-TR-01B (reference section 3.4). Flow measurement and control would also be required in the remote pipe jumper.

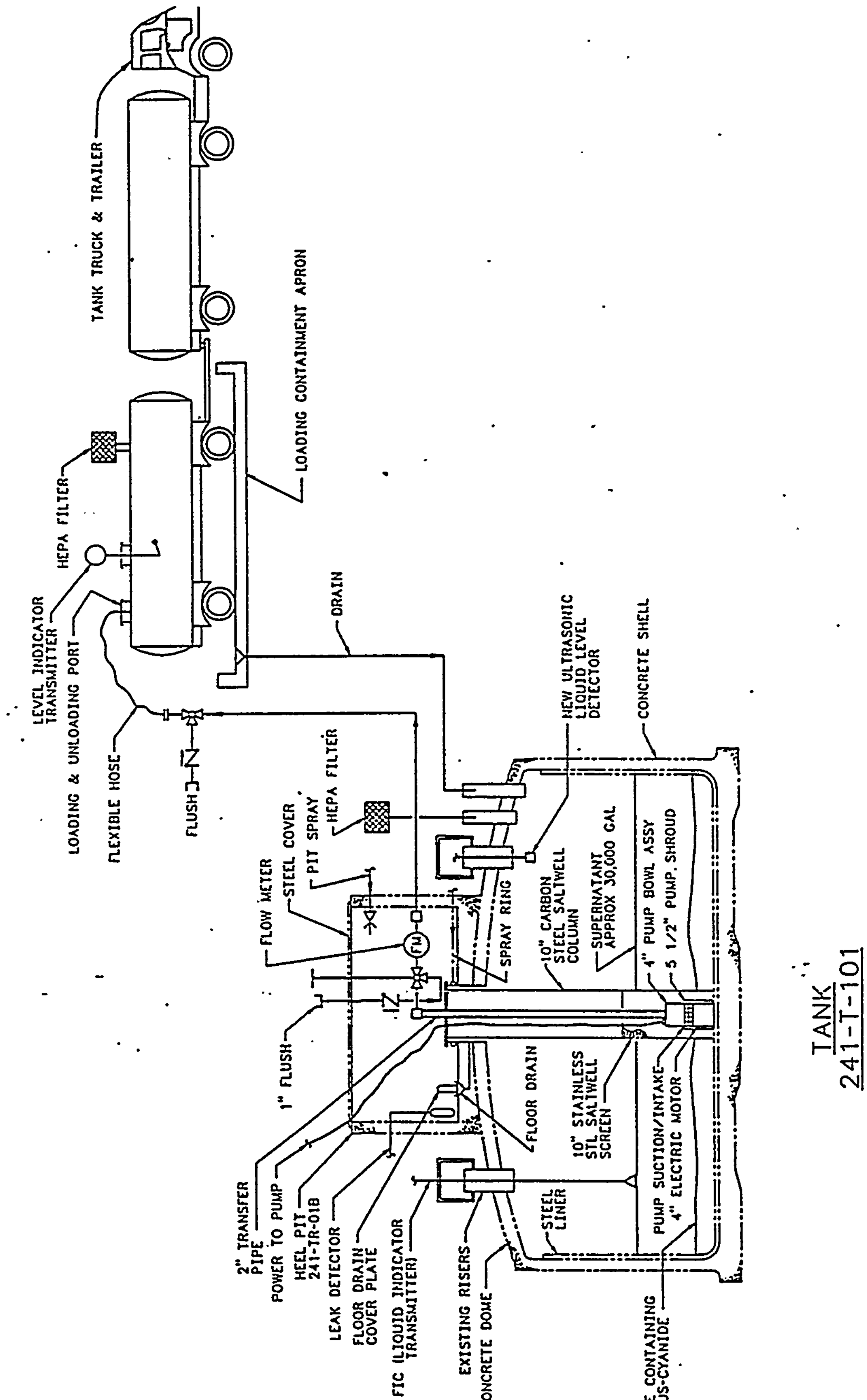
The transfer piping from the heel pit to the tank truck or railcar is described in Subsection 3.4.2.2, as a temporary double contained piping system.

The tank liquid would be sampled and analyzed along with core samples for tank characterization before pumping.

An addendum to SAR SD-WM-SAR-034 would be prepared to evaluate this type of transfer.

3.4.3.1 Tank Truck. The 3,000-gal capacity tank truck and trailer can be driven into the tank farm fenced area and parked adjacent to Tank 241-T-101 on a loading containment apron, as shown in Figure 3-13. The containment apron will drain back to the Tank 241-T-101 in the event of a spill. The drain will be plugged when not in use. After loading, the waste will be delivered to the 244-AR unloading facility in the 200-East Area. The waste can be transferred from the 244-AR unloading facility through existing buried, encased pipe lines to a number of DSTs.

Figure 3-13. Tank Truck Transfer.
(ER3415/TMBM5)



The trailer will be equipped with:

- A HEPA filter to remove any particulates from the air
- Level indicator transmitter interlocked with transfer pump to effect a shutdown on high-level condition
- Loading port with rupture disc and pressure relief valve
- Unloading port
- Shielding.

3.4.3.2 **Tank Railcar.** There is a railroad track approximately 900 ft on the east and west sides of T-Tank Farm. The tank railcar with a capacity of approximately 15,000 gal could be positioned at one of the track and filled via a new pipeline from Tank 241-T-101 as shown in Figure 3-14.

The tank railcar equipment, filling, transporting, and unloading will be similar to the tank truck and trailer described in Subsection 3.4.3.1.

Future decommissioning and cleanup of all tanks in Tank Farm T, TX, and TY could justify building a railroad spur along the west side of the tank farms.

3.4.4 Pump In Option - Internal Bladder Vessel

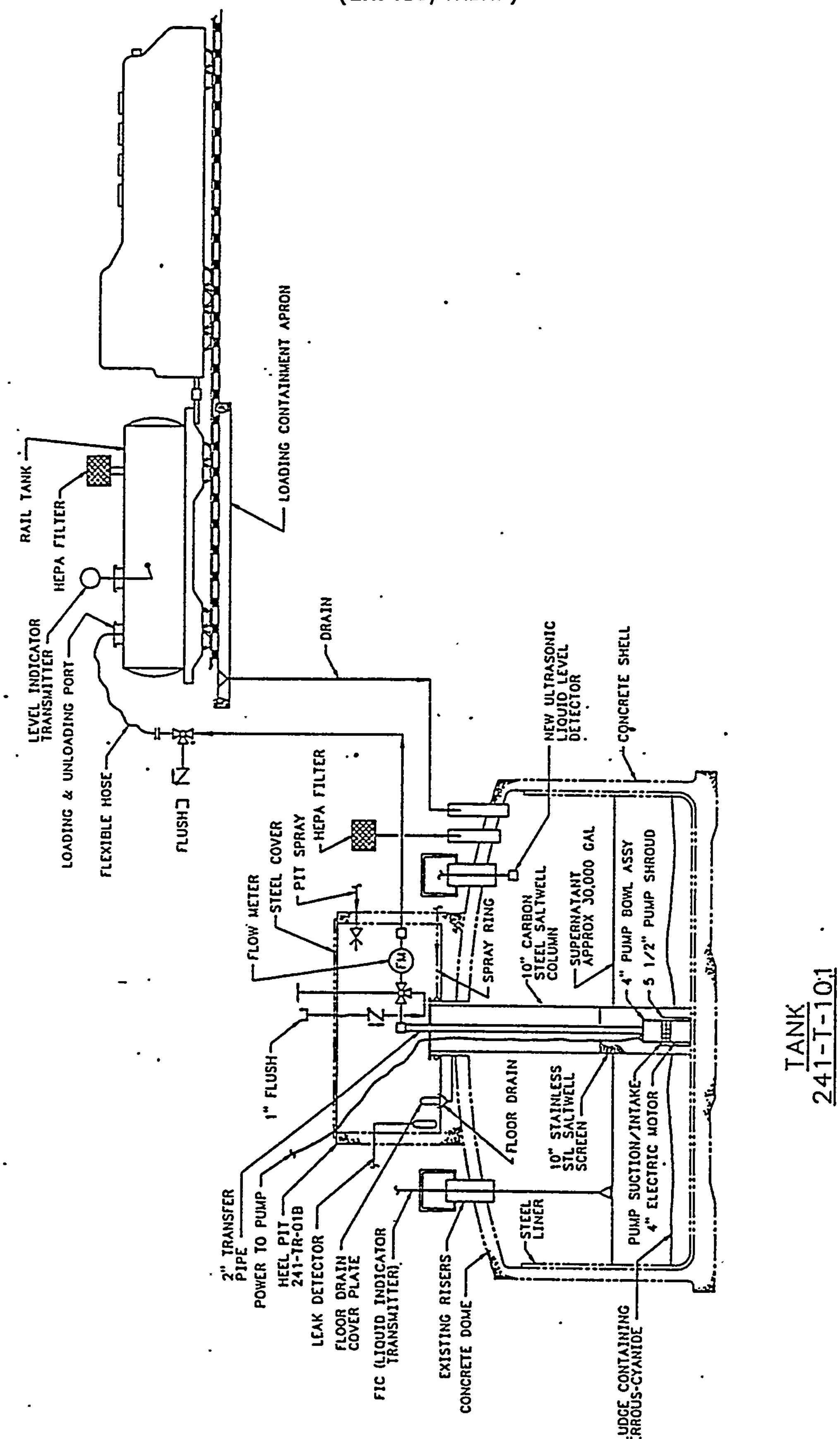
If Tank 241-T-101 or a similar SST were found to be leaking, a resilient material bladder with a sump pump attached to it could be placed in the bottom of the tank through a new or existing tank riser. The sump pump would then be energized to transfer the supernate into the bladder vessel. The supernate would be temporarily contained and the leak alleviated. At an appropriate time, the bladder vessel could be pumped out and the bladder vessel removed.

Tank 241-T-101 has 30.5 cm (12 in.) diameter risers near the tank edge opposite each other and one 30.5 cm (12 in.) diameter riser on the center that could be used to insert three 10,000 gal capacity bladder vessels with sump pumps. Alternatively, if a 30.5 cm (12 in.) riser is large enough to accommodate the insertion of a single 30,000 gal capacity bladder, the center riser would be used. Technology for the bladder vessel has not been developed for wastes similar to those at Hanford. They have been used extensively in the petrochemical industry.

3.5 TOTAL RETRIEVAL ALTERNATIVE

Total retrieval of contents from within Tank 241-T-101 shall be defined as removing as much of the existing liquids and salt cake/sludge as practical. The selected total retrieval system will be required to dislodge/mix tank contents before pumping the slurry/sludge mixture via new encased lines to an approved double-shell storage tank. Currently, the proposed retrieval systems are thought to be the most viable to accomplish total retrieval.

Figure 3-14. Tank Railcar Transfer.
(ER3415/TMBM7)



3.5.1 Unlimited Sluicing Option

The unlimited sluicing (low pressure - high volume) retrieval system consists of a pump and a sluicing nozzle to dislodge and mix solids followed by pumping of the suspended solids by a sludge/slurry pump. Unlimited sluicing is similar to the past practice used to remove wastes from Hanford SSTs. Sufficient water would be added by the sluicer to suspend the in-tank sludge.

Description of Unlimited Sluicing. In this system, a sluicing pump will deliver 350 to 400 gal/min of liquid at a pressure of 175 lb/in^2 to a 1-in. diameter nozzle. Note: with a liquid velocity in excess of 100 miles/hour leaving the sluicing nozzle, the liquid stream should dislodge and suspend the in-tank sludge. The sluicing nozzle assembly will be inserted into the tank and move in a horizontal and vertical pattern to cover the entire tank bottom. A sludge/slurry pump will pump 350 to 400 gal/min of slurry through a new encased pipe transfer line to a double-shell receiver/lag storage tank (see Figure 3-15).

The slurry will be allowed to settle in the receiver/lag storage tank and the decanted supernate shall be recycled back through the sluicer assembly located on Tank 241-T-101. Note: using the recycled supernate will minimize the need to add liquids to the sluicing operation.

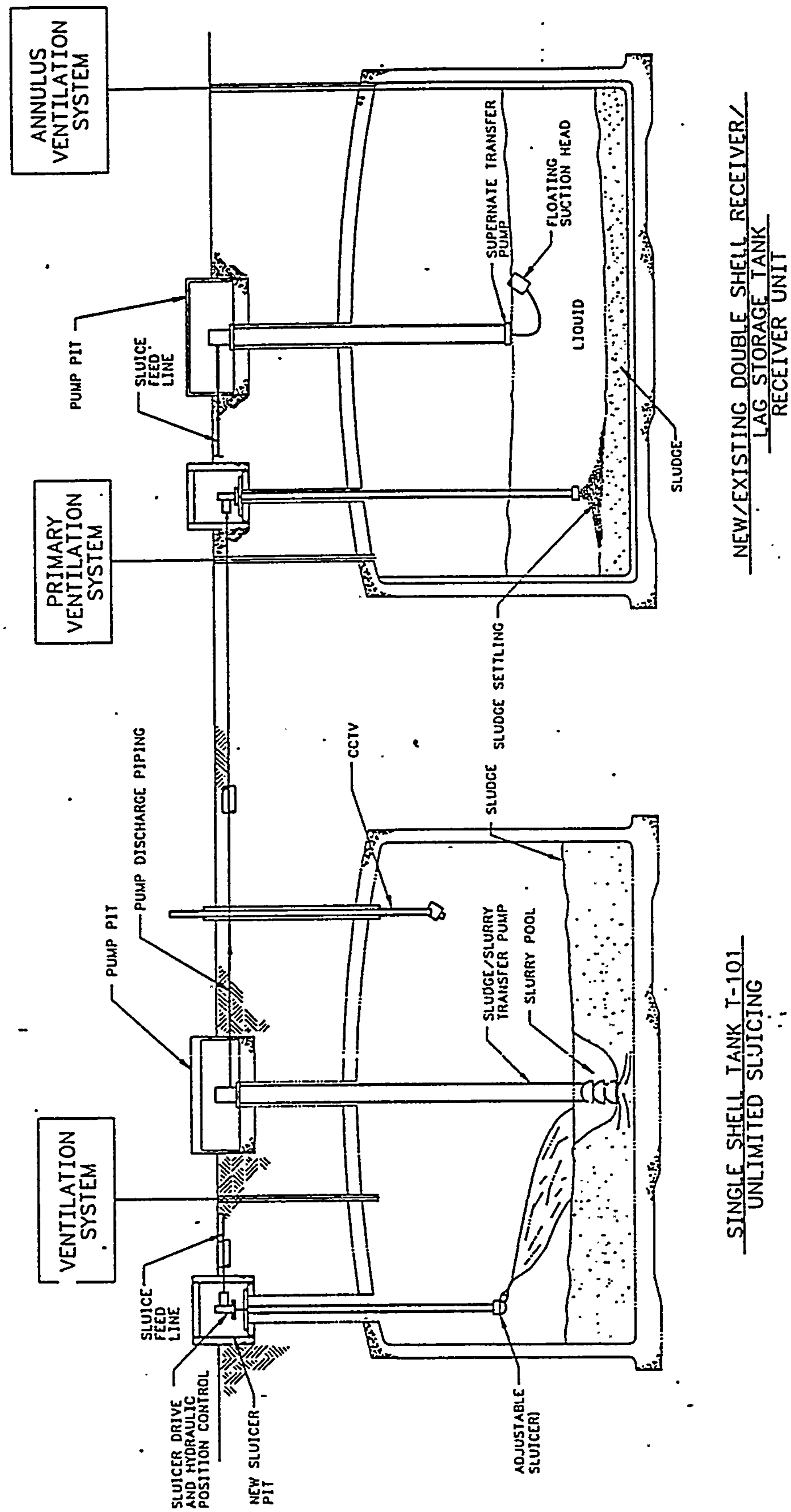
Advantages

- Unlimited sluicing techniques are well known and a proven Hanford technology
- Sluicing is adaptable to the specific needs of Tank 241-T-101 sludge clean out
- The new unlimited sluicer could be installed in the existing 30.5 cm (12 in.) riser R-3 located in Sluice Pit 241-TR-01C
- A new sludge/slurry pump could be installed in the existing 30.5 cm (12 in.) riser R-10 located in Heel Pit 241-TR-01B
- A new remote two-camera CCTV system could be installed in the existing 30.5 cm (12 in.) risers R-6 and R-2.
- Existing small Tank 241-T-101 risers may need minor modifications to accept new instruments required to monitor and control the unlimited sluicing retrieval system
- The new unlimited sluicing equipment is reusable and can be readily transported and installed for use in other SSTs.

Disadvantages

- The existing heel pit 241-TR-01B may require structural upgrades to permit installation of a new sludge/slurry pump (e.g., new cover blocks, shielding plugs, metal pit liner, and pit reconfiguration

Figure 3-15. Unlimited Sluicing.



- Existing equipment pits on Tank 241-T-101 to be reused for the installation of unlimited sluicing equipment need to be modified for installation of a 3,000 lb/in^2 decontamination system
- The existing sluice pit 241-TR-01C may require structural upgrades to permit installation of a new unlimited sluicing assembly (e.g., new cover blocks, shielding plugs, metal pit liner, and pit reconfiguration)
- Sluicer technologies are inefficient for removing sludge. Large volumes of liquid (as much as 100:1) are needed to move, mix, and recover SST solids with a low-pressure, high-volume sluicer
- Large capacity double-contained receiving tanks are required to settle sludge/slurry and decant supernate for recycle back to Tank 241-T-101
- A "compliant" recycle/return system is required between Tank 241-T-101 and one or more sludge/slurry double-contained receiving tanks.

3.5.2 Limited Sluicing Option

Limited sluicing (high pressure - low volume) is a variation of the past practiced sluicing method, i.e., the intent to minimize the amount of additional water added to the tank to dislodge solids while preventing high-pressure water from harming the tank walls or other internal fixtures. This is accomplished by carrying out the sluicing operation in a controlled manner. Several sluicing nozzles are placed in close proximity to the sludge and the direction of the water spray is controlled so that dislodged sludge and water are directed toward the center of the tank. Sluicing in this manner creates a slurry pool at the center of the tank that is then pumped out to the designated storage tank. An articulated robot arm concept is shown in Figure 3-16.

The system would use four sluicing arms placed 90 degrees apart in new 46 cm (18 in.) risers. The detailed concept is depicted in Figure 3-17. One cutting nozzle and eight sweeping nozzles are on each sluicing arm. Each sluicing head is positioned by a boom. The nozzle has full altitude control. The boom fore section would have an extension and retraction portion. A screw-jack drive system would move the boom and nozzle carriage up and down. The direction of the nozzle is controlled hydraulically, with both programmed automatic sweep or manual control of the nozzle. The sludge/slurry pump would be sized to fit through the 12 in. opening in the tank's heel pit (241-TR-018) at the center of the tank.

Once pumped out of the tank, the sludge/slurry would be mixed with additional liquids, if required, to permit pump transfer by pipe. The sludge/slurry pump outlet would be connected by a jumper to a dilution feed line, and a new pipe-in-pipe transfer line.

Figure 3-16. Limited Sluicing.

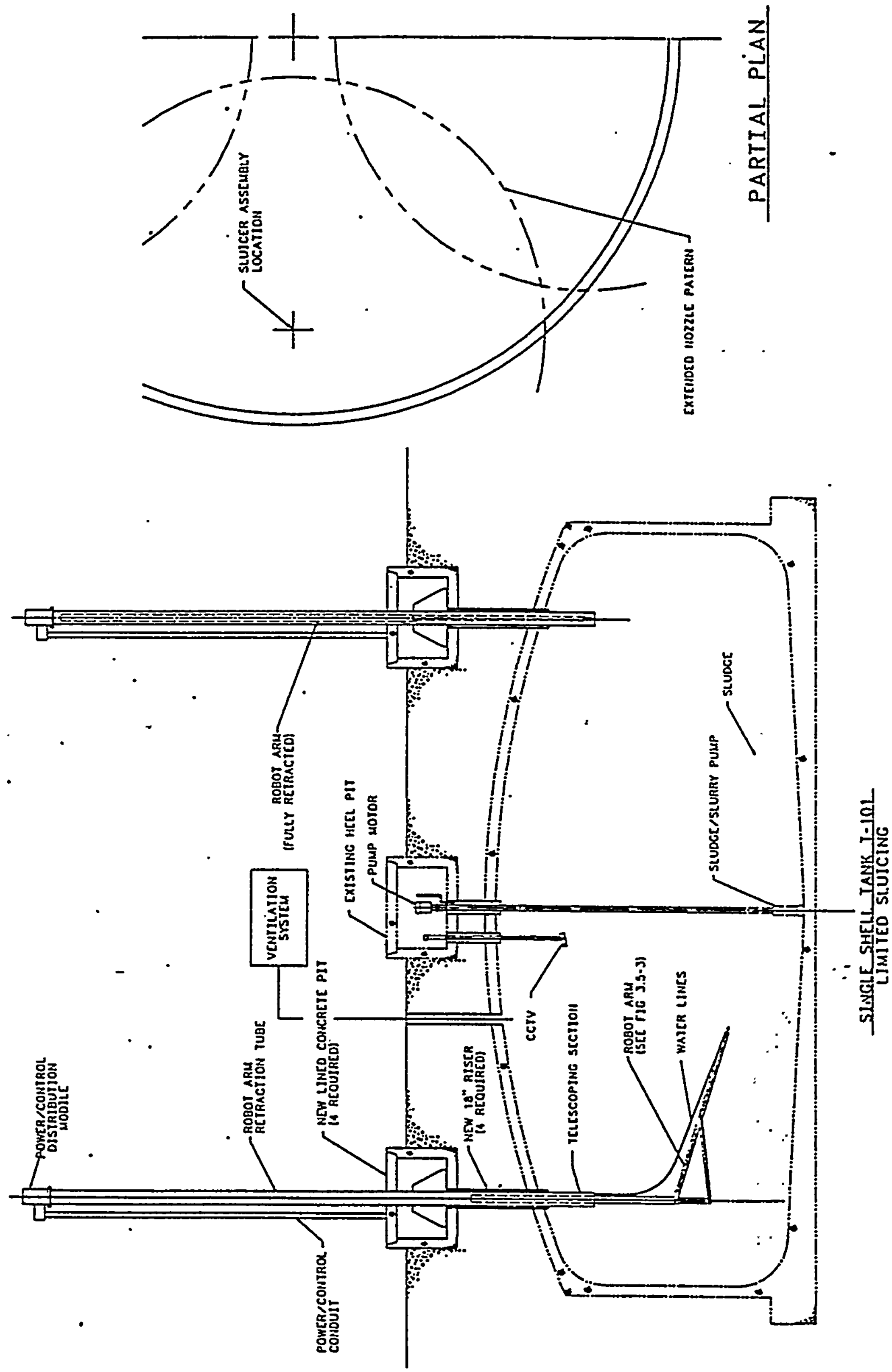
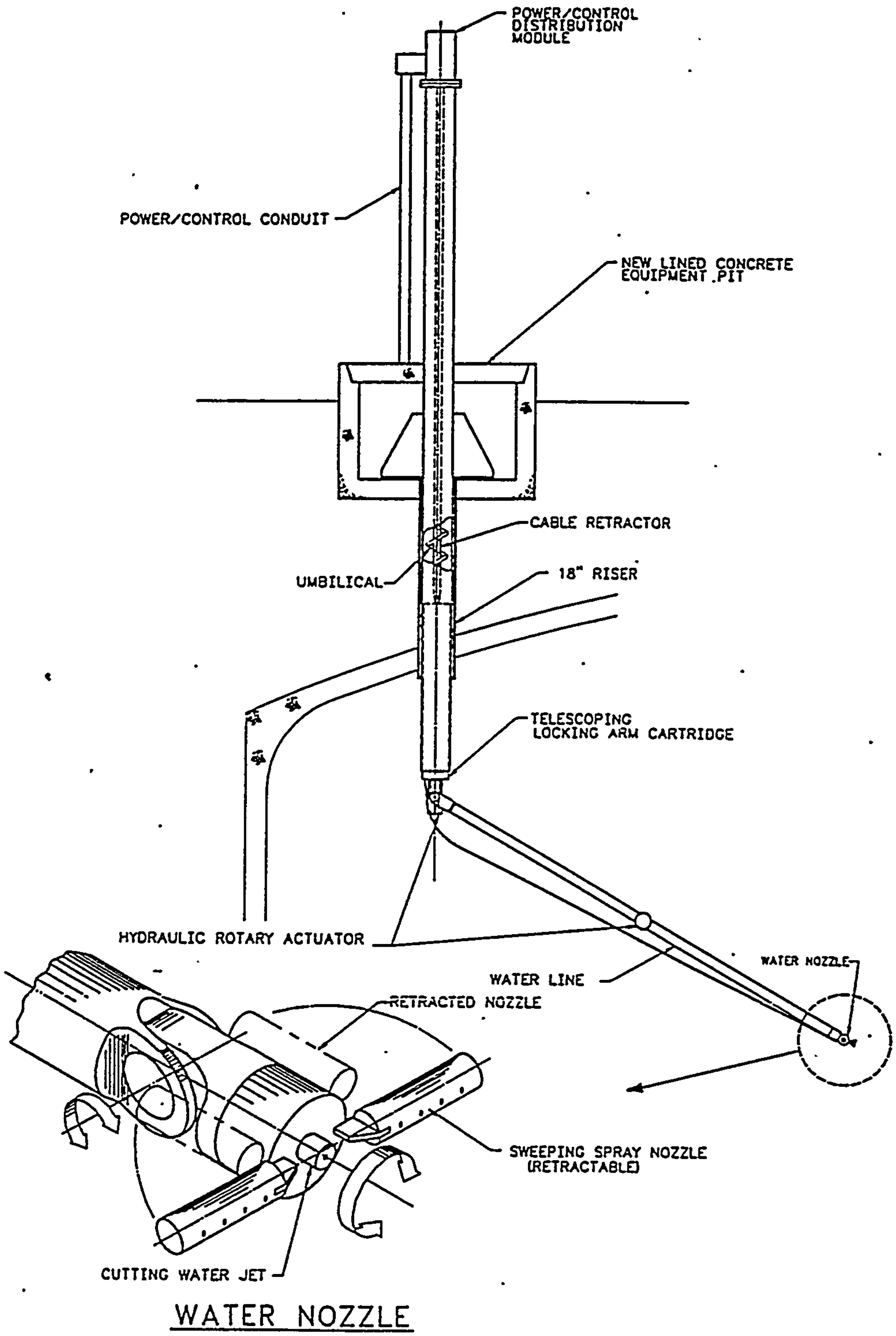


Figure 3-17. Limited Sluicing Assembly.



LIMITED SLUICING ASSEMBLY.

The slurry is then pumped through a new pipe-in-pipe transfer line to a double-shell receiver/lag storage tank. Unlike past sluicing methods, the supernate liquids from the receiver/lag storage tank cannot be reused because of erosion/corrosion effects on the sluicing nozzles.

Advantages

- Limited sluicing is adaptable to the specific needs of Tank 241-T-101 sludge cleanout
- This system minimizes the amount of water added to Tank 241-T-101 for sludge retrieval operation
- A new sludge/slurry pump could be installed in the existing 30.5 cm (12 in.) riser R-10 located in heel pit 241-TR-01B
- Existing small Tank 241-T-101 risers may need only minor modifications to accept new instruments required to monitor and control the limited sluicing system operation
- The new limited sluicing equipment is reusable and can be readily transported and installed for use in other SSTs
- A new remote CCTV two-camera system could be installed in the existing 30.5 cm (12 in.) risers R-6 and R-2.

Disadvantages

- Four new 46 cm (18 in.) risers will need to be installed through the existing Tank 241-T-101 concrete dome
- Lined concrete equipment pits need to be constructed over each of the new 46 cm (18 in.) risers to enclose limited sluicing equipment. Each new equipment pit requires a 3,000 lb/in^2 decontamination system
- Existing equipment pits on Tank 241-T-101 to be reused for the installation of retrieval systems equipment need to be modified for the installation of a 3,000 lb/in^2 decontamination system
- The existing heel pit 241-TR-01B may require structural upgrades to permit installation of a new sludge/slurry pump (e.g., new cover blocks, shielding plugs, metal pit liner, and pit reconfiguration)
- For Tank 241-T-101, an accumulator tank and transfer lines do not exist to permit implementation of this concept.

3.5.3 Articulated Arm Scarifier

The articulated arm scarifier is an untried waste retrieval concept that is based on a commercial water scarifier design. Commercial scarifiers are used to remove paving materials from roadways and bridge decks. A key feature of this concept is a high-pressure multijet sluicer that is housed in two hemispherical shells with an annular space between them to allow for the inflow of air. The low-volume, high-pressure water jets dislodge and mix the sludge. Suction provided by an air lift system removes the sludge/slurry mixture as soon as it is formed.

The use of this type of air conveyance system has not been demonstrated for use on sludge wastes having an uneven surface. A large R&D effort would be required to prove the system, therefore, this system is not yet considered a viable option for the removal of SST sludge wastes.

The articulated arm scarifier consists of a 1 m (3 ft) diameter dome or shell containing eight water jet nozzles and the intake for the air conveyance system (Barnes 1991). The outer shell provides an air channel to feed the pneumatic intake even when the module is submerged. The module is mounted on an articulated robotic arm that can move in any direction desired within the tank. The concept is illustrated in Figure 3-18.

The high-pressure, low-volume water jet nozzles with flow rates from 6 gal/min at 20,000 lb/in^2 up to 1/2 gal/min at 55,000 lb/in^2 would sluice and mix the sludge. Each nozzle is fed separately with clean water from a high-pressure supply unit located above the tank. The water jets dislodge and blow the sludge into a high-velocity air path created by the air conveyance system. The suspended sludge/slurry inside the sluicing module is pneumatically transported out of the module and pumped to a new process building where the air will be separated from the sludge/slurry. Since the supernate has already been removed, the sludge/slurry will be mixed with additional liquids as required (approximately 30% solids) to permit transfer by pipe-in-pipe to a double-shell receiver/lag storage tank.

All equipment needed to operate the arm and jets is located in a utility module. The utility module transmits hydraulic power and electricity to a distribution module. The distribution module serves as the interface point from the utility module to the scarifier and robotic arm via the retrieval tower. The retrieval tower functions as the arm transport, arm storage, and arm support for activities inside the tank.

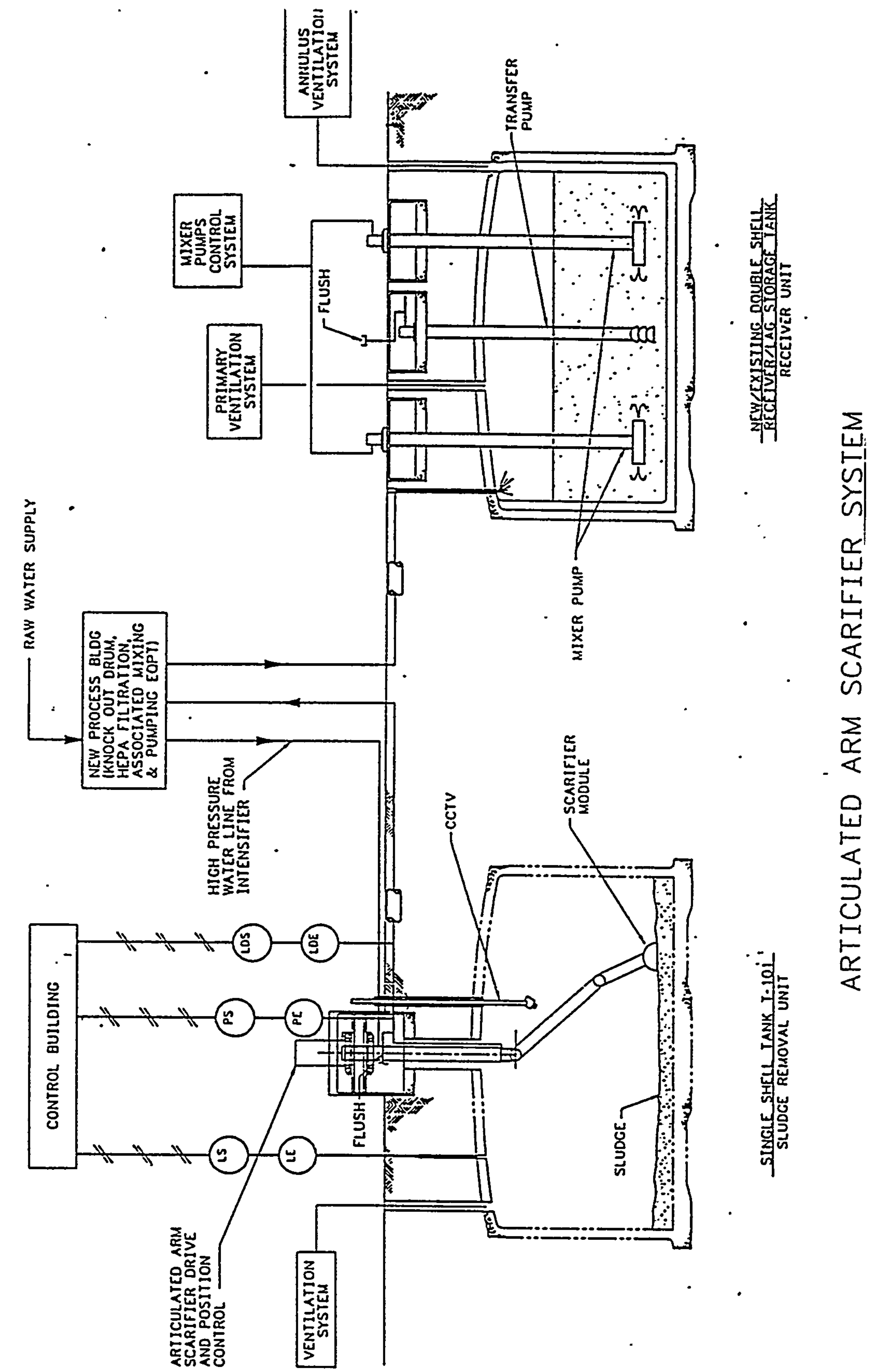
Advantages

- This system minimizes the amount of water added to a tank
- Neither the scarifier nor the air conveyance system have moving parts
- This system can break up and mix very hard materials/sludges not amenable to removal by other sluicer technologies
- The scarifier will not erode the walls and floor of the tank unless desired
- Equipment associated with the system lends itself to modular design, and use in more than one SST.

Disadvantages

- The system is not available commercially. It must be designed, fabricated, tested and developed

Figure 3-18. Articulated Arm Scarifier System.



- An untested, large positive displacement air conveyance system would be required to transport the waste to the surface
- A 1 m (4 ft) to 2 m (6 ft) diameter hole would be required in the Tank 241-T-101 dome to install this system (Barnes 1991).

3.5.4 Mining

There are a number of physical mining concepts that have been considered in the past for retrieval of solid wastes from SSTs. Most studies have concluded that physical mining is not a feasible concept. Safety issues, research and development, maintenance and operations drive life cycle costs so high that they are dismissed from further consideration.

An engineering study for retrieval of Tank 241-C-106 wastes demonstrates the magnitude of the impacts from certain proposed mining concepts (Barnes 1991). The following concepts were studied:

- Mechanical dredge (tethered systems)
- Direct retrieval - air mining (robotic arm)
- Mechanical extraction (robotic arm)
- Direct pumping of sludge (robotic arm)

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4.0 HAZARDS EVALUATION

Existing SSTs have exceeded their design life. Little is known about the physical conditions of the tank structures or the physicochemical characteristics of the stored waste. Fresh radioactive waste has not been introduced into the tanks since the 1980s.

Some of the tanks have several safety concerns. Single-shell tanks that meet Priority 1 safety issues have been categorized according to the safety concern and placed on a watch list (see Table 4-1). Priority 1 tanks are defined as ones containing most of the necessary conditions that could lead to worker onsite or public radiation exposure through an uncontrolled release of fission products. Tanks that are placed on the watch list contain one or more of the following features:

- Organic-nitrate or total organic carbon greater than 3% in weight (10% weight sodium acetate equivalent)
- Ability to produce, entrap, and periodically release flammable gas
- Ferrocyanide ion content greater than 1,000 g-mole
- Heat load that exceeds 40,000 Btu/hr, and requires active cooling for temperature maintenance.

Tank 241-T-101 is on the ferrocyanide tank watch list.

4.1 CHEMICAL AND RADIOLOGICAL HAZARDS

Waste quantities in the tanks are based on estimated levels by the computerized tracking program known as Track Radioactive Components (TRAC). The TRAC data is questionable because it is based mainly on historical records with few backup samples. More sampling is needed to obtain a better knowledge of the tank waste characteristics. Some chemical and radiological concentrations in Tank 241-T-101 are known from supernatant samples taken in August 1989, see Tables 4-2 and 4-3 (Vail 1992). These samples contained 69% water in weight, had a specific gravity of 1.2, and a pH of 13.3.

The principal radionuclides of concern are 90Sr, 99Tc, 137Cs, and transuranics 239Pu, 240Pu, and 241Am. Hazardous materials include toxic elements, nitrites, nitrates, hydroxides, and organics. Currently, there is no watch list for toxic vapor releases; however, RL considers the problem of dome space toxic vapors to be a priority concern (Kummer et al.). Toxic elements that may be a problem include constituents such as heavy metals, chromium, cadmium, arsenic, and mercury. The primary chemical elements/compounds for Tank 241-T-101 are listed in Table 4-4.

Table 4-1. Watch List Tank Status as of August 1992.

	Hydrogen/ flammable gas	Ferrocyanide	Organic salts	High heat
1	101-A	102-BX	103-B	104-A
2	101-AX	106-BX	103-C[1]	105-A
3	103-AX	110-BX	102-S*	105-C
4	102-S*	111-BX	106-SX*	106-C
5	111-S	101-BY	105-TX	107-SX
6	112-S	103-BY	118-TX*	108-SX
7	101-S*	104-BY	106-U	109-SX*[1]
8	102-SX	105-BY	107-U	110-SX
9	103-SX	106-BY		111-SX
10	104-SX	107-BY		112-SX
11	105-SX	108-BY		114-SX
12	106-SX*	110-BY		
13	109-SX*	111-BY		
14	110-T	112-BY		
15	103-U	108-C		
16	105-U	109-C		
17	108-U	111-C		
18	109-U	112-C		
19	103-AN+	101-T		
20	104-AN+	107-T		
21	105-AN+	118-TX*		
22	101-SY+	101-TY		
23	103-SY+	103-TY		
24		104-TY		

*These tanks appear on two lists.
+Double-shell tanks.
[1]Tank 103-C has separable organic layer on surface of waste.
[2]Tank 109-SX has hydrogen potential because Tanks 101 through 106-SX vent through it.

Data taken from "Operations Specifications for Watch List Tanks," OSD-T-151-00030.

Table 4-2. Composition of Tank 241-T-101 Supernatant (Chemicals).

Component	As Is, g/l	Filtered, g/l
NO_2	--	22.85
NO_3	--	160.6
OH	--	3.65
Al	0.316	0.034
CO_3	39.72	--
SO_4	13.16	--
PO_4	4.48	--
F	<1.09	--
Cl	1.08	--
TOC	--	--
P	1.07	--
K	0.53	--
Na	59.08	--
Cr	1.53	--
B	0.012	--
Ca	0.007	--

Data from "Justification for Continued Operation of Hanford High Level Waste Tanks," Correspondence number 9257718, WHC-SD-SQA-CSA-20355, Rev. 0.

Table 4-3. Composition of Tank 241-T-101 Supernatant (Radiological).

Components	As is (g/L)	Filtered (g/L)
$^{239,240}Pu$	0.000004	0.0000025
^{241}Am	$<10^{-7}$	$<10^{-7}$
$^{89,90}Sr$	$<10^{-6}$	--
^{99}Tc	0.0063	--
^{137}Cs	0.001	--

Data from "Justification for Continued Operation of Hanford High Level Waste Tanks," Correspondence Number 9257718, WHC-SD-SQA-CSA-20355, Rev. 0.

Table 4-4. Track Radioactive Component Inventories for Primary Nonfissile Compounds in Tank 241-T-101.

Component	Total moles
Al	1.E+06
$C_6H_5O_7$	3.E+05
CO_2	9.E+06
F	2.E+05
Fe	4.E+04
K	1.E+05
NO_2	1.E+05
NO_3	1.E+07
Na	3.E+07
OH	2.E+05
PO_4	2.E+06
SO_4	3.E+05

Data from "Justification for Continued Operation of Hanford High Level Waste Tanks," Correspondence number 9257718, WHC-SD-SQA-CSA-20355, Rev. 0.

4.2 HYDROGEN GAS AND ORGANICS

Currently, 18 SSTs and 5 DSTs are on the hydrogen/flammable gas watch list (see Table 4-1). Hydrogen/flammable gas buildup in the tanks can lead to a radioactive material release to the environment because of over pressurization or explosion. The best example of over pressurization is Tank 101-SY. This tank periodically releases built-up hydrogen gas over a short period of time in sufficient concentrations to support combustion. Depending upon the rate of gas release and volume, the tank may also become pressurized. An explosion could result if an ignition source were present at the peak of release. Currently, hydrogen is not a problem in Tank 241-T-101; however, little is known about how the hydrogen is produced, so it cannot be dismissed.

Eight tanks are on the organic salts watch list. Two of these contain hydrogen/flammable gas and one contains ferrocyanide (see Table 4-1). Organic salt tanks have potentially explosive organic chemicals. Organics in the tank, flammable gases, and ferrocyanide-nitrate mixtures are sources of deep safety concern. However, an explosion is deemed unlikely because of relatively low tank temperatures at present and the high ignition temperature required to initiate a reaction. Major safety issues involve tanks that contain mostly solids. If solids dry out, any high organic concentrations could be heated to high temperatures by radioactive decay to create an exothermic condition. This could further raise the temperatures in the tank to the ignition point of other chemicals such as ferrocyanides. Ultimately, this could result in release of high-level waste (HLW) because of tank pressurization. Two options for dealing with the hazards of organic tanks are:

1. Prove or demonstrate that an explosion is highly unlikely
2. Remove or destroy the hazardous waste constituents.

Tank 241-T-101 is not included on the organic watch list.

4.3 FERROCYANIDE STABILITY

Ferrocyanide was originally added to waste to precipitate radioactive nitrate constituents from the liquid for the purpose of gaining additional storage space during the 1950s (Kummer 1992b). Tanks on the ferrocyanide list contain 1,000 g-mole or more of ferrocyanide. There are currently 24 tanks listed as ferrocyanide tanks, one is also listed as an organic tank (see Table 4-1). Ferrocyanide can be oxidized by nitrate. This oxidation results in the release of thermal energy that can lead to an explosion, pressurization of the tank, and ejections of hazardous and radioactive materials into the atmosphere and surrounding environment. Options that are being considered to deal with or limit the hazards of ferrocyanide tanks are:

- Demonstrate that the possibility of a runaway chemical reaction is remote. Therefore, only surveillance of the tank is needed

- Maintain and monitor tank's water content to cool the waste and prevent an explosion

- Remove the waste and destroy the ferrocyanide as proposed in project W-236B, initial pretreatment module.

Tank temperatures at Hanford do not exceed 93 °C. A ferrocyanide induced pressurization event could take place under certain conditions. Conditions include a temperature of 285 °C, dryness, and proper chemical mixtures and concentrations. Tank temperatures have actually been decreasing at 2 °C per year due to radioactive decay. A recent investigation of the watch-list ferrocyanide tanks found incorrect characterization data. Tanks 241-T-101, BX-106, BX-110, and BX-111 were apparently incorrectly placed on the list of ferrocyanide tanks. These tanks contain less than the required amount of ferrocyanide to be on the watch list. Tank 241-T-101 has not been formally removed from the ferrocyanide tank watch list. The temperature of Tank 241-T-101 was 21 °C (70 °F) in August 1992. Highest yearly temperature for stabilized ferrocyanide tanks are shown in Table 4-5.

4.4 CRITICALITY

Since many of the HLW tanks at Hanford contain more than the minimum fissile material necessary to cause a criticality event, a criticality must be considered for each. Criticality is a self-sustained atomic reaction and is possible under optimal conditions in the tanks. The fissile material

Table 4-5. Temperature History of Stabilized Ferrocyanide Tanks.

Tank	Highest yearly temperatures (°F)												
	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	91'	92'
BY-101		75	96	72	84						76	76	75
BY-104	170	145	164	145	143	158	145	149	136	148	130	129	129
BY-107*											86	94	97
BY-108	117	96	119	118		97					103	102	92
BY-110	139	132	118	147	148	140	145	139	133	136	135	120	122
BY-111						97					87	83	87
BY-112		93				93					84	82	83
TX-118			100	108	85	89					78	78	77
TY-101	80	62	78	68				68	79		71	71	71
TY-103	69	75		64			65				69	69	67

Shaded areas indicate that the tank was jet pumped.
*Tank BY-107 was jet pumped in 1979.
Data from "Safety Assessment for Interim Stabilization of Ferrocyanide Tanks," WHC-SD-WM-SAD-018, Rev. 0.

of greatest criticality concern at Hanford is plutonium. Plutonium fissile concentrations of at least 3.0 g/l over a large volume of the tank waste are needed for criticality. Criticality requires a plutonium mass of at least 4.0 g Pu/l. The greatest plutonium concentration reported in tanks is 0.038 g/l in Tank 107-C. Because of a void of plutonium, a criticality is extremely unlikely to occur in Tank 241-T-101, even if the liquid is pumped from the tank. The concentrations shown in Table 4-6 are based on TRAC data and, therefore, are questionable.

4.5 HIGH HEAT

Currently, 11 tanks are listed as high-heat tanks (see Table 4-1). Only one of these tanks, 106-C is on the watch list. High-heat tanks have a heat load greater than 40,000 Btu/hr, and require surveillance. Water is added to regulate the temperatures in tanks 105-C and 106-C. If the water is removed from a tank during interim stabilization, there could be an increase in the thermal resistivity of the salt cake and a corresponding increase in the total tank temperature. Higher temperatures may result from ferrocyanide and nitrate mixtures reacting, and further increase the temperature. Salt well jet pumping has shown no long-term temperature increase in ferrocyanide tanks such as Tank 241-T-101. In fact, a downward temperature trend has been noticed in ferrocyanide Tanks BY-104 and BY-110 with the highest temperatures (see Table 4-5). The decrease in tank temperature is attributed to removal of 137Cs in liquids and to the nuclear decay inside the tank. Tank 241-T-101 is not currently listed as a high-heat tank. Tank 241-T-101 has a fairly normal temperature with a maximum 70 °F temperature in August 1992; this is slightly above the ground temperature.

Table 4-6. Track Radioactive Component Inventories for Pu and U Isotopes in Tank 241-T-101.

Component	Concentration in sludge (g/l)	Total quantity* moles	Total quantity* (kg)
^{239}Pu	0.0043	7.E+00	1.67
^{240}Pu	0.00012	2.E-01	0.048
^{241}Pu	0.00000	4.E-03	0.001
^{233}U	0.00000	9.E-06	0.000
^{235}U	12.0	2.E+04	4700.0
^{238}U	1831.0	3.E+06	714000.0

*This includes all liquid and all solids.

Data from "Justification for Continued Operation of Hanford High Level Waste Tanks," Correspondence number 9257718, WHC-SD-SQA-CSA-20355, Rev. 0.

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5.0 ALTERNATIVES SELECTION CRITERIA

Selection criteria are established in the section for evaluating the potential advantages and disadvantages associated with implementing a given interim waste management strategy for Tank 241-T-101. Criteria was selected that can readily be evaluated using engineering judgement and experience and can be understood to significantly impact or influence the selection process. The criteria are not all inclusive or detailed in scope. They represent a wide range of safety and socioeconomic issues that permit the screening of potential candidate technologies for acceptability. Alternatives passing the initial screening will be analyzed further to select those deemed to have the greatest possibility for successful implementation.

The selection criteria are health, safety, regulatory compliance, waste safety, tank integrity, future retrieval and processing, cost, schedule, technical feasibility, maintainability, and operability. Each is weighted from 1 to 5 to reflect its relative importance to other criteria in the decision making process. A weight of 5 had the highest importance and 1 the lowest.

Table 5-1. Weight Factor.

Importance	Weight factor
Low	1
Low/medium	2
Medium	3
Medium/high	4
High	5

Score factors are also given for each of the selection criteria within each alternative and option. Numerical scores of 0 to 5 reflect the estimated impact on the selection criteria.

Table 5-2. Score Factor.

Impact	Score
None	0
Light	1
Light/moderate	2
Moderate	3
Moderate/heavy	4
Heavy	5

An option's impact score multiplied by the importance weight determines its weighted score. This weighted score indicates how the alternative performs. The higher the impact score, the less favorable the alternative/option.

5.1 HEALTH SAFETY

Health safety concerns include public safety, worker safety, and environmental impacts. Safety concerns are given the highest subjective weight factors, i.e., 5.

5.1.1 Public Safety

Environmental releases to air, soil, and ground water that potentially could affect the public are considered. Short-term releases from activities associated with the alternative/option are examined to determine their potential impact on the public health. Long-term releases of radionuclides and hazardous chemicals are not considered because they are associated with the final disposal site.

5.1.1.1 Short Term - Chronic. The short-term or chronic radionuclides and chemical releases from normal operations of facility equipment and transportation are examined for each alternative/option. The evaluation is based on an estimate of the integrated population dose (manirems) from all activities associated with the alternative/option.

5.1.1.2 Short Term - Acute. Short-term or acute releases result from plant and transportation accidents. Short-term acute releases are estimated based on the potential for accidental release of large quantities of hazardous materials from activities associated with the alternative/option. The score includes estimates of the fraction of total inventory released as well as probability of occurrence.

5.1.2 Worker Safety

Worker safety involves estimating potential health impacts from industrial accidents and from routine radiation doses. Industrial accidents are based on total manhours estimated to be involved in the alternative/option. The worker radiation dose is based on total manhour estimates and estimated exposure to radioactive waste during operation and transport activities.

The total man-rems for worker radiation doses are based on total estimated manhours required for the project and on the potential for exposure to elevated levels of radioactivity from handling and transportation activities.

5.1.3 Environmental Safety

The potential for release and the relative magnitude of the release of hazardous and radioactive materials are evaluated for a given alternative/option. The resulting harm or insult to the environment is assessed and ranked.

5.2 REGULATORY COMPLIANCE

How an alternative/option is judged to comply with current regulations/laws is evaluated. Regulatory compliance is estimated to be of slightly less importance than safety and was given a weight factor of 4.

5.2.1 Washington Administrative Code (WAC), Dangerous Waste Regulations

The ability to meet WAC 173-303, "Dangerous Waste Regulations" (Ecology 1993) is the principle regulatory concern. The current action to achieve compliance for leaking SSTs is to pump the liquid contents to a double-contained, receiver/storage tank (ultimately to a DST). Each alternative/option is measured against this approved method or its ability to stabilize an SST and prevent/stop leaks. There is no WAC requirement to pump a nonleaking tank.

5.2.2 Closure/Post-Closure Activities

The impact of an alternative/option upon the ability to clean the site to background levels, i.e., regulatory closure/post-closure activities, is evaluated in this subsection. For example, options that cause soil contamination or contaminate large amounts of equipment would significantly impact closure/post-closure activities. Alternatives/options are rated on the perceived effort required to clean the site/contaminated equipment to background levels.

5.3 WASTE SAFETY

There are several unresolved waste safety related issues associated with the retrieval of SST wastes. The effect on solid waste of the removal of water and hydroxide solutions has not been adequately determined. Water removal and the heating and drying of waste can decrease the ability of the waste to cool. The possibility for thermal runaway reactions between oxidants (nitrates) and organics/ferrocyanide significantly increases as moisture is removed or heat is added to tank solids. The most significant unresolved waste safety issues are discussed in the following subsections.

5.3.1 Hydrogen/Flammable Gas Generation

There are a number of HLW tanks that have the potential to generate flammable gas (hydrogen, organics, and/or nitrous oxide). A possibility exists for a fire in these tanks and release of radioactive/hazardous material to the environment if an ignition source is provided. An unfiltered release could occur in the event of an overpressurization of the tank ventilation system during periodic gas venting. The possibility for this condition to occur during waste retrieval operations is examined.

5.3.2 Ferrocyanide Stability

Twenty-four SSTs may contain enough ferrocyanide precipitates to be a safety concern. Ferrocyanide compounds can react and detonate if conditions are right. Among these conditions are sufficient ferrocyanide chemical concentrations and elevated temperatures. Dryness coupled with hot spots could elevate tank waste temperatures to produce exothermic reactions of present organic wastes (220 to 250 °C) or ferrocyanide compounds (285 °C). The possibility for such a reaction is evaluated for each alternative/option.

5.3.3 Criticality

Analytical results from tank core samples consistently show fissile material concentrations that are at least an order of magnitude lower than the 1 g/l allowed by the criticality prevention specification. However, few tanks have been sample-cored. A safety criticality concern exists about the effect of removing supernate from the tanks because supernate is a moderator. The potential impact of actions taken to implement an alternative/option is evaluated with respect to creating a criticality event within a given tank.

5.3.4 Heat Load

Any drying of salt cake/sludge is expected to increase thermal resistivity. This resistivity can affect the ability of tank waste to cool, and hot spots could be created. If organics/ferrocyanide compounds are present in sufficient quantities, an exothermic reaction could occur causing tank pressurization and loss of containment. High sludge temperatures may cause structural damage to the tank resulting in a possible dome collapse and exposure of waste to the environment.

5.4 TANK INTEGRITY

The SSTs have exceeded their original design life. Available information on the physical condition of the tank structure is limited. Monitoring equipment is unreliable. The steel liners on approximately half the SSTs may have already leaked. Tanks low in hydroxide are considered most vulnerable because hydroxide is known to inhibit corrosion of mild steel. Potential structural safety concerns and impacts associated with SST waste storage and removal operations that could influence the selection of a waste retrieval technology are addressed below. Tank integrity concerns are given a weight factor of 3.

5.4.1 Waterline Corrosion

No waterline attack has been observed at the SRS or at Hanford. If the waste solution has a high pH and contains nitrites, waterline corrosion is not thought to play a major role in creating leaks in SSTs. However, histories of waste storage and waste chemistries in SSTs are complex. Waterline corrosion may be a factor in SSTs that originally stored bismuth-phosphate waste solution from old T-Plant and B-Plant operations or which contained insufficient hydroxides and nitrites. Waterline corrosion should have little or no impact on Tank 241-T-101 safety, because of the corrosion inhibiting properties of the current wastes.

5.4.2 SCC

Stress corrosion cracking of the steel liner is the cause of previous leaks from the nonstress relieved tanks at SRS. Also, this is probably the cause of the SST leaks at Hanford. The SCC could have started soon after liquid water was routed into the SSTs. Crack growth may be a continuing phenomena that gradually enlarges the leakage path.

5.4.3 Crevice Corrosion

No crevice corrosion attack has been observed at the SRS or Hanford Site. This failure mechanism is not considered to have any impact on tank safety. It is included to show completeness in the evaluation.

5.4.4 Concrete Degradation/Cracking

Stress corrosion cracking of the steel liner will permit the waste to come into contact with the concrete wall. Westinghouse Hanford Company has investigated the potential for failure of the concrete over a period of years and has concluded that the concrete has not been significantly degraded by either elevated temperatures or chemicals in the waste. Currently, SSTs are believed to be structurally sound.

5.4.5 Ease of Maintaining Confinement

A number of the options considered in this study will require additional 30.5 cm (12 in.) or larger risers to be added to the tank lid. These penetrations will complicate waste containment activities significantly, and will increase HVAC requirements to maintain confinement. These penetrations may also require structural analysis to ensure that the dome has adequate strength to support the overburden and equipment associated with the added penetrations and operations.

5.5 FUTURE RETRIEVAL AND PROCESSING

Alternatives and options are evaluated for potential impact on future retrieval, transport, storage, and waste processing operations. Actions that may potentially compromise, severely impact, or complicate retrieval, transport, storage, or waste treatment are identified and rated for each option. Major operations that could be individually affected are listed in the following subsections.

5.5.1 Waste Retrieval

Existing and planned Hanford facilities are designed to handle and transfer liquids. Waste retrieval involves the sluicing or mixing of present solids with liquids to permit the transfer of the liquid and slurry via pumps through existing and future transfer lines to storage and processing systems. The advantages of liquid retrieval transport versus air transport and physical mining of hazardous materials are numerous. Principle advantages involve safety, cost, mature technology, maintainability, ease of shielding for radioactivity, and a system in existence on the Site. Options are evaluated on the basis of the potential impact on future waste retrieval and processing operations. Judgement is made on whether the option increases or decreases waste retrievability and recovery.

5.5.2 Soil Retrieval

Alternatives and options are evaluated for their potential to contaminate soil and thereby require retrieval and future treatment of large volumes of soil. Options deemed to have a high potential to contaminate soil are given a high score as to their impact on future retrieval and processing operations.

5.5.3 Transfer System Integrity

The potential impact of the proposed option on existing and future waste transfer systems is evaluated. Whether the options facilitate transport and handling, or complicate it and conflict with existing and planned waste transfer systems are evaluated. Options are judged on their compatibility with existing and planned transfer, and waste storage/processing facilities.

5.5.4 Storage Availability

Alternatives and options are evaluated on their potential impact on current waste storage volumes. Options likely to significantly add to the waste volume to be handled, stored, and processed are deemed to have a high impact. Options causing little or no growth in the volume of waste to be retrieved are rated lower. The need for additional storage space significantly impacts other selection criteria such as cost, schedule, and safety.

5.5.5 Treatment Compatibility

Alternatives/options are evaluated on their compatibility with existing and planned waste treatment operations for tank waste. Options that render the wastes more difficult to treat and process into final disposal form are given higher impact scores than those options that are compatible with the planned HLW treatment facilities (glassification of radioactive/toxic waste; grouting of chemical wastes).

5.6 COST

Alternatives and options are evaluated and ranked with respect to each other based on their potential cost. Costs are primarily based on engineering experience; however, some cost data was available. Included in the cost assessment are considerations of existing systems and facilities and compatibility with planned waste retrieval, handling, storage, treatment, and disposal activities. Prudent trade offs between safety, compliance, schedules, technical feasibility, and costs are assumed in making relative cost estimates.

5.7 SCHEDULE

Alternatives and options are evaluated to determine if the Tri-Party Agreement milestone schedule can be met and the relative timeframe necessary to complete the option. The options considered to require the most time to achieve were given the highest impact score. The schedule is given a weight factor of 3.

5.8 TECHNICAL FEASIBILITY

Alternatives and options are evaluated and rated as to their technical maturity in this section. Options were ranked and rated with respect to each other on the basis of the research and development (R&D) effort thought to be required to bring them to maturity. Engineering judgement and experience was used to assess the amount of R&D effort required.

5.9 MAINTAINABILITY AND OPERABILITY

The degree of difficulty in maintaining and operating an alternative and option is considered in this part of the selection criteria. Options are rated and then ranked with respect to each other and to the perceived degree of difficulty required to operate and maintain the facilities/processes involved in the option. Options having a complex technology, i.e., requiring facilities, large amounts of equipment, chemicals, etc., are deemed to heavily impact maintenance and operations. Maintainability and operability is given a weight factor of 3.

5.10 SELECTION CRITERIA WEIGHT FACTORS

Engineering judgement and experience was used to determine the relative importance of each selection criterium. Health and waste safety concerns were given the highest weight by the eight-member evaluation team. Regulatory compliance was also considered extremely important. The selection criteria are not truly independent of one another. Safety can always be increased by adding cost and schedule at an increasingly lower benefit to cost ratios. Likewise, other selection criteria may be altered up or down to the detriment or enhancement of other criteria. In performing this preliminary screening, the evaluation team assumes that a balanced approach will be used to trade-off potential benefits and costs, and that this evaluation will identify the most promising of the potential technologies for retrieval of SST wastes and, in particular, that of Tank 241-T-101.

The impact importance (weight factor) given for each of the selection criteria is provided in Table 5-3.

Table 5-3. Criteria Weight Factors.

Weight factors given for selected criteria	
Criteria	Weight factor
Health Safety	5
Compliance with Regulations/Laws	4
Waste Safety	5
Tank Safety	3
Future Retrieval/Processing	3
Cost	2
Schedule	3
Technical Feasibility	3
Maintenance/Operations	2

6.0 COMPARISON OF ALTERNATIVES/OPTIONS

Scoring of the options within an alternative is discussed in this chapter and compared in Table 6-1. Key basis for this evaluation are DOE's commitments to totally and safely retrieve, process and dispose of tank wastes and cleanup the Hanford Site where practicable.

Consideration was given to a full spectrum of possible methods for managing or recovering stored tank wastes, including doing nothing (no-action), to total recovery of tank wastes (total retrieval). The evaluation is focused on the front end of the waste management program, i.e., retrieval or continued storage. Each option within the alternatives is scored from 0 to 5 for each criterion to indicate the option's adverse impact upon that criterion. The most adverse score is 5. This score is weighted according to the relative importance of each criterion by multiplying the option's score by the criterion's weight. The more important criteria are given higher weights (see Section 5.10). The sum of all these weighted scores indicates the options total impact upon all criteria and is used to rank the alternatives and options. The alternative and option with the lowest impact score is the preferred waste management method.

Table 6-1. Total Weighted Scores for Each Alternative.

Option No.	No Action[a]	In-Tank Stabilization[b]	External Tank Stabilization[c]	Liquid Retrieval[d]	Total Retrieval[e]
1	135	116	100	10	55
2	142	142	100	19	74
3	--	180	134	29	122
4	--	88	130	49	--
5	--	154	--	--	--
6	--	199	--	--	--
7	--	154	--	--	--
8	--	113	--	--	--

[a]No-action options (see Section 3.1).
1. Existing monitoring system, 2. Enhanced (improved monitoring system).

[b]In-tank stabilization options (see Section 3.2).
1. Tank wall inhibitors, 2. Diatomaceous earth, 3. Portland cement 4. Desiccants/gels, 5. Heat exchangers, 6. Microwave, 7. Air drying, 8. Stop leak.

[c]External tank stabilization options (see Section 3.3).
1. Geomembrane walls/jet grouting, 2. Slurry walls/jet grouting, 3. Sheet piling, 4. Ground freezing.

[d]Liquid retrieval options (see Section 3.4).
1. Existing pipeline (below grade), 2. New pipeline (below or above grade), 3. Tank truck/railcar, 4. Internal bladder.

[e]Total retrieval options (see Section 3.5).
1. Unlimited sluice (low pressure-high volume), 2. Limited sluice (high pressure-low volume), 3. Articulated arm scarifier.

A panel of eight experts was used to establish criteria and criteria weights, collect information from presentations by cognizant engineers on each alternative, and to make final judgement on the scoring recommending by these engineers.

Tank 241-T-101 was selected for analysis because this tank is presumed to be a new (mid-1992) leaker containing approximately 30,000 gal of supernatant and requiring recovery action. It is one of the 44 SSTs that have not been interim stabilized.

The summed, weighted scores for the alternatives and options evaluated are shown in Table 6-1. The liquid retrieval alternative least impacted the evaluation criteria and is the preferred alternative. The total retrieval alternative also scored relatively low and should be considered if DST space were available because the alternative also eliminates solid waste. Safety, regulatory compliance, site cleanup, and feasibility uncertainties heavily impact the no-action, in-tank stabilization and external tank stabilization alternatives and options making them considerably less desirable.

Alternatives that involve immediate retrieval and containment of liquids and solid wastes from a leaking SST appear to impact selection criteria the least. Weighted scores for long-term health safety, regulatory compliance, schedule, clean-up, and technical feasibility issues favor existing technologies that ensure containment and minimize releases to the environment. The liquid retrieval alternative, option 1 (pump out - through existing pipeline to an existing DST) has the least immediate impact upon Tank 241-T-101 because systems to implement this option exist and DST space is available. Other liquid retrieval options are fairly easily implemented, but have higher impacts because these options require more effort and time for implementation. The total retrieval alternative offers the additional long-term advantage of solid-waste removal and clean-out. Because DOE is committed to totally cleaning out SSTs, there is no front-end advantage to delay. The SSTs will continue to degrade and leak and will become increasingly more difficult to safely manage and modify. The disadvantages of total retrieval are that potential leaks to the environment can occur during retrieval and that little DST space is available to permit near-term implementation of this alternative.

In-tank stabilization alternative, option 4, may stop a leak until retrieval operations are more opportune but this option is an unproven technology. In-tank stabilization alternative, option 1, is not a viable option because corrosion inhibitors will not stop leaks.

Although the external tank stabilization alternative had significantly higher impacts than retrieval alternatives, the external tank stabilization alternative will confine wastes that have leaked into the environment. External tank stabilization methods could be used to restrict released waste from contaminating additional soil or to confine liquid releases from a failed SST.

6.1 COMPARISON OF OPTIONS FOR NO-ACTION

Table 6-2 lists scores for the no-action alternative options. Safety and compliance issues made the impacts for both options scores high and unfavorable to implement. In the following sections, the reasons and considerations for the scores are given.

Table 6-2. Comparison of Options for No-Action Alternative.

Selected criteria (impacts)		Weight (1-5)	Option 1		Option 2	
			Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.1.1	Health Safety	5				
6.1.1.1	Public Safety		5	25	5	25
6.1.1.2	Worker Safety		0	0	2	10
6.1.1.3	Environmental Safety		5	25	5	25
6.1.2	Compliance with Laws/Regulations	4				
6.1.2.1	WAC 173-303 Codes		5	20	3	12
6.1.2.2	Closure/Post-Closure Activities		5	20	3	12
6.1.3	Waste Safety	5				
6.1.3.1	Hydrogen/Flammable Gas Generation		0	0	0	0
6.1.3.2	Ferrocyanide Stability		1	5	1	5
6.1.3.3	Criticality		0	0	0	0
6.1.3.4	Heat Load		0	0	0	0
6.1.4	Tank Safety	3				
6.1.4.1	Waterline Corrosion		0	0	0	0
6.1.4.2	Stress Corrosion Cracking		5	15	5	15
6.1.4.3	Crevice Corrosion		0	0	0	0
6.1.4.4	Concrete Degradation/ Cracking		2	6	2	6
6.1.4.5	Ease of Maintaining Confinement		0	0	0	0
6.1.5	Future Retrieval and Processing	3				
6.1.5.1	Waste Retrieval		0	0	0	0
6.1.5.2	Soil Retrieval		5	15	5	15
6.1.5.3	Transfer Systems Integrity		0	0	0	0
6.1.5.4	Storage Availability		0	0	0	0
6.1.5.5	Treatment Compatibility		0	0	0	0
6.1.6	Cost	2	2	4	3	6
6.1.7	Schedule	3	0	0	0	0
6.1.8	Technical Feasibility/Research and Development Requirements	3	0	0	3	9
6.1.9	Maintenance and Operations	2	0	0	1	2
	Total (weighted score)			135		142

Options:

1. Existing SST systems
2. Enhanced (improved) SST systems

Score:

0 = No impact
5 = High impact

6.1.1 Health Safety

Health safety issues discussed in Section 5.1 are applied to the no-action alternative options.

6.1.1.1 Public Safety. The score for options 1 and 2 is 5 because a leak allows the entry of radioactive materials from Tank 241-T-101 into the environment.

6.1.1.2 Worker Safety. The score for option 1 is 0 because of the status quo condition. The score for option 2 is 2 because of the potential for worker exposure.

6.1.1.3 Environmental Safety. The score for options 1 and 2 is 5 because a leak from Tank 241-T-101 into surrounding soil would continue.

6.1.2 Compliance with Laws and Regulations

Compliance with existing laws and regulations is evaluated (see Section 5.2). The option's impact upon future closure and post-closure activities is also evaluated.

6.1.2.1 WAC 173-303. The score for option 1 is 5 because materials leaking from the tank into the soil violates WAC 173-303. The score for option 2 is 3 because new instrumentation would confirm leakers sooner and permit earlier recovery actions.

6.1.2.2 Closure and Post-Closure Activities. The score for option 1 is 5 because leakage to surrounding soil has already occurred. This leakage complicates site and closure cleanup. The score for option 2 is 3 because less soil would be contaminated if there was better monitoring.

6.1.3 Waste Safety

Reduction of tank liquid wastes can have a safety impact on the remaining waste (see Section 5.3). Waste can dry out and heat increases the possibility of exothermic chemical reactions, criticality, and flammable gases. Other side effects such as corrosion and stress cracking of steel and deterioration of concrete can also occur.

6.1.3.1 Hydrogen and Flammable Gas Generation. The score for both options is 0 because the occurrence of this scenario in Tank 241-T-101 is unlikely.

6.1.3.2 Ferrocyanide Stability. The score for both options is 1 because the occurrence of ferrocyanide reactions is unlikely.

6.1.3.3 Criticality. The score for both options is 0 because the occurrence of criticality in Tank 241-T-101 is unlikely.

6.1.3.4 Heat Load. The score for both options is 0 because the occurrence of heat load in Tank 241-T-101 is unlikely.

6.1.4 Tank Safety

The integrity of the tank and the mild steel liner are important safety considerations. The effect of physicochemical processes that compromise tank structural integrity (see Section 5.4) are evaluated.

6.1.4.1 Waterline Corrosion. The score for both options is 0 because waterline corrosion has not been observed at Hanford and SRS for alkaline-nitrite/nitrate wastes.

6.1.4.2 SCC. The score for both options is 5 because SCC is the hypothesized cause of SST steel liner failure and neither option mitigates this type of failure.

6.1.4.3 Crevice Corrosion. The score for both options is 0 because crevice corrosion has not been observed to date.

6.1.4.4 Concrete Degradation/Cracking. The score for both options is 2 because cracks in the steel tank permit the waste solution to contact the concrete. This contact could accelerate the concrete cracking.

6.1.4.5 Ease of Maintaining Confinement. The score for both options is 0 because the present confinement system is not modified by tank dome penetrations.

6.1.5 Future Retrieval and Processing

The potential impact of each option on future retrieval and processing operations is considered. Considerations include waste and soil retrieval, transfer system integrity, storage availability, and treatment compatibility.

6.1.5.1 Waste Retrieval. The score for both options is 0 because waste retrieval does not exist for either option.

6.1.5.2 Soil Retrieval. The score for both options is 5 because leaks to the environment are not prevented. Leaks contribute significantly to the amount of contaminated soils that must be retrieved and processed.

6.1.5.3 Transfer System Integrity. The score for both options is 0 because transportation of wastes is not conducted for either option.

6.1.5.4 Storage Availability. The score for both options is 0 because a storage requirement does not exist. Wastes remain in the tank or leak to the surrounding soils.

6.1.5.5 Treatment Compatibility. The score for both options is 0 because treatment is not provided for either option.

6.1.6 Cost

The score for option 1 is 2 because soil waste retrieval and processing will increase costs. The score for option 2 is 3 because the total cost effect for Tank 241-T-101 is unknown. Potential cost savings related to earlier detection and removal of contaminated soil would be offset by instrument development costs.

6.1.7 Schedule

The scores for both options are 0 because the no-action alternative does not require any activity.

6.1.8 Technical Feasibility/Research and Development Requirements

The score for option 1 is 0 because the status quo would be continued. The score for option 2 is 3 because considerable R&D effort could be required to develop dependable and accurate liquid level monitoring instrumentation.

6.1.9 Maintenance and Operations

The score for option 1 is 0 because the status quo would be continued. The score for option 2 is 1 because the new monitoring instrumentation would require increased maintenance.

6.2 COMPARISON OF OPTIONS FOR IN-TANK STABILIZATION

Table 6-3 lists scores for the in-tank stabilization alternative options. Safety and compliance issues made the impacts for the majority of in-tank stabilization option's score high and unfavorable to implement. In the following sections the reasons and considerations for the scores are given.

6.2.1 Health Safety

Health safety concerns as discussed in Section 5.1 are applied to the in-tank stabilization options.

6.2.1.1 Public Safety.

- Option 1--The score for option 1 is 3 because leaks would continue. Continued leakage would allow contamination of the environment and groundwater.
- Options 2 and 3--The score for options 2 and 3 is 1. The addition of DE or portland cement would have no adverse effect on the public. However, new risers may have to be installed on the tank. Penetration of the tank dome by these risers pose a remote threat to the public in the event of a mishap.
- Option 4--The score for option 4 is 0 because the addition of desiccants or gels to the tank would prevent leaks. Prevention of leaks would prevent contamination of the environment and groundwater.

Table 6-3. Comparison of Options for In-Tank Stabilization Alternatives. (2 sheets)

Selected criteria (impacts)	Weight (1-5)	Option 1		Option 2		Option 3		Option 4		Option 5		Option 6		Option 7		Option 8	
		Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.2.1 Health Safety	5																
6.2.1.1 Public Safety		3	15	1	5	1	5	0	0	3	15	3	15	3	15	1	5
6.2.1.2 Worker Safety		1	5	2	10	2	10	2	10	3	15	3	15	3	15	2	10
6.2.1.3 Environmental Safety		4	20	1	5	1	5	0	0	4	20	4	20	4	20	1	5
6.2.2 Compliance with Laws/Regulations	4																
6.2.2.1 WAC 173-303		5	20	5	20	5	20	5	20	5	20	5	20	5	20	5	20
6.2.2.2 Closure/Post-Closure Activities		2	8	3	12	5	20	2	8	2	8	2	8	2	8	1	4
6.2.3 Waste Safety	5																
6.2.3.1 Hydrogen/Flammable Gas Generation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.2.3.2 Ferrocyanide Stability		0	0	0	0	0	0	0	0	1	5	3	15	1	5	0	0
6.2.3.3 Criticality		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.2.3.4 Heat Load		0	0	0	0	1	5	0	0	0	0	4	20	0	0	2	10
6.2.4 Tank Integrity	3																
6.2.4.1 Waterline Corrosion		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.2.4.2 Stress Corrosion Cracking		2	6	0	0	0	0	0	0	2	6	2	6	2	6	3	9
6.2.4.3 Crevice Corrosion		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.2.4.4 Concrete Degradation/Cracking		2	6	0	0	0	0	0	0	2	6	3	9	2	6	1	3
6.2.4.5 Ease of Maintaining Confinement		4	12	4	12	4	12	2	6	3	9	3	9	3	9	3	9
6.2.5 Future Retrieval and Processing	3																
6.2.5.1 Waste Retrieval		0	0	4	12	5	15	1	3	4	12	4	12	4	12	0	0

Table 6-3. Comparison of Options for In-Tank Stabilization Alternatives. (2 sheets)

Selected criteria (impacts)	Weight (1-5)	Option 1		Option 2		Option 3		Option 4		Option 5		Option 6		Option 7		Option 8	
		Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.2.5.2 Soil Retrieval		5	5	1	3	1	3	2	6	4	12	4	12	4	12	3	9
6.2.5.3 Transfer Systems Integrity		0	0	5	15	5	15	1	3	1	3	1	3	1	3	0	0
6.2.5.4 Storage Availability		1	3	5	15	5	15	0	0	0	0	0	0	0	0	0	0
6.2.5.5 Treatment Compatibility		0	0	4	12	5	15	3	9	0	0	0	0	0	0	3	9
6.2.6 Cost	2	1	2	3	6	5	10	3	5	2	7	4	8	2	4	2	4
6.2.7 Schedule	3	0	0	3	9	5	15	3	9	2	6	3	9	2	6	1	3
6.2.8 Technical Feasibility/Research and Development Requirements	3	0	0	2	6	5	15	2	6	3	9	4	12	3	9	3	9
6.2.9 Maintenance and Operations	2	2	4	0	0	0	0	1	2	2	4	3	6	2	4	2	4
Total (weighted score)			116		142		180		88		154		199		154		113

<u>Options</u>:
1. Tank wall inhibitors
2. Diatomaceous earth
3. Portland cement
4. Desiccants/gels
5. Heat exchangers
6. Microwave
7. Air drying
8. Stop leak

<u>Score</u>:
0 = No impact
5 = High impact

- Options 5, 6, and 7--The score for options 5, 6, and 7 is 3 because drying would proceed so slowly that a leak to the environment would continue. Continued leakage would allow contamination of the environment and groundwater.

- Option 8--The score for option 8 is 1 because waste will continue to leak for several days after addition of the stop-leak. Continued leakage would allow contamination of the environment and groundwater.

6.2.1.2 Worker Safety.

- Option 1--The score for option 1 is 1 because cleanup of contaminated soils would expose the workers to radioactivity and toxic waste. This exposure would be minor because the leak in Tank 241-T-101 is small.

- Options 2, 3, and 4--The score for options 2, 3, and 4 is 2 because tank dome penetrations would be required for installation of equipment and because work would be performed in close proximity to the tank. Exposure to radioactivity, toxic waste, and accidents would increase correspondingly.

- Options 5, 6, and 7--The score for options 5, 6, and 7 is 3 because tank dome penetrations would be required for risers, equipment, and HVAC modifications and because work would be performed in close proximity to the tank. Exposure to radioactivity, toxic waste, and accidents would increase correspondingly. This exposure would be significantly greater than for options 1, 2, 3, and 4.

6.2.1.3 Environmental Safety.

- Option 1--The score for option 1 is 4 because corrosion inhibitors are unlikely to stop leaking of the tank liquids.

- Options 2 and 3--The score for options 2 and 3 is 1 because DE and portland cement are unlikely to stop leakage.

- Option 4--The score for option 4 is 0 because gel and desiccant are expected to stop leakage into the environment.

- Options 5, 6, and 7--The score for options 5, 6, and 7 is 4 because drying would proceed so slowly that a leak to the environment would continue. Continued leakage would allow contamination of the environment.

- Option 8--The score for option 8 is 1 because waste will continue to leak for several days after addition of stop leak. Continued leakage would allow contamination of the environment. Leaks would be smaller than for options 1, 5, 6, and 7.

6.2.2 Compliance with Laws/Regulations

Compliance with existing laws and regulations is evaluated (see Section 5.2). Impact of the option upon future closure and post-closure activities is also evaluated.

6.2.2.1 WAC 173-303. The score for all options is 5 because none of the options are in compliance with WAC-173-303, which requires that leaking tanks be emptied of liquids.

6.2.2.2 Closure/Post-Closure Activities.

- Option 1--The score for option 1 is 2 because corrosion inhibitors may make remediation actions more difficult and allow more soil to be contaminated.
- Option 2--The score for option 2 is 3 because the increased waste volumes from the addition of DE will make closure more difficult.
- Option 3--The score for option 3 is 5 because the time needed for retrieval and processing would be lengthened and waste left in place would require monitoring for a long time. Closeout would be extremely difficult if the waste had to be retrieved or processed.
- Option 4--The score for option 4 is 2 because the addition of desiccants and gels would increase requiring disposal waste volumes requiring disposal.
- Options 5, 6, and 7--The score for options 5, 6, and 7 is 2 because the amount of contaminated soil will be increased.
- Option 8--The score for option 8 is 1 because the amount of contaminated soil will be increased.

6.2.3 Waste Safety

Reduction of tank liquids can have a safety impact on the remaining waste (see Section 5.3). Waste can dry out and heat up; this increases the possibility for exothermic chemical reactions, criticality, and flammable gases. Other side effects such as corrosion and stress cracking of steel and concrete can also occur.

6.2.3.1 Hydrogen/Flammable Gas Generation. The score for all options is 0 because there is little possibility of hydrogen and other flammable gas generation.

6.2.3.2 Ferrocyanide Stability.

- Options 1, 2, 3, 4, and 8--The score for options 1, 2, 3, 4, and 8 is 0 because ferrocyanide stability will be unaffected.
- Options 5 and 7--The score for options 5 and 7 is 1 because drying may concentrate the ferrocyanide increasing the likelihood of ignition in the presence of elevated temperatures.

- Option 6--The score for option 6 is 3 because drying may concentrate the ferrocyanide increasing the likelihood of ignition in the presence of elevated temperatures. The occurrence of this event would be more likely under option 6 than under options 5 and 7.

6.2.3.3 Criticality. The score for all options is 0 because there are no criticality concerns.

6.2.3.4 Heat Load.

- Options 1, 2, 4, 5, and 7--The score for options 1, 2, 4, 5, and 7 is 0 because heat load will not be generated.

- Option 3--The score for option 3 is 1 because the amount of generated heat load will be minimal.

- Option 6--The score for option 6 is 4 because the amount of generated heat load will be significant.

- Option 8--The score for option 8 is 2 because the generated heat load will be greater than under option 3, but significantly less than under option 6.

6.2.4 Tank Safety

The impact of implementing the option's effect upon the processes that compromise tank structural integrity is evaluated (see section 5.4).

6.2.4.1 Waterline Corrosion. The score for all options is 0 because waterline corrosion is not considered to be a cause of leaks.

6.2.4.2 SCC.

- Option 1--The score for option 1 is 2 because a corrosion inhibitor will slow, but not stop, SCC.

- Options 2, 3, and 4--The score for options 2, 3, and 4 is 0 because the absorption of liquids by DE, portland cement, desiccants, and gels should eliminate further SCC.

- Options 5, 6, and 7--The score for options 5, 6, and 7 is 2 because SCC should gradually decrease and eventually end as waste is dried. However, areas where corrosion has occurred may provide paths for leaching if the tank is used for long-term storage.

- Option 8--The score for option 8 is 3 because stop-leak may have some corrosion inhibitors.

6.2.4.3 Crevice Corrosion. The score for all options is 0 because crevice corrosion is not considered to be a cause of leaks.

6.2.4.4 Concrete Degradation and Cracking.

- Option 1--The score for option 1 is 2 because corrosion inhibitors would prevent leaks.
- Option 2, 3, and 4--The score for options 2, 3, and 4 is 0 because liquids would be absorbed; therefore contact with concrete and the resulting concrete degradation would be prevented.
- Options 5 and 7--The score for options 5 and 7 is 2 because concrete degradation and cracking should decrease as waste is dried.
- Option 6--The score for option 6 is 3 because concrete degradation and cracking should decrease as waste is dried. Microwave equipment may increase the heat load on the concrete.
- Option 8--The score for option 8 is 1 because the stop-leak prevents leaks that could comprise tank concrete. However, some leakage is required to implement this option.

6.2.4.5 Ease of Maintaining Confinement.

- Option 1--The score for option 1 is 4 because new penetrations of the tank dome would be required for the installation of mixing equipment.
- Options 2 and 3--The score for options 2 and 3 is 4 because new penetrations of the tank dome would be required for the installation of equipment.
- Option 4--The score for option 4 is 2 because additional penetrations of the tank dome would be required for the installation of equipment. The number and size of penetrations would not be as great as for options 2 and 3.
- Options 5, 6, and 7--The score for options 5, 6, and 7 is 3 because penetrations of the tank dome would be required for the installation of the heat exchanger, microwave, air-drying, and HVAC equipment. The number of penetrations needed would be greater than for options 1, 2, and 3, but fewer than for option 4.
- Option 8--The score for option 8 is 3 because this option is similar to option 4 except that more mixing equipment would be required.

6.2.5 Future Retrieval and Processing

The impact of each option on future retrieval and processing operations has been considered. Considerations included waste and soil retrieval, transfer system integrity, storage availability, and treatment compatibility.

6.2.5.1 Waste Retrieval.

- Option 1--The score for option 1 is 0 because the inhibitor will not impact retrieval of tank wastes.

- Option 2--The score for option 2 is 4 because the addition of DE will significantly increase the difficulty of waste retrieval. Existing used retrieval equipment is designed to handle liquid waste. Either equipment would have to be designed and procured for removal of solid waste or waste would have to be redissolved.

- Option 3--The score for option 3 is 5 because the addition of portland cement would significantly increase the difficulty of waste retrieval. Existing retrieval equipment is designed to handle liquid waste. Heavy-duty equipment would have to be developed to break the cement into small pieces for removal through existing tank openings. Equipment would have to be designed and developed to process the solid waste after it is broken up.

- Option 4--The score for option 4 is 1 because the addition of desiccants and gels would increase the difficulty of waste retrieval. Either the waste would have to be liquified for pumping or a new method would have to be developed for removing the waste from the tank.

- Options 5, 6, and 7--The score for options 5, 6, and 7 is 4 because retrieval of solidified waste would be more difficult. Either solidified waste would have to be redissolved or a method of retrieving solid waste would have to be developed.

- Option 8--The score for option 8 is 0 because stop-leak will not affect retrieval, but it will make processing marginally more difficult because it contains silica.

6.2.5.2 Soil Retrieval.

- Option 1--The score for option 1 is 5 because confidence is lacking in the ability of corrosion inhibitors to stop or prevent leaks. Large amounts of soil would be contaminated.

- Options 2 and 3--The score for options 2 and 3 is 1 because DE and portland cement would stop a leak quickly if placed close to the leak. However, placement would be imprecise. Until the liquid is absorbed or the leak stopped, waste would continue to contaminate the soil.

- Option 4--The score for option 4 is 2 because desiccants and gels would require time to be effective. Desiccants will not stop an existing leak quickly. In addition, a gel would require placement near the defect to be effective.

- Options 5, 6, and 7--The score for options 5, 6, and 7 is 4 because all three methods would take considerable drying time to stop the leak. Soil would continue to become contaminated.

- Option 8--The score for option 8 is 3 because stop leak would require time to be effective. The soil would continue to become contaminated.

6.2.5.3 Transfer System Integrity.

- Option 1--The score for option 1 is 0 because the liquid transfer system would not be affected by the addition of corrosion inhibitors.

- Option 2--The score for option 2 is 5 because the transfer system is not designed to handle the solid waste produced by DE. The waste would have to be dissolved or transported by another method.

- Option 3--The score for option 3 is 5 because the existing transfer system would have to be abandoned and a new solid-waste retrieval system developed.

- Option 4--The score for option 4 is 1 because no difficulty is anticipated in converting gel water to liquid form for transferral to processing.

- Options 5, 6, and 7--The score for options 5, 6, and 7 is 1 because the dried waste could not be transferred using the existing liquid transport system. Either a new solid waste transport system would have to be developed or the waste would have to be redissolved and liquified.

- Option 8--The score for option 8 is 0 because stop-leak will not adversely impact the transfer system. The transfer system would have to be monitored and modified for the abrasive effects of the silica.

6.2.5.4 Storage Availability.

- Option 1--The score for Option 1 is 1 because adding corrosion inhibitors would have little effect on DST storage space requirements. Storage requirements for contaminated soils would likely increase.

- Options 2 and 3--The score for options 2 and 3 is 5 because the storage areas for the waste would have to be significantly enlarged to accommodate the increased waste volume from DE and portland cement.

- Options 4, 5, 6, 7, and 8--The score for options 4, 5, 6, 7, and 8 is 0 for the same reasons as option 1, except that options 4, 5, 6, 7, and 8 would have slightly less impact than option 1.

6.2.5.5 Treatment Compatibility.

- Option 1--The score for option 1 is 0 because the treatment process would be unaffected by the corrosion inhibitor.

- Option 2--The score for option 2 is 4 because the treatment process is not compatible with the solid waste generated by the addition of DE. The DE would have to be removed or dissolved before treatment.

- Option 3--The score for option 3 is 5 because a method to treat the waste after mixing with the cement does not exist. A method to either treat or dissolve the solid waste would need to be developed.
- Option 4--The score for option 4 is 3 because silicate loading by the gelling compound would make treatment more difficult.
- Options 5, 6, and 7--The score for options 5, 6, and 7 is 0 because dried nitrate and nitrite wastes can be redissolved in water. Current waste treatment processes should be unaffected by drying the waste.
- Option 8--The score for option 8 is 3 because modifications to the treatment process would be required to accommodate silica.

6.2.6 Cost

- Option 1--The score for option 1 is 1 because the time and manpower required for applying the inhibitor, testing, and additional monitoring would increase the cost.
- Option 2--The score for option 2 is 3 because the volume of waste would be increased, retrieving and processing would be more difficult, and the schedule would be lengthened.
- Option 3--The score for option 3 is 5 because the schedule would be lengthened, retrieval and processing would be more difficult, and equipment would have to be designed and purchased.
- Option 4--The score for option 4 is 3 because significant research and development costs are anticipated. The gelling media may have a high cost and the treatment process may have to be significantly modified to handle the silica loads imposed by the gels.
- Options 5 and 7--The score for options 5 and 7 is 2 because high operations and maintenance costs would occur. Waste would have to be redissolved for retrieving and processing. Some modifications would have to be made to the HVAC system.
- Option 6--The score for option 6 is 4 because the microwave drying system is in the development stage. New risers and HVAC would have to be added. The schedule to bring microwave technology to maturity, although uncertain, is likely to be long.
- Option 8--The score for option 8 is 2 because processing will increase in difficulty.

6.2.7 Schedule

Efforts to stabilize tank waste contents may impact the schedule for disposal and site closure. Considerations of these impacts are provided below.

- Option 1--The score for option 1 is 0 because the schedule for disposal and final closure would not be effected by the addition of an inhibitor.

- Option 2--The score for option 2 is 3 because the schedule would have to be lengthened to accommodate the increased waste volume and the difficulty in retrieving and processing DE waste.

- Option 3--The score for option 3 is 5 because the increase in waste volume and the difficulty in retrieving waste would lengthen the schedule.

- Option 4--The score for option 4 is 3 because the retrieving and processing time would be increased. In addition, research and development efforts for a gelling media would cause a delay.

- Options 5 and 7--The score for options 5 and 7 is 2 because dissolution of solid wastes would length the schedule.

- Option 6--The score for option 6 is 3 because dissolution of solid wastes would lengthen the schedule. Dissolution under option 6 is expected to be slightly more difficult than under options 5 and 7.

- Option 8--The score for option 8 is 1 because processing of waste containing silica would be more difficult; therefore, more time would be required.

6.2.8 Technical Feasibility/Research and Development Requirements

This selection criteria evaluates the feasibility of technical requirements for accomplishing in-tank stabilization and the amount of research required to accomplish the option.

- Option 1--The score for option 1 is 0 because the contents of the tank need only be analyzed to determine the amount of inhibitors needed.

- Option 2--The score for option 2 is 2 because research and development would be required to develop methods to inject DE into the waste to ensure adequate absorption of the liquid.

- Option 3--The score for option 3 is 5 because new equipment would have to be developed to inject the portland cement and mix the waste.

- Option 4--The score for option 4 is 2 because research is needed to determine the effects of a desiccant on the waste if the desiccant were immersed in the waste. The gelling media will need research and development.

- Options 5 and 7--The score for options 5 and 7 is 3 because the microwave drying system needs further development. If the solid waste were retrieved and treated, a method to either dissolve the waste or break the waste up for treatment would have to be developed.

- Option 6--The score for option 6 is 4 because microwave technology requires significant research before it may be used at Hanford in a waste tank.

- Option 8--The score for option 8 is 3 because the effects of the stop-leak upon the waste and the amount needed have to be ascertained.

6.2.9 Maintenance and Operations

Maintenance and operations are required to accomplish an option. The option's maintenance and operation impacts on the criteria are listed below.

- Option 1--The score for option 1 is 2 because the corrosion inhibitor will increase maintenance and operations to ensure proper inhibitor concentrations.

- Option 2--The score for option 2 is 0 because DE would not interfere with maintenance and operations.

- Option 3--The score for option 3 is 0 because portland cement would not affect maintenance and operations.

- Option 4--The score for option 4 is 1 because desiccants and gels may increase maintenance and operations.

- Option 5--The score for option 5 is 2 because drying of the waste would increase normal maintenance and operations. Addition activities would be required to maintain and operate new drying and HVAC equipment.

- Option 6--The score for option 6 is 3 because the microwave drying system would significantly increase maintenance and operations.

- Option 7--The score for option 7 is 2 because air drying would have little effect upon maintenance and operation activities for the tank. Maintenance and operations would be expanded to accommodate new air-drying equipment.

- Option 8--The score for option 8 is 2 because the stop-leak option should have little effect upon maintenance and operations. Mixer equipment with heating capability would require additional maintenance.

6.3 COMPARISON OF OPTIONS FOR EXTERNAL TANK STABILIZATION

Table 6-4 lists scores for the external tank stabilization alternative options. Weighted scores are fairly high for environmental safety, compliance, and future retrieval and process criteria. These high scores

Table 6-4. Comparison of Options for External Tank Stabilization Alternative. (2 sheets)

Selected criteria (impacts)	Weight (1-5)	Option 1		Option 2		Option 3		Option 4	
		Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.3.1 Health Safety	5								
6.3.1.1 Public Safety		0	0	0	0	3	15	2	10
6.3.1.2 Worker Safety		1	5	1	5	1	5	2	10
6.3.1.3 Environmental Safety		2	10	2	10	3	15	3	15
6.3.2 Compliance With Laws/Regulations									
6.3.2.1 WAC 173-303 Codes	4	5	20	5	20	5	20	5	20
6.3.2.2 Closure/Post-Closure Activities		4	16	4	16	4	16	4	16
6.3.3 Waste Safety	5								
6.3.3.1 Hydrogen/Flammable Gas Generation		0	0	0	0	0	0	0	0
6.3.3.2 Ferrocyanide Stability		0	0	0	0	0	0	0	0
6.3.3.3 Criticality		0	0	0	0	0	0	0	0
6.3.3.4 Heat Load		0	0	0	0	0	0	0	0
6.3.4 Tank Safety	3								
6.3.4.1 Waterline Corrosion		0	0	0	0	0	0	0	0
6.3.4.2 Stress Corrosion Cracking		0	0	0	0	0	0	0	0
6.3.4.3 Crevice Corrosion		0	0	0	0	0	0	0	0
6.3.4.4 Concrete Degradation/Cracking		0	0	0	0	0	0	0	0
6.3.4.5 Ease of Maintaining Confinement		0	0	0	0	0	0	0	0
6.3.5 Future Retrieval and Processing	3								
6.3.5.1 Waste Retrieval		0	0	0	0	0	0	0	0

Table 6-4. Comparison of Options for External Tank Stabilization Alternative. (2 sheets)

Selected criteria (impacts)	Weight (1-5)	Option 1		Option 2		Option 3		Option 4	
		Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.3.5.2 Soil Retrieval		3	9	3	9	5	15	1	3
6.3.5.3 Transfer System Integrity		2	6	3	9	4	12	2	6
6.3.5.4 Storage Availability		3	9	3	9	4	12	2	6
6.3.5.5 Treatment Compatibility		3	9	3	9	3	9	3	9
6.3.6 Cost	2	2	4	2	4	3	6	4	8
6.3.7 Schedule	3	2	6	2	6	2	6	3	9
6.3.8 Technical Feasibility/Research and Development Requirements	3	2	6	1	3	1	3	4	12
6.3.9 Maintenance and Operations	2	0	0	0	0	0	0	3	6
Total (weighted score)			100		100		134		130

<u>Options</u>:
1. Geomembrane walls/jet grouting
2. Slurry walls/jet grouting
3. Sheet metal piling
4. Ground freezing

<u>Score</u>:
0 = No impact
5 = High impact

indicate that the external tank stabilization alternative would be undesirable to implement for a leaking SST. Geomembrane walls and slurry walls in combination with jet grouting appear to be viable methods of external stabilization where containment of contaminants from past leaks is desired. The adverse impacts and costs from ground freezing appear to outweigh its advantages based on the criteria examined in this study. The ability to move in close to the contamination source is a highly desirable feature of this technique. If external stabilization is required for future tank operations, further research and a field demonstration of geomembrane walls in conjunction with jet grouting is recommended. In the following sections, the reasons and considerations for the scores are given.

6.3.1 Health Safety

Health safety concerns as discussed in Section 5.1, are applied to the external tank stabilization. Barriers are created to contain the spread of contamination from leaks. Adverse impacts to safety are only partially mitigated.

6.3.1.1 Public Safety.

- Options 1 and 2--The score for options 1 and 2 is 0 because geomembrane walls/jet grouting and slurry walls/jet grouting are routinely used in the hazardous waste remediation industry to confine hazardous materials. Exposure of the public to Tank 241-T-101 releases would be minimal and easily contained.

- Option 3--The score for option 3 is 3 because sheet metal pilings are routinely used in the construction industry to prevent groundwater intrusion into a construction site. The rocky soils surrounding the tanks would complicate placement of the pilings and metal sheeting. Bottom sealing is not feasible. The metal sheets are subject to electrolytic corrosion. As a result, the possibility for loss of containment and exposure of the public is significant.

- Option 4--The score for option 4 is 2 because the behavior of contaminants in frozen soil is not known and the risk of refrigerant equipment failure is significant.

6.3.1.2 Worker Safety.

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 1 because geomembrane walls/jet grouting, slurry walls/jet grouting, and sheet metal piling are passive containment systems after installation. Installation procedures have been developed over the years to ensure worker safety.

- Option 4--The score for option 4 is 2 because ground freezing is a continuous operation that requires constant monitoring and maintenance. Refrigerant technologies have been safely and routinely used for years in industry, but represent a higher risk for workers than the passive containment options.

6.3.1.3 Environmental Safety.

- Options 1 and 2--The score for options 1 and 2 is 2 because geomembrane walls/jet grouting and slurry walls/jet grouting would not prevent spread of contamination between the tank and the vertical and horizontal barriers.

- Option 3--The score for option 3 is 3 because sheet metal piling would not prevent the spread of contamination between the tank and the vertical barrier. A bottom seal cannot be installed to prevent continued migration of contaminants toward groundwater.

- Option 4--The score for option 4 is 3 because the risk of refrigerant equipment failure is significant. Lengthy downtimes could allow the soil to thaw and the contamination to spread.

6.3.2 Compliance with Laws/Regulations

Barrier option scores are high because barriers do not stop or remove the leaking contamination source and they allow contamination of soil up to the barriers. To be effective and to ensure compliance with laws and regulations, barriers would need to be in place before containment loss and a means devised to remove or stop the contamination from leaking into the environment.

6.3.2.1 WAC 173-303. The score for all options is 5 because WAC 173-303 requires that liquids from a leaking tank be removed and that the leaking tank be taken out of service or enough liquid be removed to allow examination and determination that the leak has stopped. Implementation of these options would not prevent continued leakage and soil contamination.

6.3.2.2 Closure and Post-Closure Activities. The score for all options is 4 because large amounts of contaminated soil would need to be retrieved and processed. Contaminated hardware and equipment would also require disposal.

6.3.3 Waste Safety

The score for all options is 0 because none of the options would affect the contents of the tank safety of the waste. During construction, safety measures would have to be taken to ensure the structural integrity of the tank.

6.3.4 Tank Safety

The score for all options is 0 because none of the options would affect the integrity of the tank structure. Safety measures would have to be taken to ensure that construction activities do not impact the tank structure.

6.3.5 Future Retrieval and Processing

The potential impact of each option on future retrieving and processing operations is considered. Considerations include impacts on waste and soil retrieval, transfer system integrity, storage availability, and treatment compatibility.

6.3.5.1 Waste Retrieval. The score for all options is 0 because waste retrieval from tanks would not be effected. The amount of liquid requiring retrieval would be reduced by the amount of before leakage.

6.3.5.2 Soil Retrieval.

- Options 1 and 2--The score for options 1 and 2 is 3 because vertical and horizontal migration of leaked contaminants would be prevented. The amount of contaminated soil requiring recovery and treatment is significant.

- Option 3--The score for option 3 is 5 because horizontal migration of leaked contaminants would be prevented, but vertical migration would continue. The amount of contaminated soil requiring recovery and treatment is significantly higher than the amount under options 1 and 2.

- Option 4--The score for option 4 is 1 because the soil surrounding the tank and some tank wastes would be frozen to stop leaks and contaminant migration. Considerably less soil would be contaminated than under other barrier options. Soil could be thawed just before recovery to limit plume migration.

6.3.5.3 Transfer System Integrity.

- Option 1--The score for option 1 is 2 because installation of geomembranes around the tank and its utilities have the potential to affect waste transfer operations.

- Option 2--The score for option 2 is 3 because shrinkage and settlement of the slurry walls may damage transfer piping.

- Option 3--The score for option 3 is 4 because sheet metal piles could damage or sever pipelines if the sheet metal is deflected during installation.

- Option 4--The score for option 4 is 2 because installation of the pipes to freeze the soil will not impact the transfer system integrity. However, the transfer system pipes could be damaged during freezing of the soil.

6.3.5.4 Storage Availability.

- Options 1 and 2--The score for options 1 and 2 is 3 because contamination of large amounts of soil would be allowed. These additional wastes would require storage, processing, and disposal. Large volumes of soils generated from installation of walls would also be generated.

- Option 3--The score for option 3 is 4 for the same reasons as options 1 and 2, except that the potential to vertically contaminate soil is greater under option 3.

- Option 4--The score for option 4 is 2 because ground freezing would confine the waste to the soil immediately surrounding the tank. This additional soil waste would impact the storage availability somewhat less than the other barrier options.

6.3.5.5 Treatment Compatibility. The score for all options is 3 because all four options allow soil contamination in varying degrees. Existing and planned treatment systems do not appear to be compatible with large amounts of solid soil wastes.

6.3.6 Cost

- Options 1 and 2--The score for options 1 and 2 is 2 each because all barrier options have a high capital cost investment to stage and install. The amount of contaminated soil that would require retrieval, treatment, and disposal is particularly high. Both options are in current use and have proven highly effective for selected applications where protection of a sensitive ecological system is required.

- Option 3--The score for option 3 is 3 for the same reason as options 1 and 2. In addition, sheet metal piling would be difficult to install correctly in the rocky soils at Hanford.

- Option 4--The score for option 4 is 4 for the same reasons as options 1 and 2. In addition, ground freezing would have higher capital and operational costs than other barrier options.

6.3.7 Schedule

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 2 because all barrier options take a significant amount of time to prepare and install. The technologies are proven, but adoptability in a tank-farm environment could take years.

- Option 4--The score for option 4 is 3 because ground freezing would require installation of piping, refrigeration machinery, and associated utilities near the tank. Studies would be required to ensure freezing does not negatively impact tanks, tank utilities, and waste transfer piping.

6.3.8 Technical Feasibility/Research and Development Requirements

- Option 1--The score for option 1 is 2 because geomembrane walls use installation techniques similar to those for sheet piles. Membranes have been accepted for hazardous waste impoundment systems. Geomembrane walls as a subsurface barrier are new in the United States but the technique is used extensively in Europe.

- Option 2--The score for option 2 is 1 because the use of slurry walls is an established method for confinement for wastes at superfund sites.

- Option 3--The score for option 3 is 1 because sheet metal pilings are commonly used during construction to prevent water intrusion.

- Option 4--The score for option 4 is 4 because ground freezing is an emerging technology. The methods and procedures required to work in close proximity to other tanks and utilities require study. The freezing of soil, tanks, tank utilities, and tank wastes require careful analysis to determine impacts.

6.3.9 Maintenance and Operations

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 0 because no additional maintenance and operation would be required for geomembrane walls, slurry walls, and sheet metal pilings. They become passive systems once installed.

- Option 4--The score for option 4 is 3 because ground freezing requires daily maintenance to keep the system operational. If the system leaked or shut down, the soil would thaw and migration of soil contaminants would resume.

6.4 COMPARISON OF OPTIONS FOR LIQUID RETRIEVAL

Scores are listed in Table 6-5 for the Liquid Retrieval options. The low total weighted scores for options 1 and 2 suggest that these two options could easily be implemented with little adverse impact on the selection criteria. In the following sections, the reasons and considerations for the scores are given.

6.4.1 Health Safety

Health safety concerns include public safety, worker safety and environmental impacts.

6.4.1.1 Public Safety. The score for all options is 0 because the safety of the public would not be adversely impacted by these options. The only impact on public safety would be road closures during transportation of radioactive liquid from Tank 241-T-101 located in 200-West Area to 244-AR unloading facility in 200-East Area during off-peak hours. Road closures would restrict public access but the impact would be minimal.

6.4.1.2 Worker Safety.

- Options 1 and 2--The score for options 1 and 2 is 0 because pipeline transfers confine liquid wastes whereby workers would be protected from exposure to radioactivity and toxic materials.

Table 6-5. Comparison of Options for Liquid Retrieval Alternatives. (2 sheets)

selected criteria (impacts)		Weight (1-5)	Option 1		Option 2		Option 3		Option 4	
			Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.4.1	Health Safety	5								
6.4.1.1	Public Safety		0	0	0	0	0	0	0	0
6.4.1.2	Worker Safety		1	5	1	5	2	10	2	10
6.4.1.3	Environmental Safety		0	0	0	0	0	0	0	0
6.4.2	Compliance with Laws/Regulations	4								
6.4.2.1	WAC 173-303		0	0	0	0	0	0	0	0
6.4.2.2	Closure/Post-Closure Activities		0	0	1	4	1	4	1	4
6.4.3	Waste Safety	5								
6.4.3.1	Hydrogen/Flammable Gas Generation		0	0	0	0	0	0	0	0
6.4.3.2	Ferrocyanide Stability		1	5	1	5	1	5	1	5
6.4.3.3	Criticality		0	0	0	0	0	0	0	0
6.4.3.4	Heat load		0	0	0	0	0	0	0	0
6.4.4	Tank Integrity	3								
6.4.4.1	Waterline Corrosion		0	0	0	0	0	0	0	0
6.4.4.2	Stress Corrosion Cracking		0	0	0	0	0	0	0	0
6.4.4.3	Crevice Corrosion		0	0	0	0	0	0	0	0
6.4.4.4	Concrete Degradation/Cracking		0	0	0	0	0	0	0	0
6.4.4.5	Ease of Maintaining Confinement		0	0	0	0	0	0	2	6
6.4.5	Future Retrieval and Processing	3								
6.4.5.1	Waste Retrieval		0	0	0	0	0	0	1	3

Table 6-5. Comparison of Options for Liquid Retrieval Alternatives. (2 sheets)

selected criteria (impacts)	Weight (1-5)	Option 1		Option 2		Option 3		Option 4	
		Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.4.5.2 Soil Retrieval		0	0	0	0	0	0	0	0
6.4.5.3 Transfer Systems Integrity		0	0	0	0	0	0	1	3
6.4.5.4 Storage Availability		0	0	0	0	0	0	1	3
6.4.5.5 Treatment Compatibility		0	0	0	0	0	0	1	3
6.4.6 Cost	2	0	0	1	2	1	2	2	4
6.4.7 Schedule	3	0	0	1	3	1	3	1	3
6.4.8 Technical Feasibility/Research and Development Requirements	3	0	0	0	0	1	3	1	3
6.4.9 Maintenance and Operations	2	0	0	0	0	1	2	1	2
Total (weighed score)			10		19		29		49

Options:
1. Existing pipeline (below grade)
2. New pipeline (below or above grade)
3. Tank truck/railcar
4. Internal bladder

Score:
0 = No impact
5 = High impact

- Option 3--The score for option 3 is 2 because worker radiation exposure would increase during transfer by; truck or train to the 244-AR building and during maintenance.

- Option 4--The score for option 4 is 2 because activity would increase around the tank during insertion of the bladder and sump pump. In addition, installation of a larger riser may be required. Workers would be exposed to radiation, toxic wastes, and construction accidents during work on the tank.

6.4.1.3 Environmental Safety. The score for all options is 0 because the potential for release to the environment is very low. Transfers are closely monitored to prevent breach of confinement. In option 3, waste is transported by truck or rail with a risk assessment less than 10^{-6} release accidents/year.

6.4.2 Compliance with Laws/Regulations

Compliance with current regulations and laws is evaluated as discussed in Section 5.2.

6.4.2.1 WAC 173-303.

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 0 because pumping of the tank's liquid contents to a double-contained receiver/storage tank complies with WAC-173-303.

- Option 4--The score for option 4 is 0 because transferal of the liquid from the leaking tank into a nonleaking bladder for later transfer to a double-contained receiver/storage tank complies with WAC 173-303.

6.4.2.2 Closure/Post-Closure Activities.

- Option 1--The score for option 1 is 0 because use of existing equipment and pipelines would require no additional decontamination or decommissioning activities.

- Options 2, 3, and 4--The score for options 2, 3, and 4 is 0 because new materials and equipment used under this option would require removal and decontaminating before disposal.

6.4.3 Waste Safety

Several unresolved waste safety issues are associated with the retrieval of SST wastes. The full effect of water and hydroxide solution removal has not been determined. Water removal and the heating and drying of waste can decrease the ability of the waste to cool. The possibility for thermal runaway reactions between oxidants such as nitrates and organics/ferrocyanide significantly increases as moisture is removed or heat added.

6.4.3.1 Hydrogen/Flammable Gas Generation. The score for all options is 0 because there is no possibility of this condition occurring within Tank 241-T-101 during the liquid retrieval operations.

6.4.3.2 Ferrocyanide Stability. The score for all options is 1 because the possibility of increased ferrocyanide concentration exists when the liquid is pumped and the sludge is left in the tank to dry.

6.4.3.3 Criticality. The score for all options is 0 because pumping would have no effect upon the criticality of the waste.

6.4.3.4 Heat Load. The score for all options is 0 because heat generated during the pumping operation will have minimal effect on the overall tank temperature.

6.4.4 Tank Safety

The SSTs have exceeded their original design life. Available information on the physical integrity and condition of the tank structures is limited. Monitoring equipment is unreliable. The steel liners on approximately half of the SSTs have already leaked. Tanks low in hydroxide are considered most vulnerable because hydroxide is known to inhibit corrosion of mild steel.

6.4.4.1 Waterline Corrosion. The score for all options is 0 because waterline attack has not been observed at the SRS or Hanford Site.

6.4.4.2 SCC. The score for all options is 0 because removal of the liquids will reduce or eliminate the SCC of the steel liner.

6.4.4.3 Crevice Corrosion. The score for all options is 0 because no crevice corrosion attack has been observed at SRS or Hanford Site.

6.4.4.4 Concrete Degradation/Cracking. The score for all options is 0 because contact between liquid waste and concrete would be prevented.

6.4.4.5 Ease of Maintaining Confinement.

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 0 because these options would leave no effect on the ease of maintaining confinement.

- Option 4--The score for option 4 is 2 because installation of a larger riser would involve light to moderate confinement risk.

6.4.5 Future Retrieval and Processing

Alternatives and options are evaluated for potential impact on future retrieval, transportation, storage and waste processing operations. Actions that may impact transportation, storage, and waste treatment are identified and rated.

6.4.5.1 Waste Retrieval.

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 0 because there was no effect on waste retrieval.

- Option 4--The score for option 4 is 1 because future retrieval would require removal of liquid, bladders, and sump pumps before the sludge could be removed.

6.4.5.2 **Soil Retrieval.** The score for all options is 0 because removal of liquids would eliminate tank leakage and resulting soil contamination.

6.4.5.3 Transfer System Integrity.

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 0 because there was no effect on transfer system integrity.
- Option 4--The score for option 4 is 1 because it allows the bladder to be pumped out through the existing transfer system.

6.4.5.4 Storage Availability.

- Option 1, 2, and 3--The score for options 1, 2, and 3 is 0 because the amounts of flush water added to the waste volume would be insignificant.
- Option 4--The score for option 4 is 1 because the amounts of flush water added to the storage volume would be small. However, the amount is greater than under options 1, 2, and 3.

6.4.5.5 Treatment Compatibility.

- Options 1, 2, and 3--The score for options 1, 2, and 3 is 0 because these options will not change the existing treatment requirements.
- Option 4--The score for option 4 is 1 because the bladder and associated sump pump become solid waste after liquid retrieval. Although it does not directly affect the future tank waste treatment processes, it adds to the volume of contaminated solid waste that must be disposed.

6.4.6 Cost

- Option 1--The score for option 1 is 0 because the use of existing pipeline would not require procurement and installation of equipment.
- Option 2--The score for option 2 is 1 because a new pipeline would be required.
- Option 3--The score for option 3 is 1 because procurement and installation of aboveground pipeline and procurement of a tank truck would be required. Additionally, modification to the railcar and possible modifications to the 244-AR unloading station would be required. An SAR addendum to SD-WM-SAR-034 and permitting would need to be prepared.

- Option 4--The score for option 4 is 2 because research, design, testing, procurement, and installation of bladder tanks, sump pumps, and associated risers would be required.

6.4.7 Schedule

- Option 1--The score for option 1 if 0 because the time required to install the pumping system and perform liquid transfers is minimal.
- Options 2 and 3--The score for options 2 and 3 is 1 because the time required to construct a new pipeline or railroad.
- Option 4--The score for option 4 is 1 because the option requires time to investigate and implement.

6.4.8 Technical Feasibility/Research and Development Requirements

- Options 1 and 2--The score for options 1 and 2 is 0 because these options represent the current method of liquid transfer.
- Option 3--The score for option 3 is 1 because R&D is required for determining modifications needed to meet environmental, health, and safety requirements.
- Option 4--The score for option 4 is 1 because bladder vessels have been used in the petrochemical industry. Some development is required to adapt the bladder to the physical parameters of Tank 241-T-101.

6.4.9 Maintenance and Operations

- Options 1 and 2--The score for options 1 and 2 is 0 because maintenance and operational requirements are the same as current and past tank farm activities.
- Option 3--The score for option 3 is 1 because increased maintenance would be required for the tank truck or the railcar and the unloading facility. Operations would have increased responsibility during transporting and unloading the liquid.
- Option 3--The score for option 4 is 1 because additional tank monitoring by operations and maintenance of equipment for an extended time period would be required until the bladder is pumped out.

6.5 COMPARISON OF OPTIONS FOR TOTAL RETRIEVAL SYSTEMS

Table 6-6 contains scores for the total retrieval options. The low total weighted score for option 1 indicates that this option is the best option. In the following sections, the reasons and considerations for the scores are given.

Table 6-6. Comparison of Options for Total Retrieval Alternatives. (2 sheets)

Selected criteria (impacts)	Weight (1-5)	Option 1		Option 2		Option 3	
		Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.5.1 Health Safety	5						
6.5.1.1 Public Safety		1	5	1	5	3	15
6.5.1.2 Worker Safety		3	15	4	20	5	25
6.5.1.3 Environmental Safety		0	0	0	0	0	0
6.5.2 Compliance with Laws/Regulations	4						
6.5.2.1 WAC 173-303		0	0	0	0	0	0
6.5.2.2 Closure/Post-Closure Activities		1	4	1	4	2	8
6.5.3 Waste Safety	5						
6.5.3.1 Hydrogen/Flammable Gas Generation (radiation levels/organics)		0	0	0	0	0	0
6.5.3.2 Ferrocyanide Stability		0	0	0	0	1	5
6.5.3.3 Criticality		0	0	0	0	0	0
6.5.3.4 Heat Load		0	0	0	0	0	0
6.5.4 Tank Safety	3						
6.5.4.1 Waterline Corrosion		0	0	0	0	0	0
6.5.4.2 Stress Corrosion Cracking		2	6	2	6	3	9
6.5.4.3 Crevice Corrosion		0	0	0	0	0	0
6.5.4.4 Concrete Degradation/Cracking		0	0	0	0	0	0
6.5.4.5 Ease of Maintaining Confinement		1	3	3	9	5	15
6.5.5 Future Retrieval and Processing	3						
6.5.5.1 Waste Retrieval		0	0	0	0	0	0

Table 6-6. Comparison of Options for Total Retrieval Alternatives. (2 sheets)

Selected criteria (impacts)	Weight (1-5)	Option 1		Option 2		Option 3	
		Score (0-5)	Weighted score	Score (0-5)	Weighted score	Score (0-5)	Weighted score
6.5.5.2 Soil Retrieval		0	0	0	0	0	0
6.5.5.3 Transfer System Integrity		0	0	0	0	0	0
6.5.5.4 Storage Availability		0	0	0	0	0	0
6.5.5.5 Treatment Compatibility		0	0	0	0	0	0
6.5.6 Cost	2	3	6	4	8	5	10
6.5.7 Schedule	3	1	3	3	9	4	12
6.5.8 Technical Feasibility/Research and Development Requirements	3	3	9	3	9	5	15
6.5.9 Maintenance and Operations	2	2	4	2	4	4	8
Total (weighted score)			55		74		122

Options:
1. Unlimited sluice (low pressure-high volume)
2. Limited sluice (high pressure-low volume)
3. Articulated arm scarifier

Score:
0 = No impact
5 = High impact

6.5.1 Health Safety

Health safety concerns include public safety, worker safety and environmental impacts.

6.5.1.1 Public Safety.

- Options 1 and 2--The score for options 1 and 2 is 1 because waste transfer occurs in a confined system such as pipe-in-pipe transfer lines.
- Option 3--The score for option 3 is 3 because the design of the air conveyance and support ventilation system for option 3 is unproven and represents a moderate potential risk to the public in the event of equipment failure.

6.5.1.2 Worker Safety.

- Option 1--The score for option 1 is 3 because major modifications or the replacement of existing concrete pits would be required. In addition, several existing tank risers may need modifications to accept new instrumentation and CCTV. The potential risks to workers during these activities is moderate.
- Option 2--The score for option 2 is 4 because the potential risks to worker safety during the installation of four 18 in. diameter risers and related tank modifications is moderate to heavy.
- Option 2--The score for option 3 is 5 because installation of a 6-ft diameter opening in the SST dome and construction of a large pit over the dome opening are required. Modifications to Tank 241-T-101 are also required to accommodate the new instrumentation and CCTV. The potential risks to workers during these activities is significant.

6.5.1.3 Environmental Safety. The score for all options is 0 because none of the options are expected to significantly impact the environment. Accidents and leaks would be detected before significant releases to the environment occur. Some small leaks could occur to the environment during sluicing of the tank. Leaks during sluicing should be minimal for Tank 241-T-101 because the amount of waste contained by this tank is small.

6.5.2 Compliance with Law/Regulations

Regulatory compliance has less importance than safety. Compliance with current regulations and laws is evaluated as discussed in Section 5.2.

6.5.2.1 WAC 173-303. The score for all options is 0 because all three options comply with WAC 173-303.

6.5.2.2 Closure/Post-Closure Activities.

- Options 1 and 2--The score for options 1 and 2 is 1 because sluicing systems would be removed and recycled prior to closure activities.

Some minimal decontamination and decommission activities would be required at the completion of sluicing operations.

- Option 3--The score for option 3 is 2 because decontamination and decommissioning would require more effort than other options.

6.5.3 Waste Safety

Waste safety concerns for Tank 241-T-101 include hydrogen/flammable gas generation, ferrocyanide stability, criticality, heat load impacts, and are evaluated as described in Section 5.2.

6.5.3.1 Hydrogen/Flammable Gas Generation. The score for all options is 0 because there is little likelihood of this condition occurring within Tank 241-T-101 during retrieval operations.

6.5.3.2 Ferrocyanide Stability.

- Options 1 and 2--The score for options 1 and 2 is 0 because the sluicing and diluting action will not alter the stability of the ferrocyanide during retrieval operations.

- Option 3--The score for option 3 is 1 because there would be a potential for a temperature increase in the salt cake after the liquids have been removed. This could set off an exothermic chemical reaction which could effect ferrocyanide stability.

6.5.3.3 Criticality. The score for all options is 0 because there would be little likelihood of this condition existing within Tank 241-T-101 during retrieval operations.

6.5.3.4 Heat Load. The score for all options is 0 because little heat would be added to Tank 241-T-101 during retrieval operations.

6.5.4 Tank Safety

The SSTs have exceeded their original design life. Available information on the physical integrity of the tank structures is limited. Monitoring equipment is unreliable. The steel liners of approximately half of the SSTs have already leaked. Tanks low in hydroxide are considered most vulnerable because hydroxide is known to inhibit corrosion of mild steel.

6.5.4.1 Waterline Corrosion. The score for all options is 0 because the proposed retrieval systems would not result in waterline corrosion.

6.5.4.2 SCC.

- Options 1 and 2--The score for options 1 and 2 is 2 because high-pressure sluicing may aggravate ongoing SCC in the tank liner.

- Option 3--The score for option 3 is 3 for the same reason as options 1 and 2 except that the aggravation of the steel liner by option 3 would be more aggressive.

6.5.4.3 Crevice Corrosion. The score for all options is 0 because the proposed retrieval systems would not result in crevice corrosion.

6.5.4.4 Concrete Degradation/Cracking. The score for all options is 0 because options would not contribute significantly to concrete degradation or cracking. The tank would be ready for decommissioning so that concrete degradation and cracking would be irrelevant.

6.5.4.5 Ease of Maintaining Confinement.

- Option 1--The score for option 1 is 1 because confinement concerns are light when using existing tank risers for installation of equipment.
- Option 2--The score for option 2 is 3 because penetration of the dome would be required for construction of an 18 in. diameter riser.
- Option 3--The score for option 3 is 5 because penetration of the dome would be required for construction of a 6 ft diameter opening.

6.5.5 Future Retrieval and Processing

The score for all options is 0 because total retrieval would be accomplished whereby future concerns would be obviated.

6.5.6 Cost

The scores for options 1, 2, and 3 are 3, 4, and 5, respectively. Scores are based on cost information in WHC-SD-W139-ES-001, Rev. 0.

6.5.7 Schedule

The scores for options 1, 2, and 3 are 1, 3, and 4, respectively. Scores are based on engineering judgements of each options ability to meet Tri-Party Agreement milestones and on the relative time frame necessary to complete the option.

6.5.8 Technical Feasibility/Research and Development Requirements

- Options 1 and 2--The score for options 1 and 2 is 3 because major development and testing of new remotely operated sluicing assemblies would be required. The new sludge/slurry pump assembly would require minor development for remote service prior to installation.
- Option 3--The score for option 3 is 5 because an unproven retrieval system is involved. Extensive development and testing of the remotely operated articulated arm scarifier assembly and air conveyance support equipment would be required.

6.5.9 Maintenance and Operations

- Options 1 and 2--The score for options 1 and 2 is 2 because maintenance and operation requirements would be light to moderate by comparison to current and past tank farm activities.

- Option 3--The score for option 3 is 4 because the maintenance and operation requirements would be moderate to heavy by comparison to current and past tank farm activities.

7.0 SELECTED ALTERNATIVE(S)

The preferred alternative is liquid retrieval. Options 1 and 2 had the least impact upon the selection criteria. Results strongly suggest that if DST space is available, and the liquid transport system operable, Tank 241-T-101 liquid contents should be transferred as soon as practicable to a DST to prevent further contamination of the environment. The evaluation results imply that other SSTs containing appreciable liquid should also be pumped out as soon as safely practicable to avoid the same safety, compliance, and cleanup impacts found for Tank 241-T-101.

Existing environmental regulations and DOE's pending commitments to retrieve and process all SST and DST wastes and to clean the site to background levels further reinforce the findings of the evaluation. The total retrieval alternative looks quite favorable because it solves the total HLW tank waste problem in one action. Transport, storage, and process systems are not yet in place at Hanford to permit the implementation of this alternative (options 1 and/or 2) in the immediate future. As a result, the total retrieval alternative cannot be implemented in sufficient time to mitigate a leaker SST. Its potential benefits will have to wait until the back end of waste management system is completed.

In summary, the following alternatives/options were found worthy of further evaluation for Tank 241-T-101 or other liquid-bearing SSTs. The listing is given in order of descending merit.

1. Liquid Retrieval Alternative
   - Option 1, pump out - using existing piping
   - Option 2, pump out - using new piping
   - Option 3, pump out - tank truck/railcar
   - Option 4, pump out - internal bladder

2. Total Retrieval Alternative
   - Option 1, unlimited sluicing
   - Option 2, limited sluicing

3. In-Tank Stabilization Alternative
   - Option 4, gels

4. External Tank Stabilization Alternative
   - Option 1, geomembrane walls/jet grouting
   - Option 2, slurry walls/jet grouting
   - Option 3, sheet piling
   - Option 4, ground freezing

The external tank stabilization alternative is included because it offers a way to control/contain the spread of contamination through soils from either past tank leaks or future leaks from waste retrieval actions. This alternative was not found to be a viable alternative in this evaluation.

Based on the engineering evaluation of alternatives, findings and preliminary estimates of schedule and costs were developed for the liquid retrieval, total retrieval, and external tank stabilization alternatives to permit comparisons. These estimates are found in Appendix A.

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9.0 GLOSSARY

ABBREVIATIONS AND ACRONYMS

CCTV	closed-circuit television
DCRT	double-contained receiver tank
DE	diatomaceous earth
DOE	U.S. Department of Energy
DST	double-shell tank
EIS	Environmental Impact Statement
FIC	Food Industry Corporation
HDW	Hanford Defense Waste
HEPA	high-efficiency particulate air
HLW	high-level waste
HVAC	heating, ventilating, and air-conditioning
LOW	liquid observation well
SAR	safety analysis report
SCC	stress corrosion cracking
sg	specific gravity
SRS	Savannah River Site
SSTs	single-shell tanks
TRAC	track radioactive components
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

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10.0 APPENDIX A

PRELIMINARY ESTIMATES OF SCHEDULE AND COST FOR SELECTED WASTE MANAGEMENT ALTERNATIVES

Preliminary estimates of schedule and costs were made for the preferred alternatives that were selected in this engineering evaluation of alternatives and for the external tank stabilization alternative. The summary results are shown in Table A-1. The results confirm that the fastest, most economical way to manage a leaking waste tank is to pump the liquids as soon as possible to a safe double-shell tank. Liquid wastes should be transferred to double-shell tanks as rapidly and safely possible to avoid the heavy safety, ecological and regulatory compliance (cleanup) impacts associated with leaks to the soil.

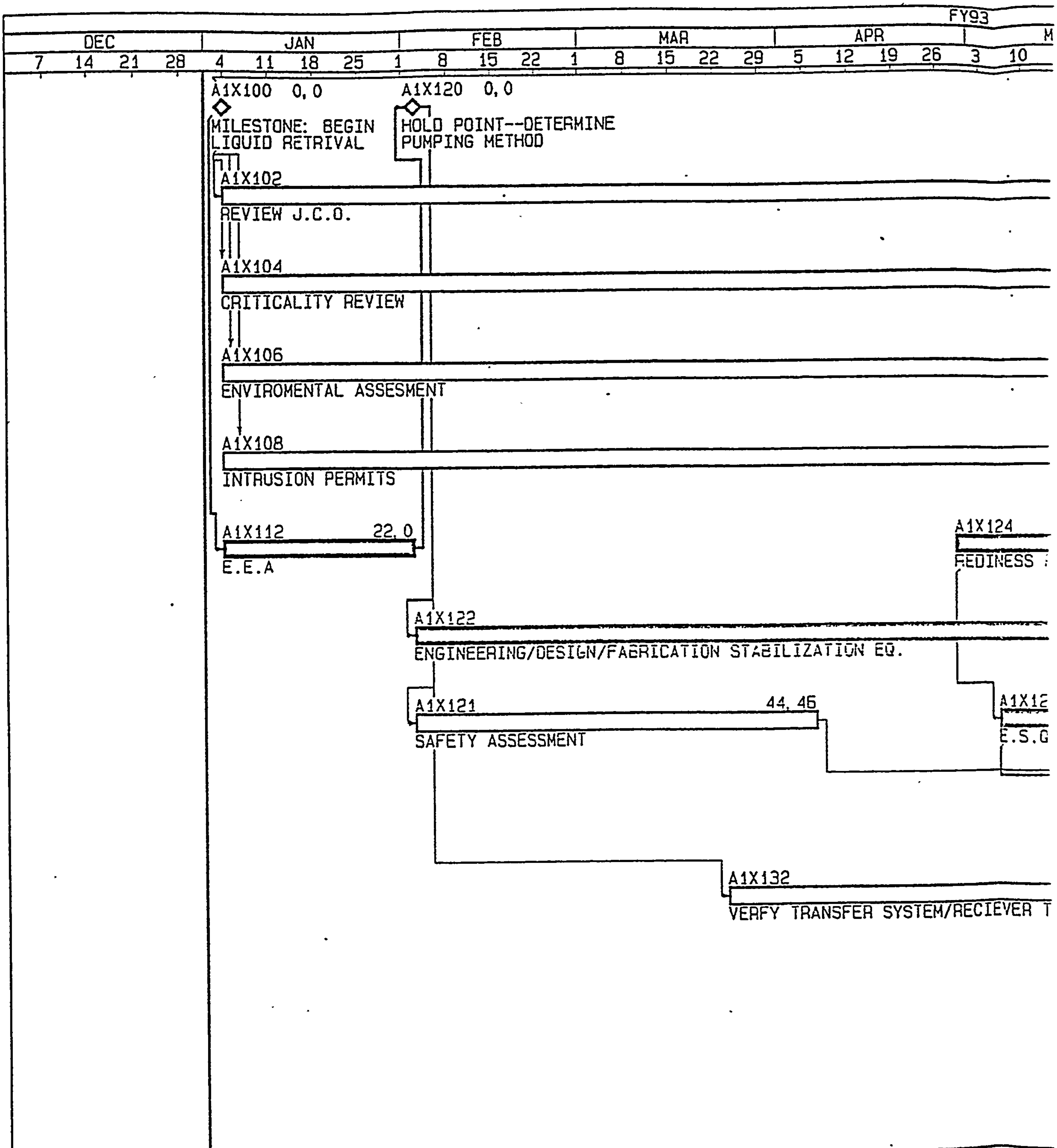
Schedule and cost details for each alternative and option are shown in Sections A-1 and A-2.

TABLE A-1 SUMMARY OF SCHEDULE AND COSTS FOR SELECTED ALTERNATIVES

Alternative	Option	Schedule-Yrs	Costs-M$
Liquid Retrieval			
• Pump out -- using existing piping	1	0.67	2.4
• Pump out -- using new pipe	2	4.0	8.3
• Pump out -- using tank truck	3	2.5	6.5
• Pump out -- using railcar	3A	2.58	13.2
• Pump out -- using internal bladders	4	4.1	8.4
Total Retrieval			
• Unlimited sluicing	1	7.67	121.7
• Limited sluicing	2	7.75	108.9
External Tank Stabilization			
• Geomembrane walls/Jet grouting	1	4.5	16.2
• Slurry Walls/Jet grouting	2	4.58	16.1
• Ground freezing	3	4.92	26.3

SECTION A-1

SCHEDULE DETAILS FOR SELECTED ALTERNATIVES



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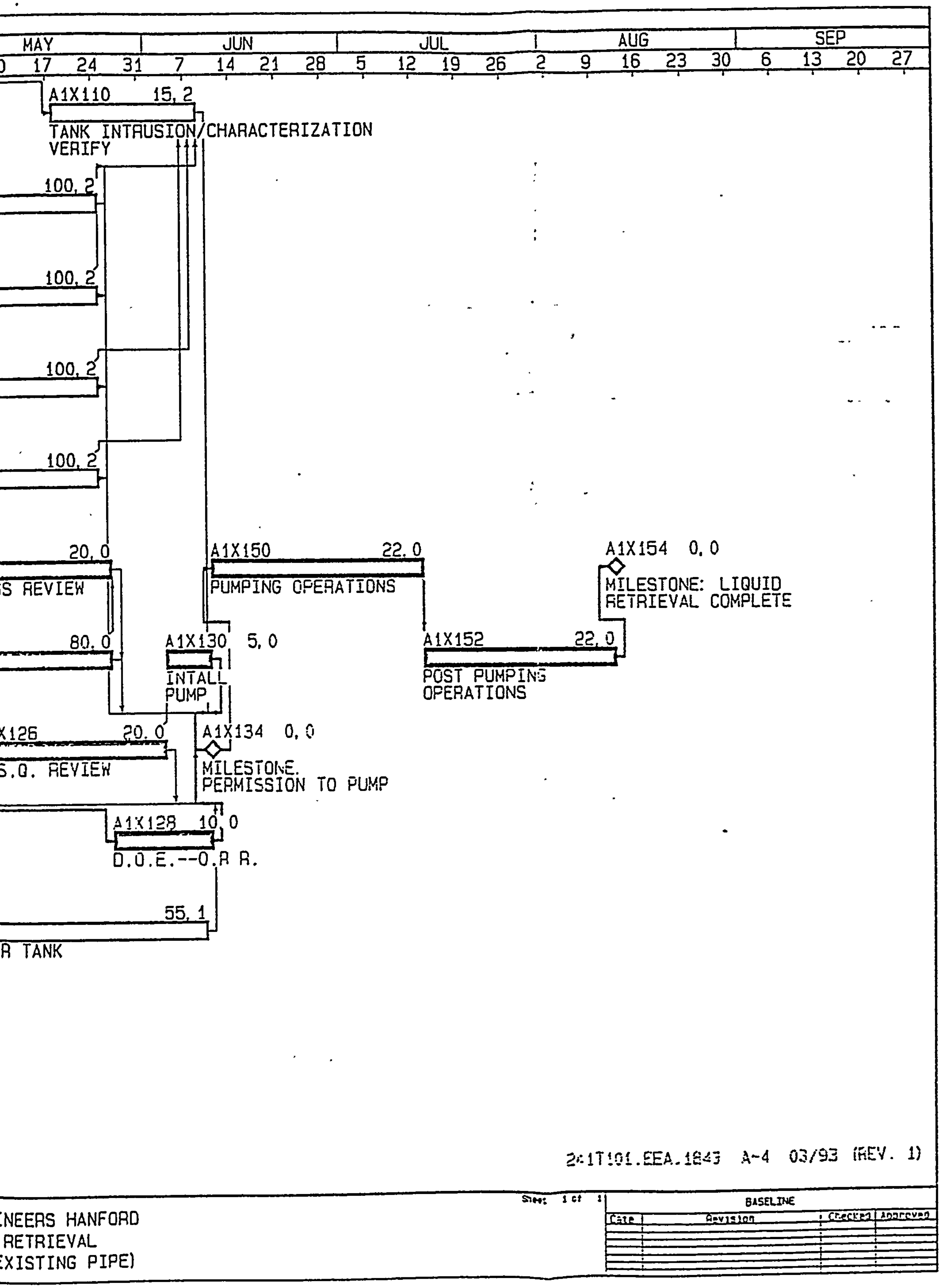
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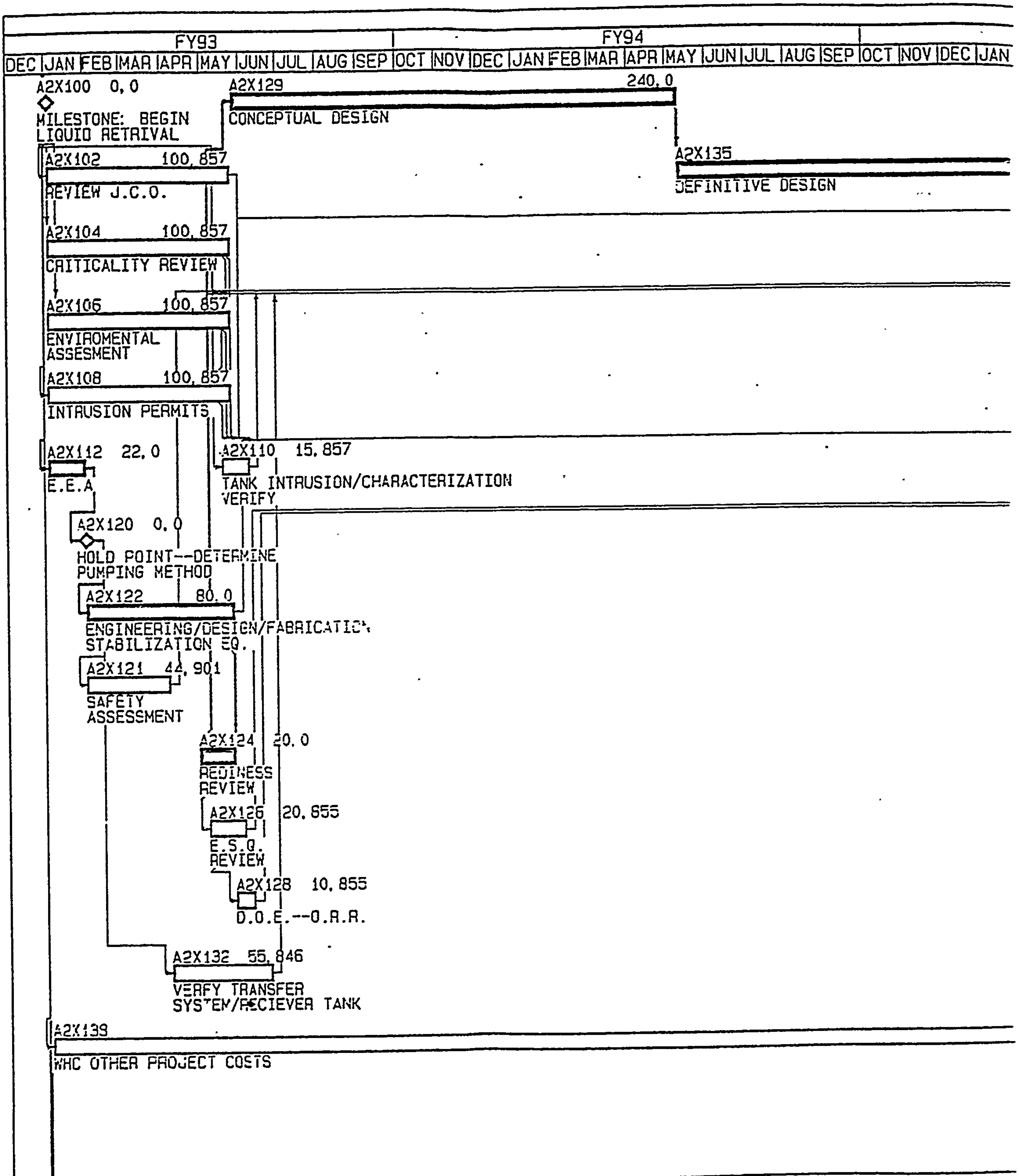

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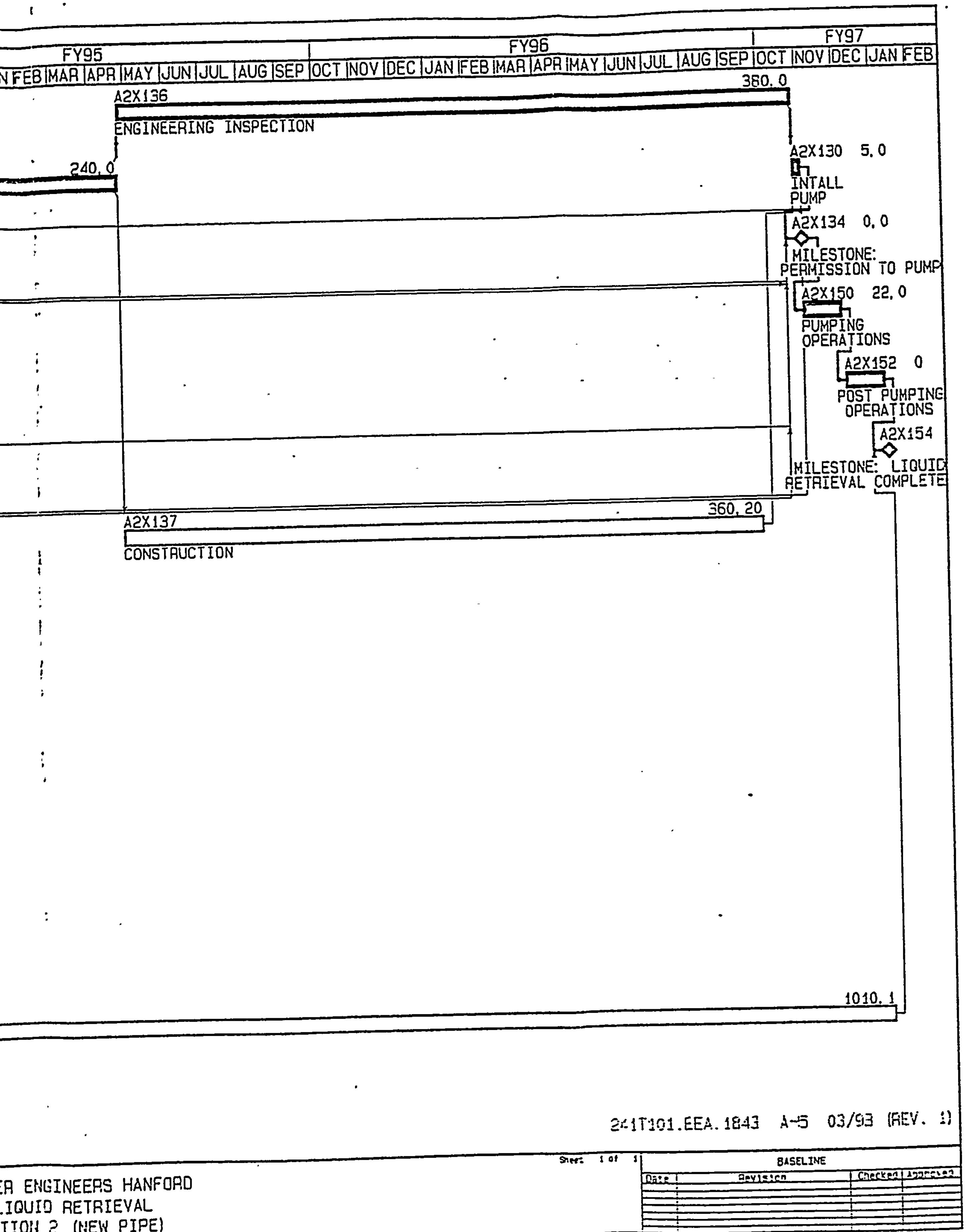
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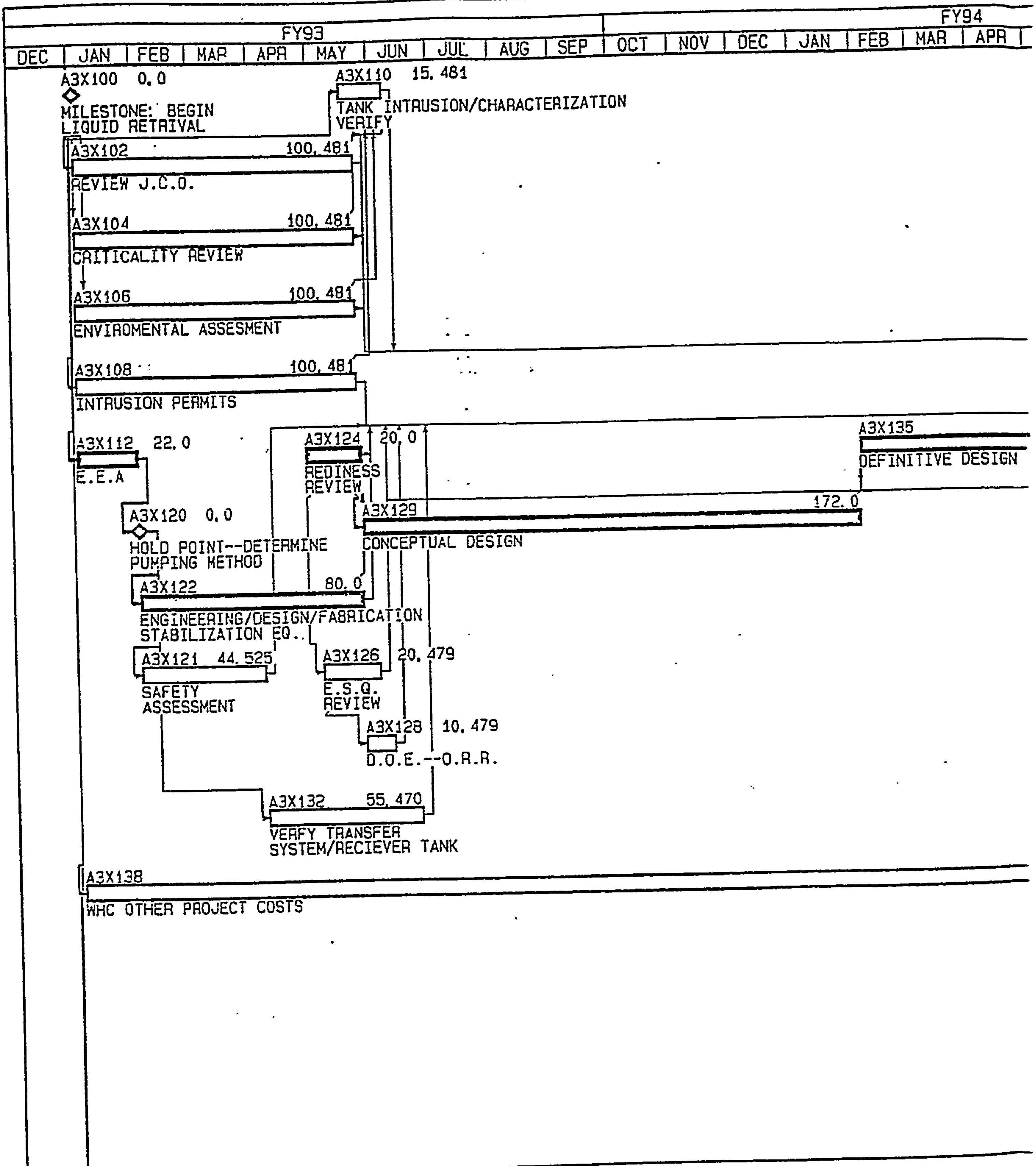

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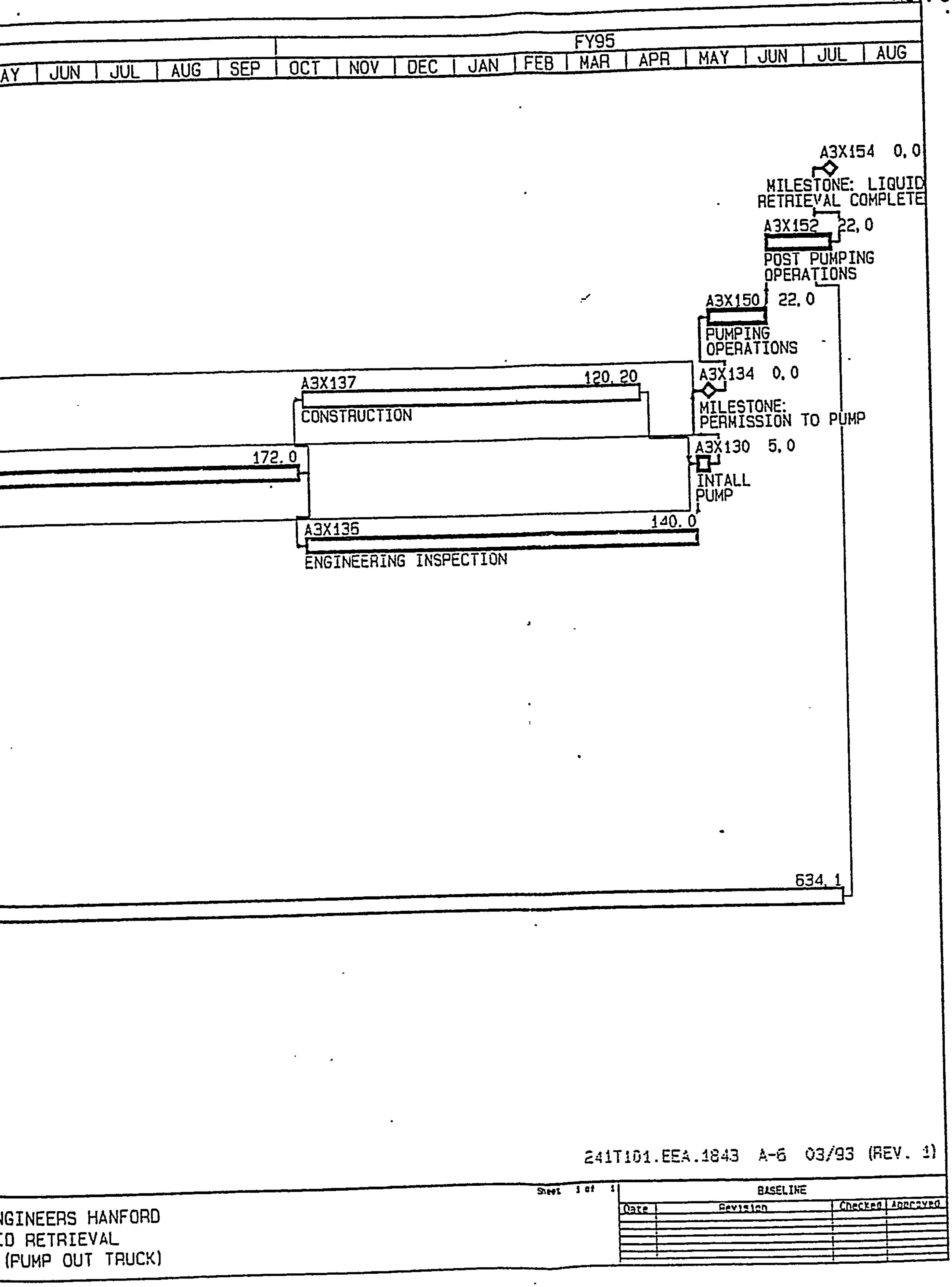
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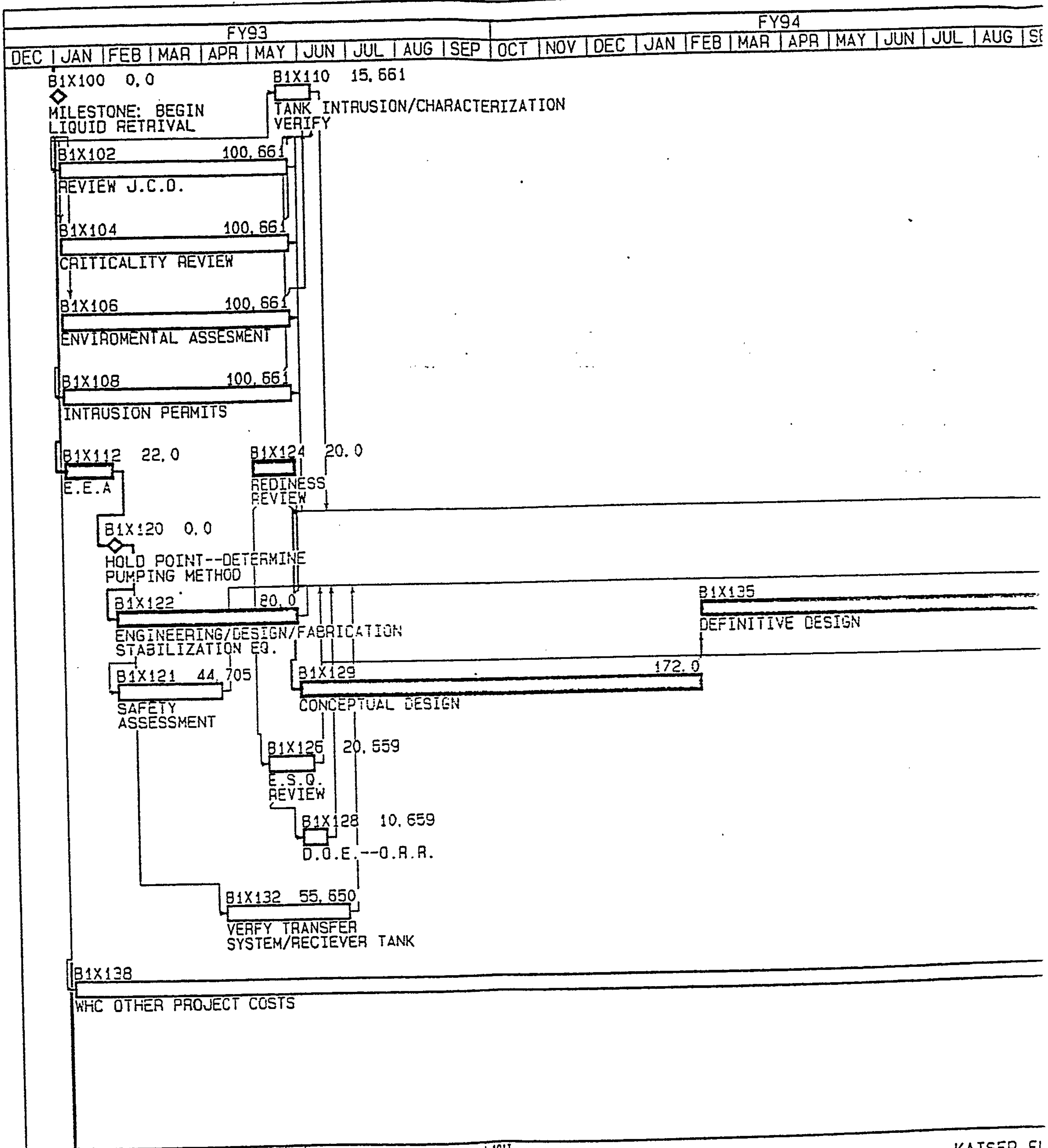

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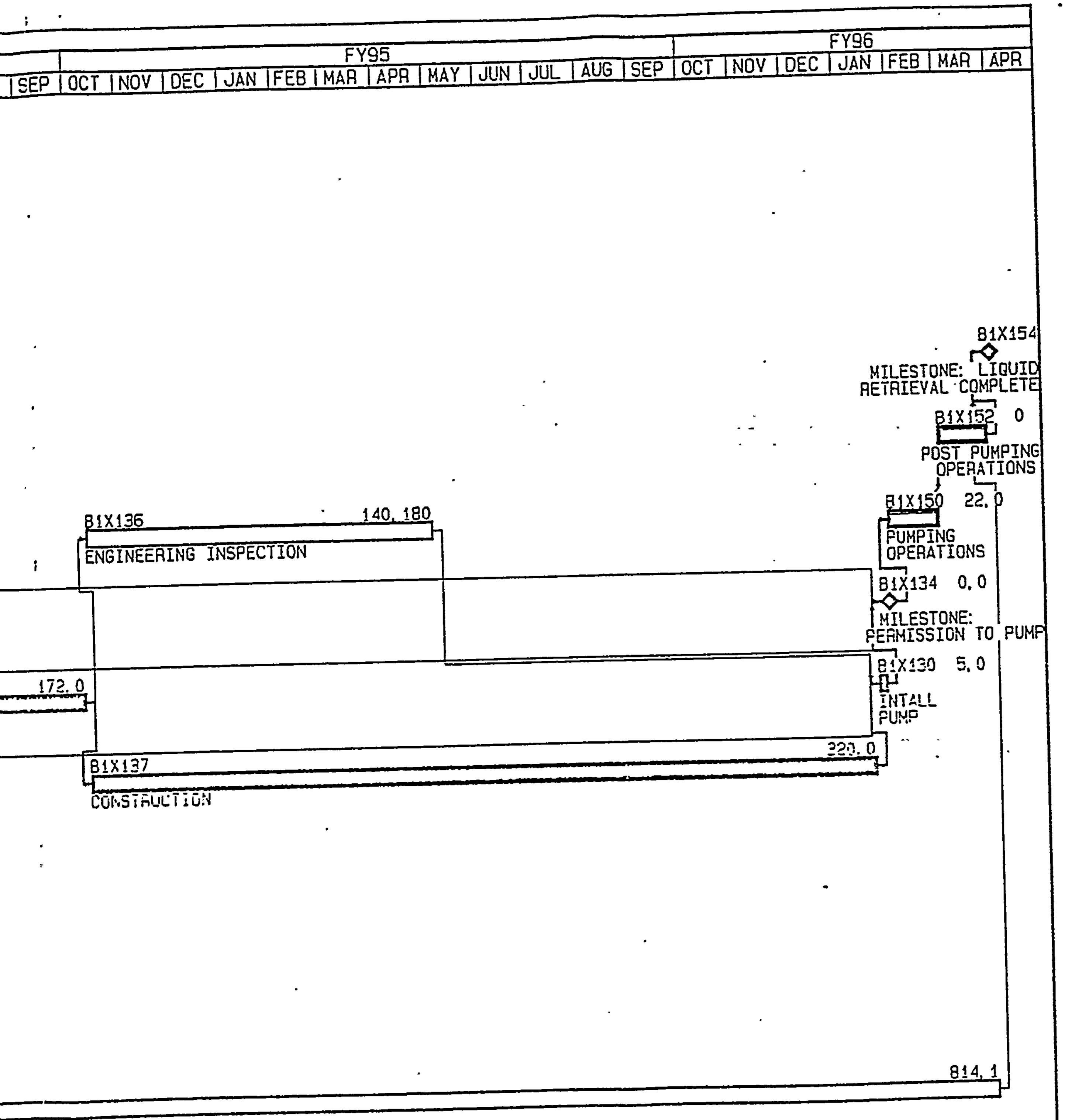

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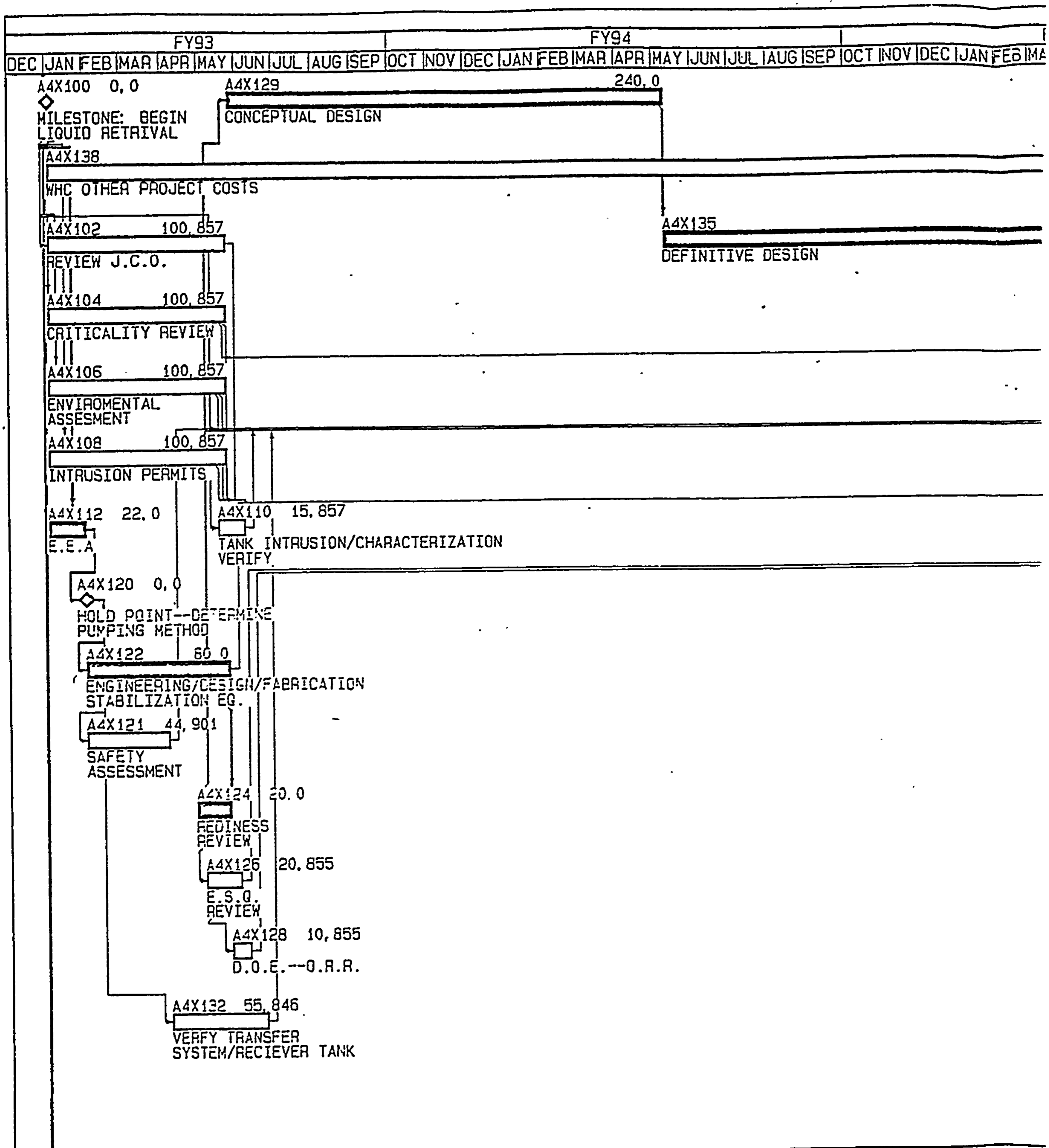

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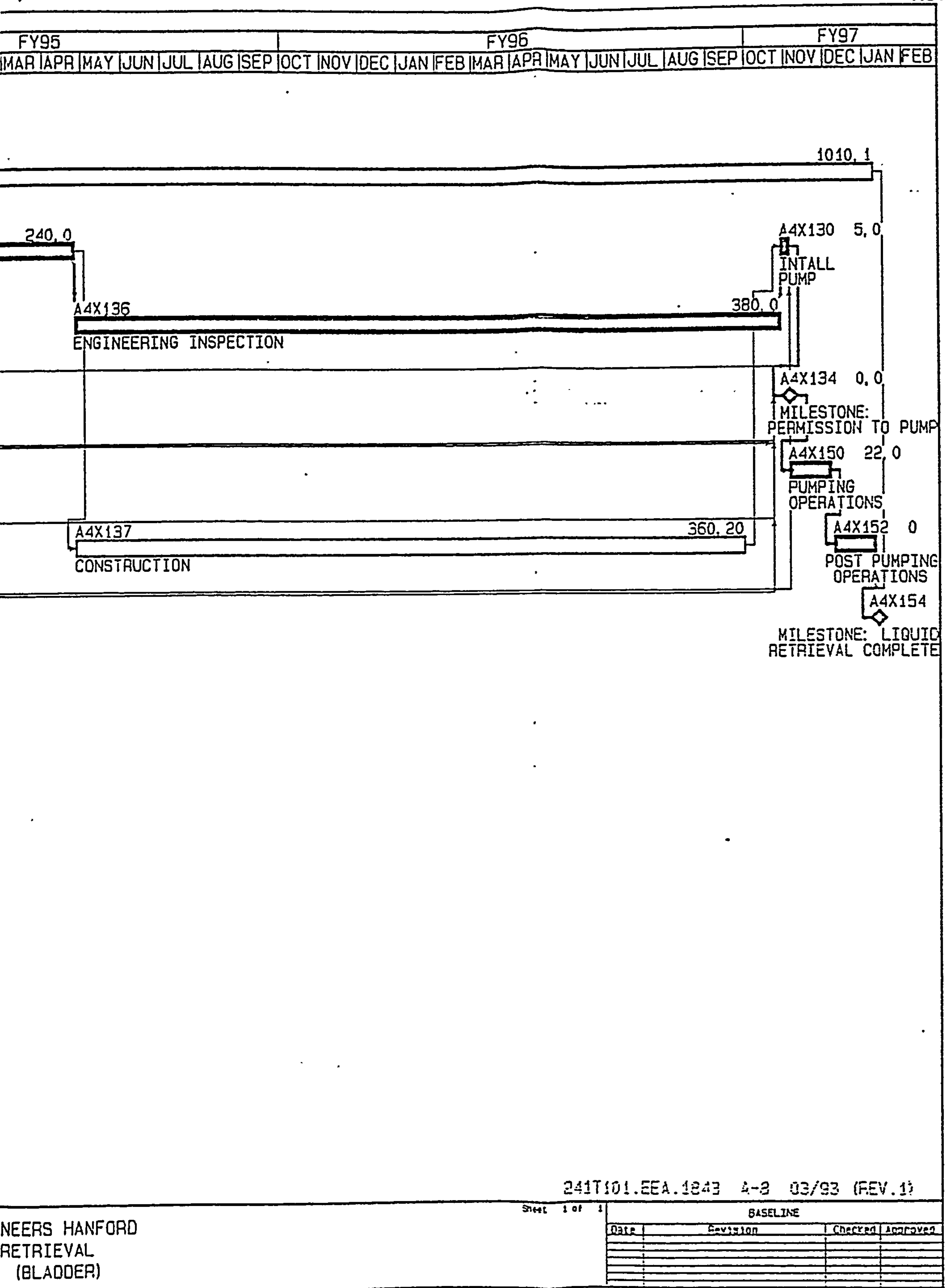
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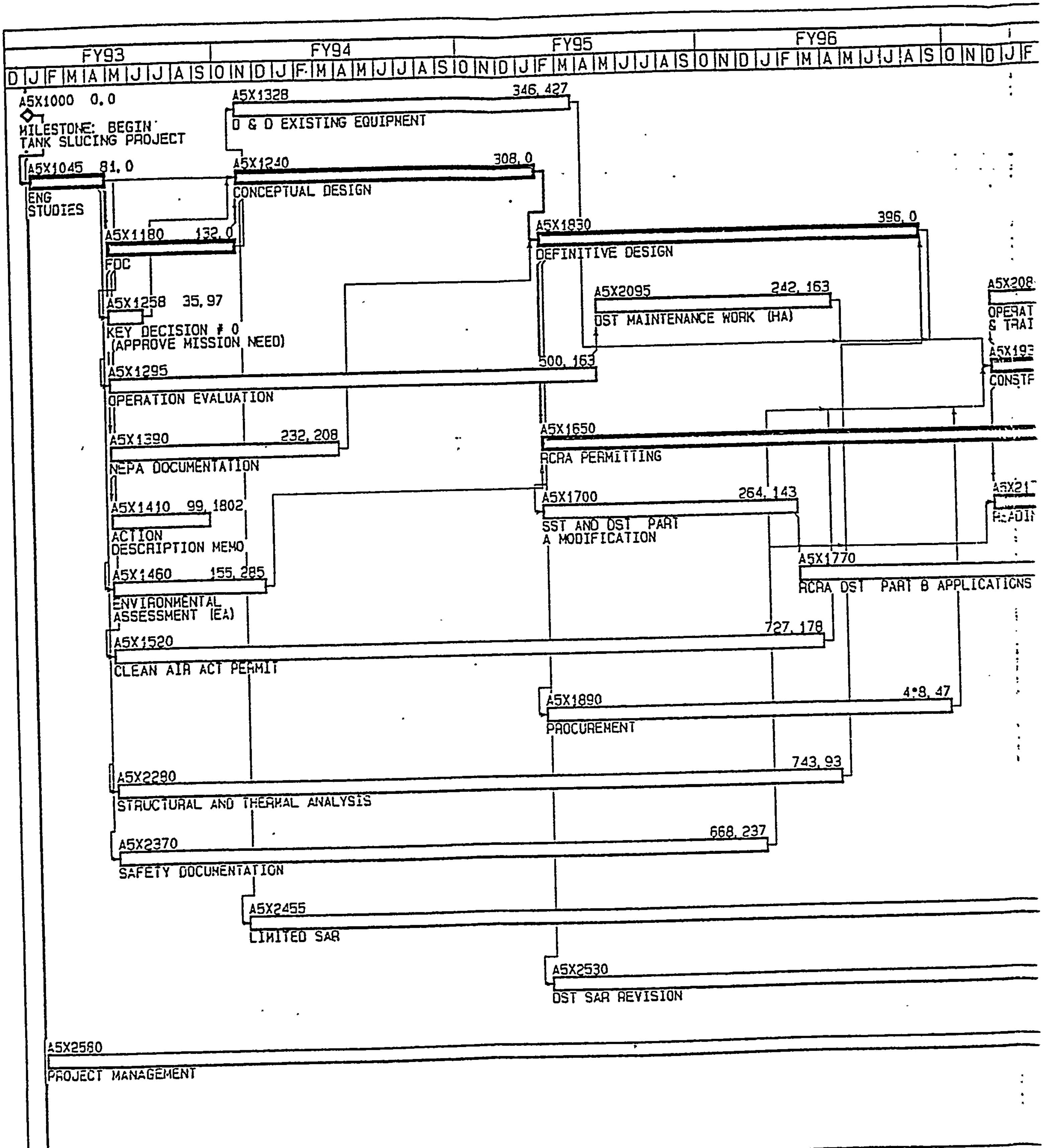

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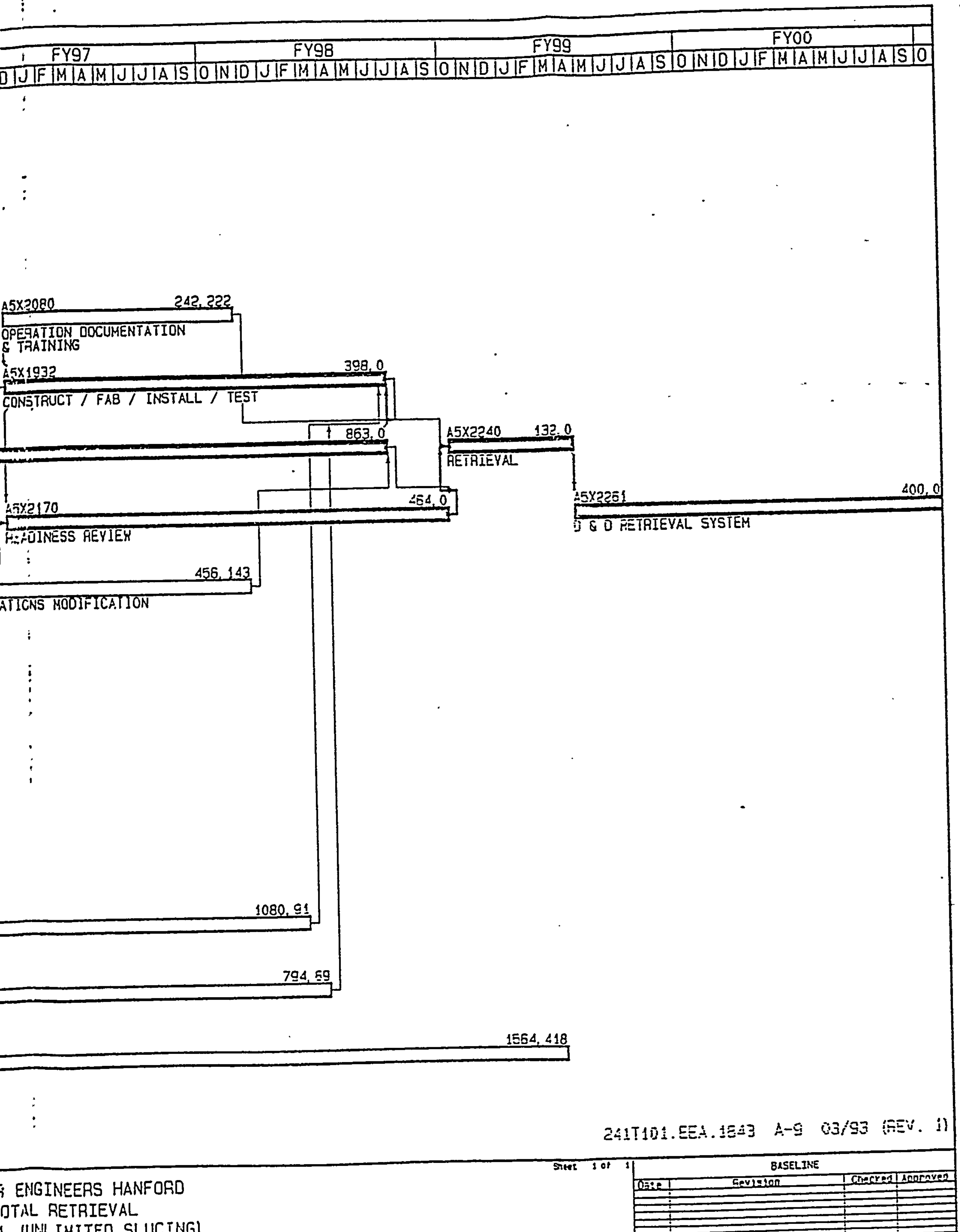
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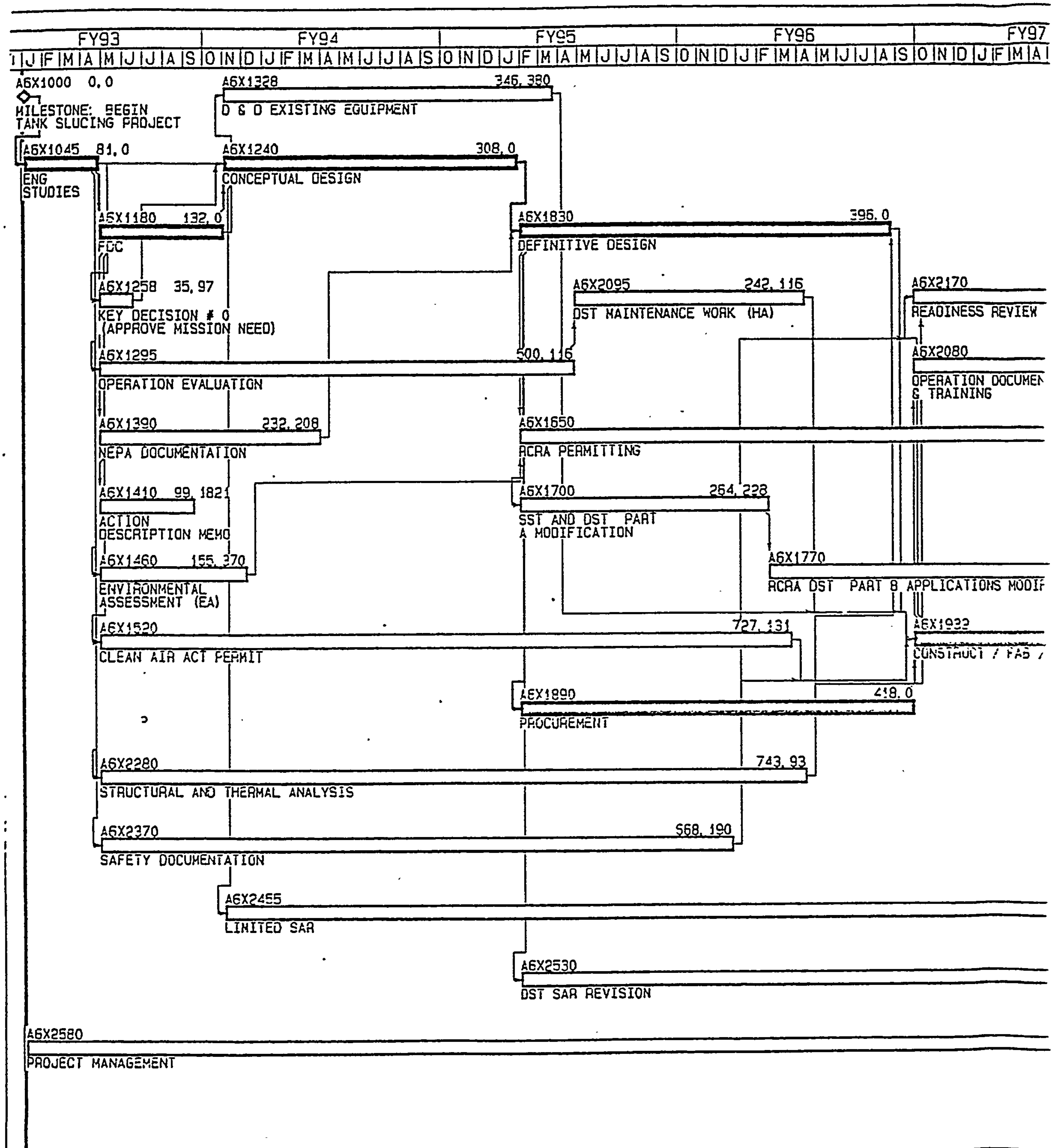

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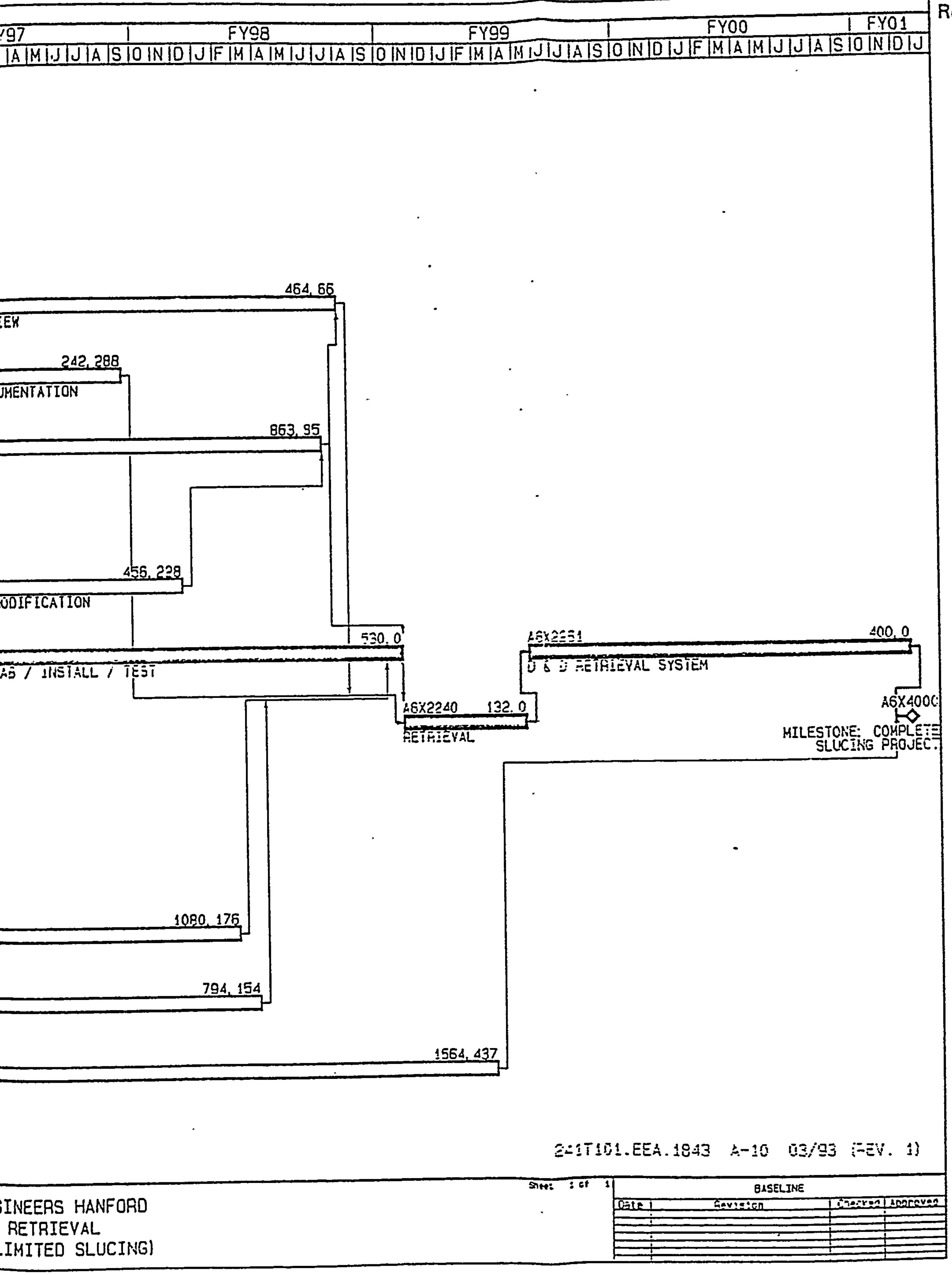
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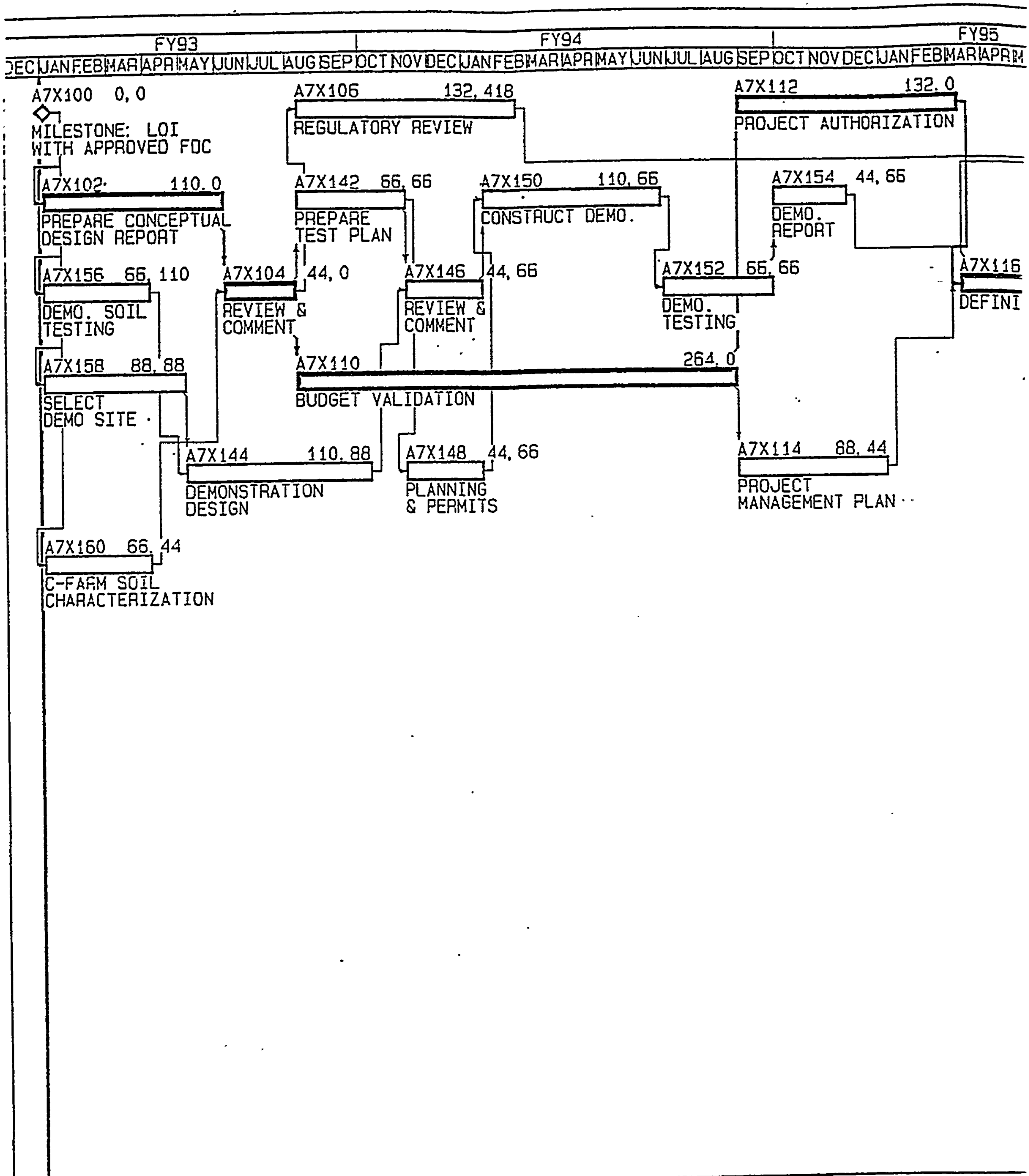

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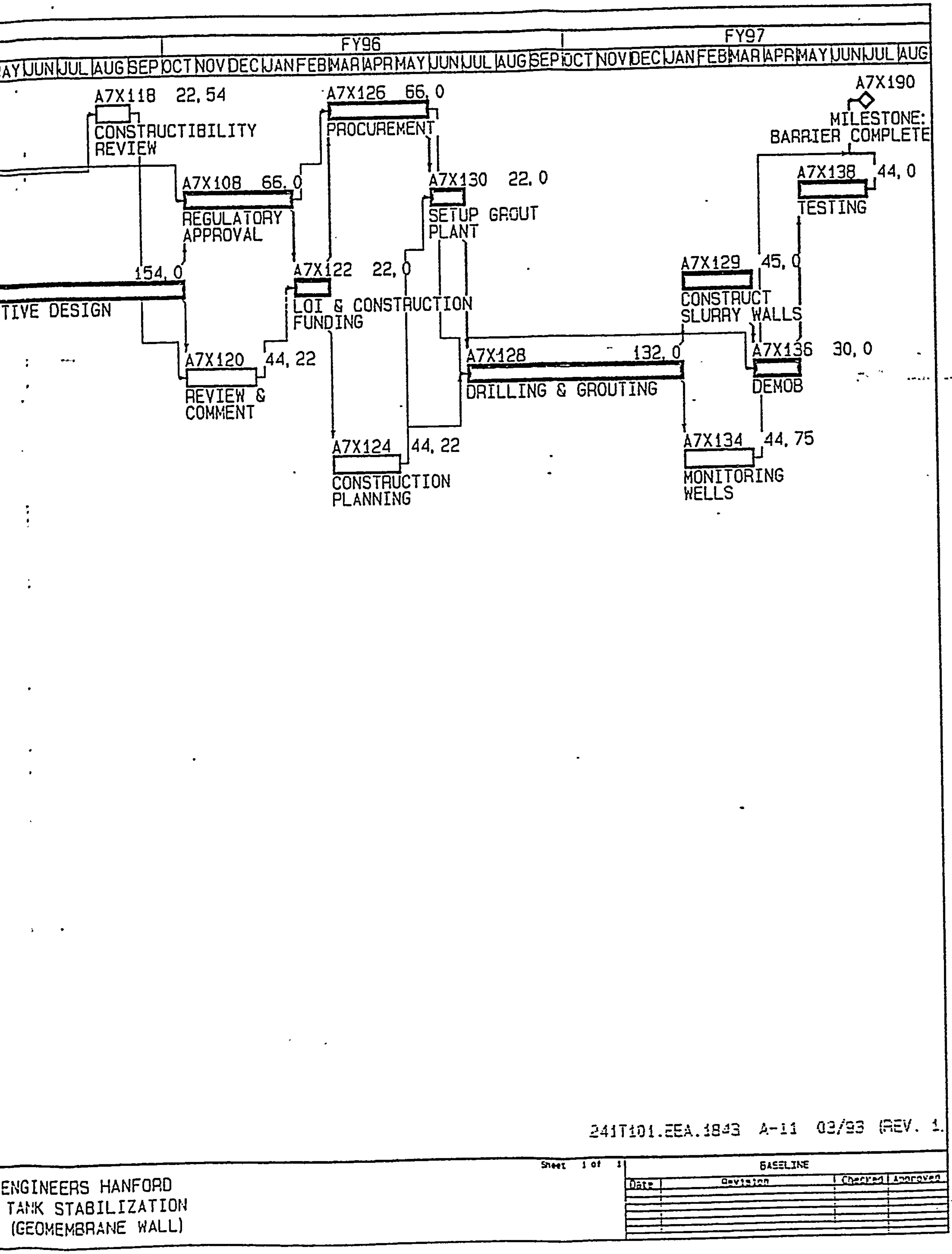
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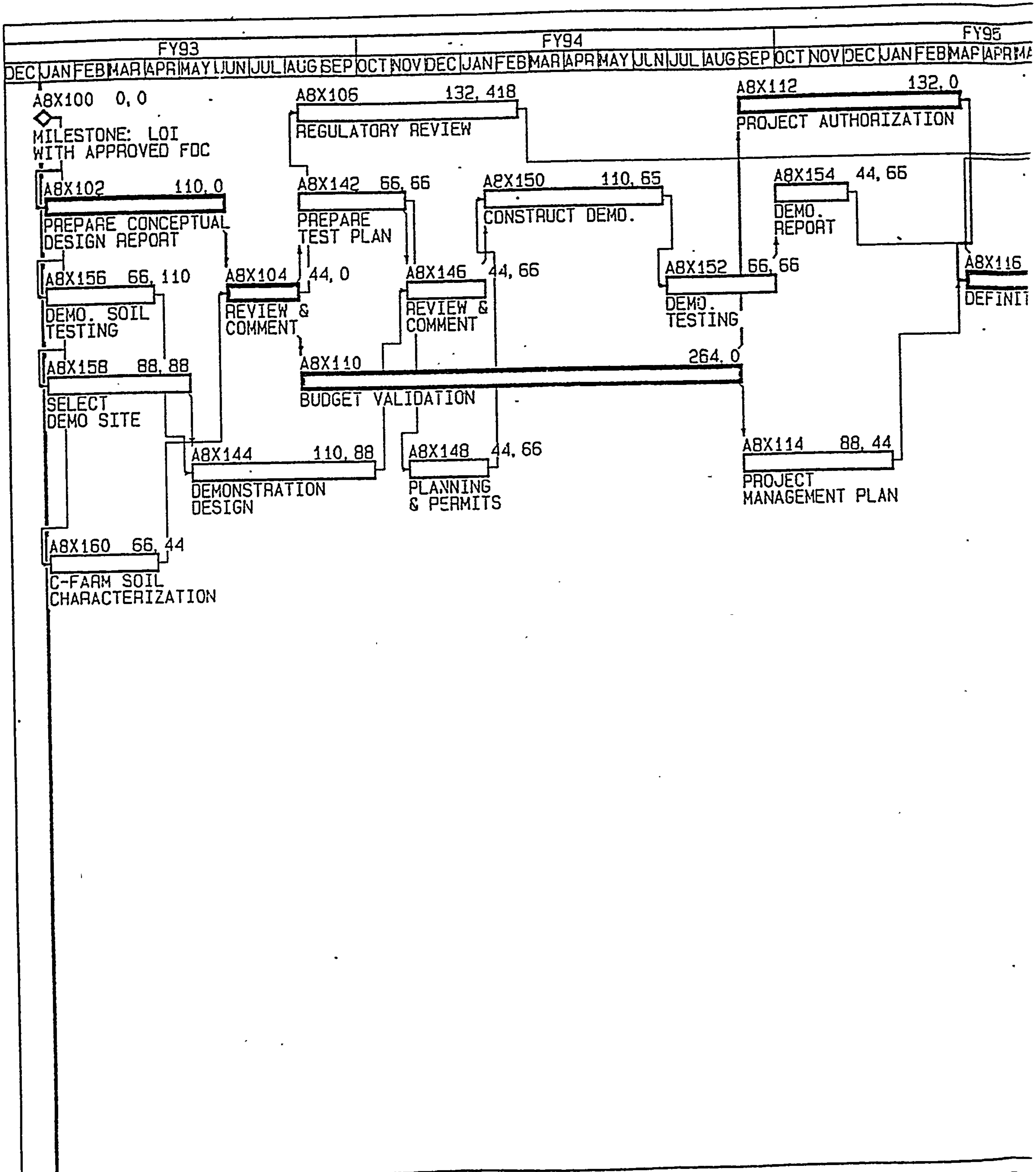

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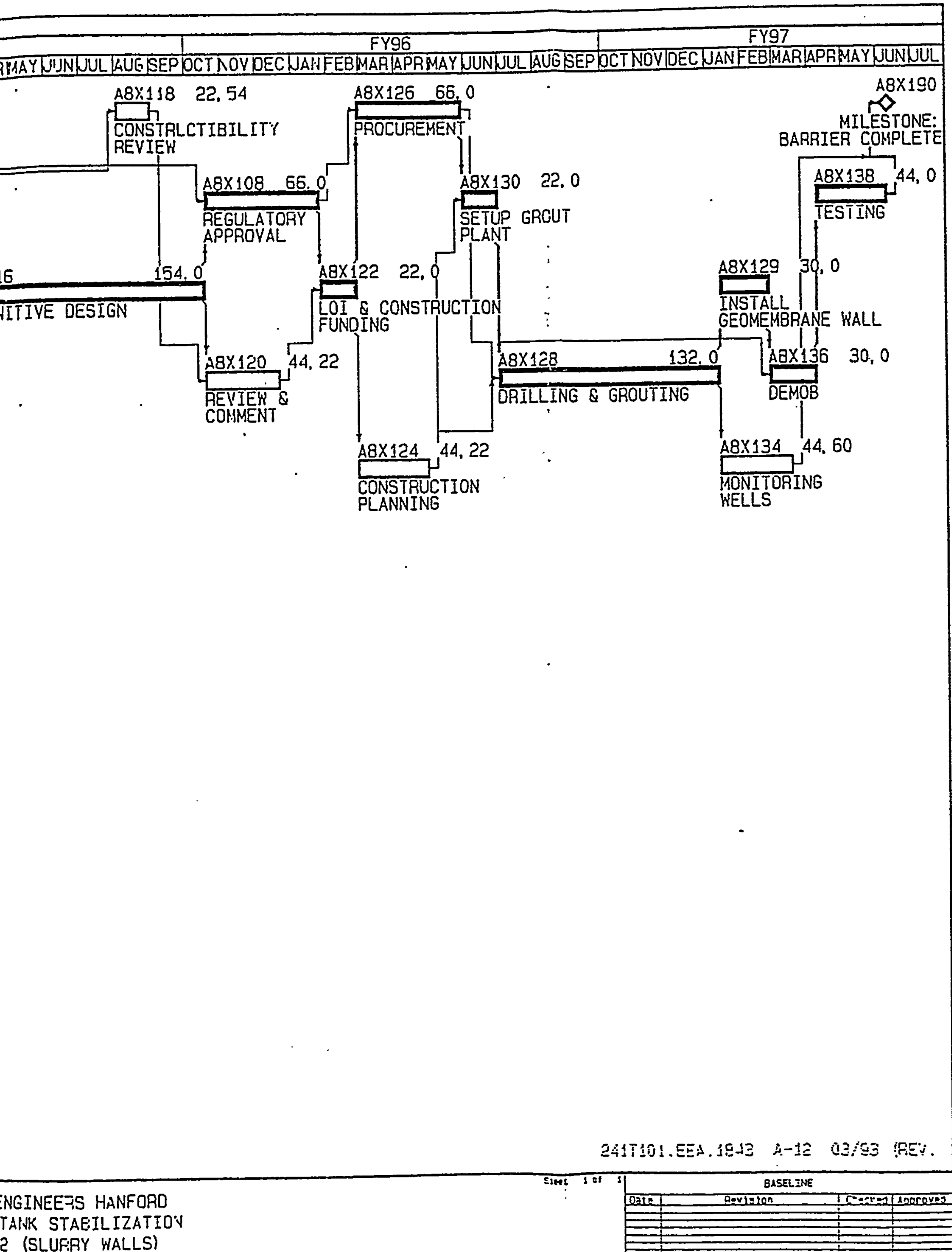
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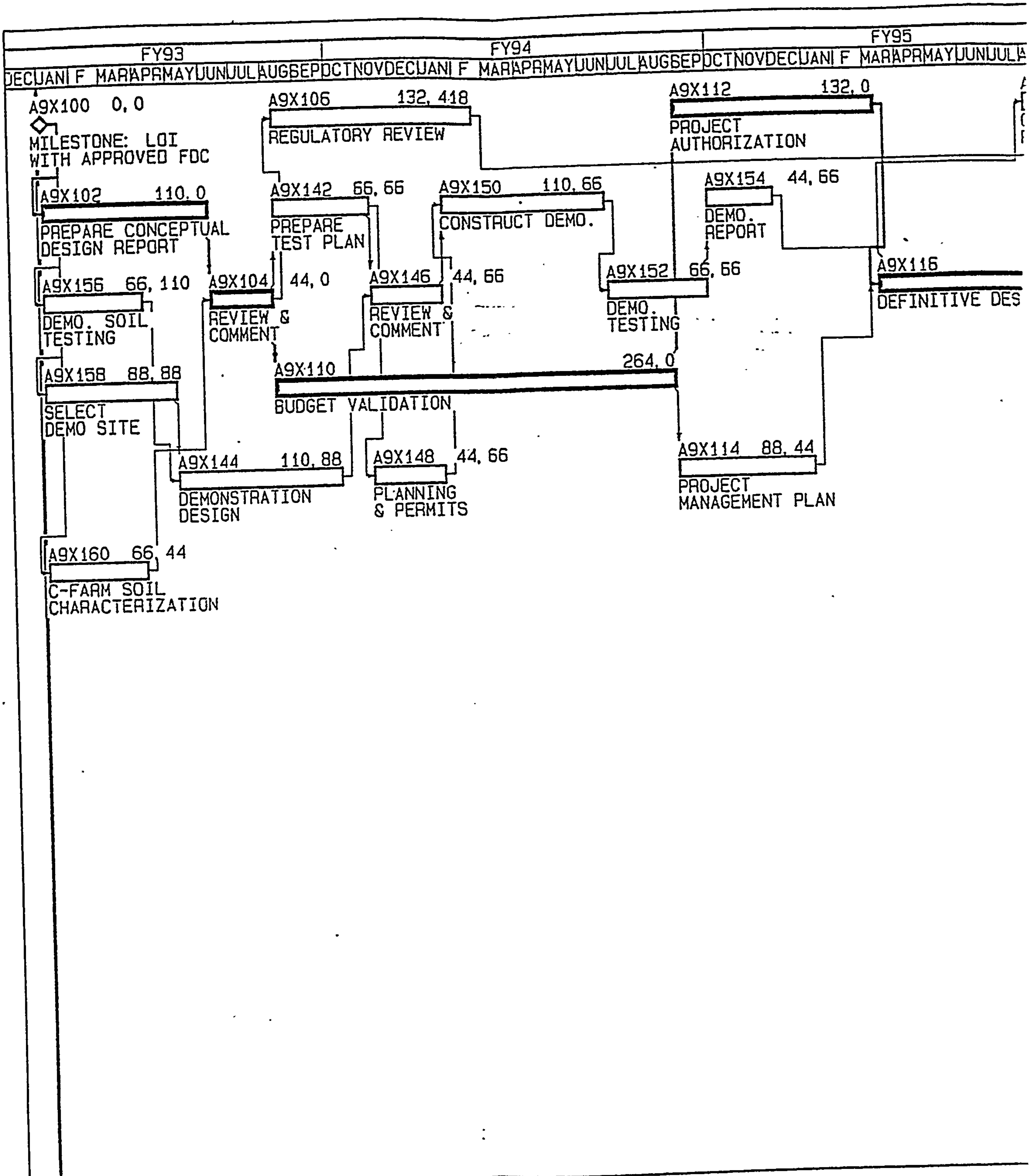
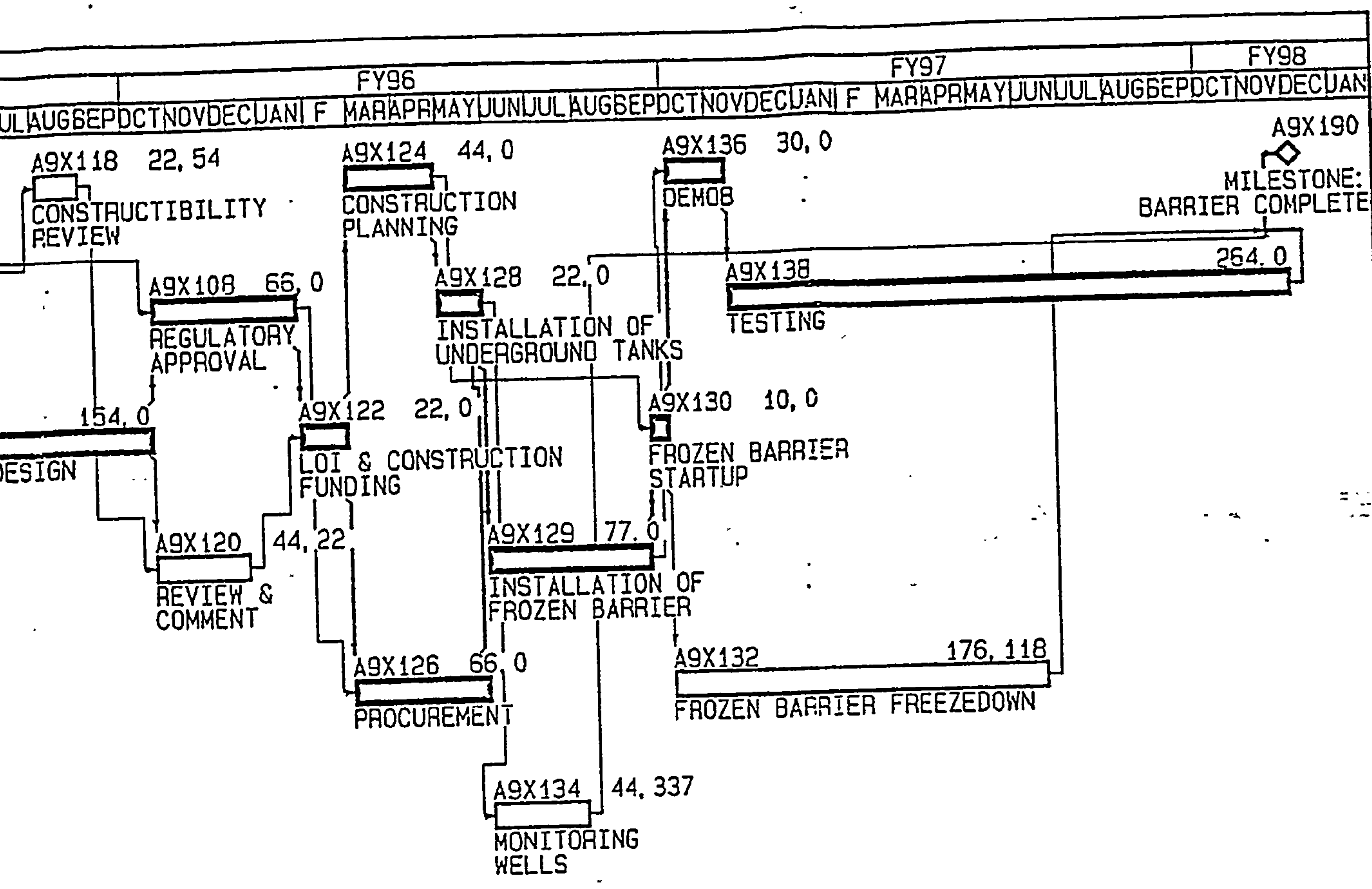


Plot Date 23MAR93 Data Date 1JAN93 Project Start 1JAN93 Project Finish 1DEC00 (c) Primavera Systems, Inc.	Activity Bar/Early Dates Critical Activity Progress Bar Milestone/Flag Activity	1011	KAISER EXTERNAL OPTION 3



241T101.EEA.1843 A-13 03/93 (REV.

Sheet 1 of 1

R ENGINEERS HANFORD
AL TANK STABILIZATION
I 3 (GROUND FREEZING)

BASELINE			
Date	Revision	Checked	Approved

SECTION A-2

COST DETAILS FOR SELECTED ALTERNATIVES

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 241TA1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #1 PUMP OUT-EXISTING PIPING
DOE_R01 - PROJECT COST SUMMARY

DATE 03/22/93 09:48:38
BY GDR

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	610,000	20	120,000	730,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	360,000	20	70,000	430,000
900	WHC "OTHER COST"	1,020,000	20	200,000	1,220,000
	(ADJUSTED TO MEET DOE 5100.4)	+10,000		+10,000	+20,000
	PROJECT TOTAL	1,200,000	20	400,000	2,400,000

TYPE OF ESTIMATE: STUDY ESTIMATE, MARCH 22, 1993	REMARKS:
ARCHITECT ENGINEER	LIQUID RETRIEVEL ALTERNATIVE
OPERATING CONTRACTOR	OPTION 1-PUMP OUT-USING EXISTING PIPING

WHC-EP-0873
Rev. 0

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
112000	WHC ENGINEERING	607100	20	607120	0.00	0	607120	20	121424	728544
SUBTOTAL 1	ENGINEERING	607100	20	607120	0.00	0	607120	20	121424	728544
330002	WHC CONSTRUCTION	356500	20	356520	0.00	0	356520	20	71304	427824
SUBTOTAL 33	CONSTRUCTION-O/C	356500	20	356520	0.00	0	356520	20	71304	427824
SUBTOTAL 3	CONSTRUCTION	356500	20	356520	0.00	0	356520	20	71304	427824
500001	WHC "OTHER PROJECT COST"	1015900	20	1015920	0.00	0	1015920	20	203184	1219104
SUBTOTAL 5	OTHER PROJECT COST	1015900	20	1015920	0.00	0	1015920	20	203184	1219104
PROJECT TOTAL		1,979,500	60	1,979,560	0.00	0	1,979,560	20	395,912	2,375,472

1. DOCUMENTS AND DRAWINGS

DOCUMENTS: MANAGING THE ASSUMED LEAK FROM SINGLE-SHELL TANK 241-T-101, DATED FEBRUARY 1993.

DRAWINGS: SKETCHES

2. MATERIAL PRICES

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES

CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS

A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.

B.) COST TO COMPLETE AND COST TO DATE WERE PROVIDED BY WESTINGHOUSE HANFORD COMPANY AND INCLUDE ALL OVERHEAD MARKUPS.

5. ESCALATION

ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1992.

6. ROUNDING

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS

A.) COST DOES NOT INCLUDE REMOVAL OF EQUIPMENT AFTER TRANSFER.
B.) ESCALATION WAS NOT INCLUDED DUE TO PROJECT WILL BE FINISHED IN 1993.
C.) COST FOR ENGINEERING, CONSTRUCTION, AND PROJECT OTHER COST WAS FURNISHED BY WESTINGHOUSE.

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 241TA1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #1 PUMP OUT-EXISTING PIPING
DOE_R04 - COST CODE ACCOUNT SUMMARY

DATE 03/22/93 09:48:47
BY GDR

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
112000	WHC ENGINEERING	607100	20	607120	0.00	0	607120	20	121424	728544
TOTAL 000	ENGINEERING	607100	20	607120	0.00	0	607120	20	121424	728544
700	SPECIAL EQUIP/PROCESS SYSTEMS									
330002	WHC CONSTRUCTION	356500	20	356520	0.00	0	356520	20	71304	427824
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	356500	20	356520	0.00	0	356520	20	71304	427824
900	WHC "OTHER COST"									
500001	WHC "OTHER PROJECT COST"	1015900	20	1015920	0.00	0	1015920	20	203184	1219104
TOTAL 900	WHC "OTHER COST"	1015900	20	1015920	0.00	0	1015920	20	203184	1219104
PROJECT TOTAL		1,979,500	60	1,979,560	0.00	0	1,979,560	20	395,912	2,375,472

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 241TA1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #1 PUMP OUT-EXISTING PIPING
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

DATE 03/22/93 09:48:50
BY GDR

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	ENGINEERING									
00	TECHNICAL SERVICES	607100	20	607120	0.00	0	607120	20	121424	728544
	TOTAL ENGINEERING	607,100	20	607,120	0.00	0	607,120	20	121,424	728,544
	CONSTRUCTION									
15	MECHANICAL	356500	20	356520	0.00	0	356520	20	71304	427824
20	OTHER COST	1015900	20	1015920	0.00	0	1015920	20	203184	1219104
	TOTAL CONSTRUCTION	1,372,400	40	1,372,440	0.00	0	1,372,440	20	274,488	1,646,928
	PROJECT TOTAL	1,979,500	60	1,979,560	0.00	0	1,979,560	20	395,912	2,375,472

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 7
COST CODE ACCOUNT SUMMARY — PAGE 5 OF 7

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 35 % .

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING
000 WBS 112000 A 20% CONTINGENCY WAS APPLIED TO ENGINEERING PER WHC.

CONSTRUCTION
700 WBS 330002 A 20% CONTINGENCY WAS USED ON CONSTRUCTION BY WHC DUE TO THE WORK BEING PERFORMED IS IN A HAZARDOUS ZONE.

WHC "OTHER COST"
900 WBS 500001 A 20% CONTINGENCY WAS APPLIED TO "OTHER PROJECT COST" PER WHC.

AVERAGE PROJECT CONTINGENCY 20%

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 241TA1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #1 PUMP OUT-EXISTING PIPING
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/22/93 09:48:56
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
112000	WHC ENGINEERING	607100	0.00	0	0	20	20
330002	WHC CONSTRUCTION	356500	0.00	0	0	20	20
500001	WHC "OTHER PROJECT COST"	1015900	0.00	0	0	20	20
PROJECT TOTAL		1,979,500		0	0	60	60

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	1,640,000	26	420,000	2,060,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	2,690,000	29	770,000	3,460,000
900	WHC "OTHER COST"	2,230,000	22	500,000	2,730,000
	(ADJUSTED TO MEET DOE 5100.4)	+40,000		+10,000	+50,000
	PROJECT TOTAL	6,600,000	26	1,700,000	8,300,000

TYPE OF ESTIMATE: STUDY ESTIMATE — MARCH 23, 1993	REMARKS:
ARCHITECT ENGINEER: GDR	LIQUID RETRIEVAL ALTERNATIVES
OPERATING CONTRACTOR	OPTION #2-PUMP OUT-USING NEW PIPE

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN (ONSITE)	515000	0	515000	6.68	34402	549402	30	164821	714223
111000	CONCEPTUAL DESIGN (ONSITE)	135000	0	135000	2.46	3321	138321	30	41496	179817
112000	WHC ENGINEERING	607100	121420	728520	0.00	0	728520	20	145704	874224
120000	ENGINEERING INSPECTION (ONSITE)	200000	0	200000	13.11	26220	226220	30	67866	294086
SUBTOTAL 12	ENGR/INSPECTION (ONSITE)	200000	0	200000	13.11	26220	226220	30	67866	294086
SUBTOTAL 1	ENGINEERING	1457100	121420	1578520	4.05	63943	1642463	26	419887	2062350
310001	TRANSFER LINE TO 244-TX VAULT	2058772	0	2058772	9.79	201554	2260326	30	684067	2944392
SUBTOTAL 31	FA CONST-ONSITE E/C	2058772	0	2058772	9.79	201554	2260326	30	684067	2944392
330001	WHC CONSTRUCTION	356500	71300	427800	0.00	0	427800	20	85560	513360
SUBTOTAL 33	CONSTRUCTION-O/C	356500	71300	427800	0.00	0	427800	20	85560	513360
SUBTOTAL 3	CONSTRUCTION	2415272	71300	2486572	8.11	201554	2688126	29	769627	3457752
500001	WHC OTHER PROJECT COST	1015900	203180	1219080	0.00	0	1219080	20	243816	1462896
500003	WHC "OTHER COST" FOR KEH CONST.	945000	0	945000	7.49	70781	1015781	25	253945	1269726
SUBTOTAL 5	OTHER PROJECT COST	1960900	203180	2164080	3.27	70781	2234861	22	497761	2732622
PROJECT TOTAL		5,833,272	395,900	6,229,172	5.40	336,278	6,565,450	26	1,687,275	8,252,724

WHC-EP-0873
Rev. 0

1. DOCUMENTS AND DRAWINGS
=====================
DOCUMENTS: ENGINEERING EVALUATION OF ALERNATEIVES - MANAGING THE ASSUMED LEAK FROM SINGLE SHELL TANK 241-T-101, 2/93.

DRAWINGS: SKETCHES

2. MATERIAL PRICES.
===============
UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES
===========
CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS
===
A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.

B.) WHC COST INCLUDED ALL ADDERS - ORG, G & A, AND CSP.

5. ESCALATION
==========
ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1992.

6. ROUNDING
=====================
U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS
=======
A.) WESTINGHOUSE ENGINEERING, CONSTRUCTION, AND PROJECT OTHER COST WERE FURNISHED BY WESTINGHOUSE.
B.) ALL CONSTRUCTION ASSOCIATED WITH NEW ENCASED LINE TO THE 244-TX VAULT WILL BE PERFORMED BY ONSITE CONTRACTOR (KEH).
C.) WBS 500003 "OTHER COST" FOR THE WHC COST ASSOCIATED WITH THE NEW ENCASED LINE TO 244-TX VAULT IS BASED ON 35% OF KEH ENGINEERING AND CONSTRUCTION, BASIS COST BY WHC ON SIMILAR PROJECT (C-106).
D.) KEH DEFINITIVE DESIGN IS BASED ON 25% OF DIRECT ONSITE CONSTRUCTION
E.) KEH ENGINEERING AND INSPECTION IS BASED ON 10% OF DIRECT ONSITE CONSTRUCTION.
F.) CONCEPTUAL DESIGN COST BY KEH IS BASED ON 5% OF DIRECT ENGINEERING AND CONSTRUCTION COST OF THE ONSITE CONTRACTOR (KEH
G.) ESCALATION WAS NOT APPLIED TO ENGINEERING, CONSTRUCTION, AND WHC OTHER COST THAT WOULD BE FINISHED IN 1993.

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	DEFINITIVE DESIGN (ONSITE)	515000	0	515000	6.68	34402	549402	30	164821	714223
111000	CONCEPTUAL DESIGN (ONSITE)	135000	0	135000	2.46	3321	138321	30	41496	179817
112000	WHC ENGINEERING	607100	121420	728520	0.00	0	728520	20	145704	874224
120000	ENGINEERING INSPECTION (ONSITE)	200000	0	200000	13.11	26220	226220	30	67866	294086
TOTAL 000	ENGINEERING	1457100	121420	1578520	4.05	63943	1642463	26	419887	2062350
700	SPECIAL EQUIP/PROCESS SYSTEMS									
310001	TRANSFER LINE TO 244-TX VAULT	2058772	0	2058772	9.79	201554	2260326	30	684067	2944392
330001	WHC CONSTRUCTION	356500	71300	427800	0.00	0	427800	20	85560	513360
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	2415272	71300	2486572	8.11	201554	2688126	29	769627	3457752
900	WHC "OTHER COST"									
500001	WHC OTHER PROJECT COST	1015900	203180	1219080	0.00	0	1219080	20	243816	1462896
500003	WHC "OTHER COST" FOR KEH CONST.	945000	0	945000	7.49	70781	1015781	25	253945	1269726
TOTAL 900	WHC "OTHER COST"	1960900	203180	2164080	3.27	70781	2234861	22	497761	2732622
PROJECT TOTAL		5,833,272	395,900	6,229,172	5.40	336,278	6,565,450	26	1,687,275	8,252,724

WHC-EP-0873
Rev. 0

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. Z031SAB1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #2 PUMP OUT-NEW PIPING
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

DATE 03/23/93 10:38:06
BY GDR

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	ENGINEERING									
00	TECHNICAL SERVICES	1457100	121420	1578520	4.05	63943	1642463	26	419887	2062350
	TOTAL ENGINEERING	1,457,100	121,420	1,578,520	4.05	63,943	1,642,463	26	419,887	2,062,350
	CONSTRUCTION									
15	MECHANICAL	2415272	71300	2486572	8.11	201554	2688126	29	769627	3457752
20	WHC OTHER COST	1960900	203180	2164080	3.27	70781	2234861	22	497761	2732622
	TOTAL CONSTRUCTION	4,376,172	274,480	4,650,652	5.86	272,335	4,922,987	26	1,267,388	6,190,374
	PROJECT TOTAL	5,833,272	395,900	6,229,172	5.40	336,278	6,565,450	26	1,687,275	8,252,724

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 7
COST CODE ACCOUNT SUMMARY — PAGE 5 OF 7

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 35 % .

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING			
000	WBS	110000	A 30% CONTINGENCY WAS APPLIED TO THE ONSITE CONTRACTOR (KEH) DEFINITIVE DESIGN DUE TO COST ARE BASED ON A PECENTAGE OF DIRECT CONSTRUCTION.
	WBS	111000	A 30% CONTINGENCY WAS APPLIED TO THE CONDEPTUAL DESIGN COST DUE TO COST WERE BASED ON A PERCENTAGE OF DIRECT ENGINEERING AND CONSTRUCTION.
	WBS	112000	A 20% CONTINGENCY WAS APPLIED TO WHC ENGINEERING PER WHC DIRECTION.
	WBS	120000	A 30% CONTINGENCY WAS APPLIED TO THE ONSITE CONTRACTOR (KEH) ENGINEERING AND INSPECTION COST DUE TO COST ARE BASED ON A PERCENTAGE OF DIRECT CONSTRUCTION.
CONSTRUCTION			
700	WBS	310001	A 30% CONTINGENCY WAS USED ON THE NEW ENCASED TRANSFER LINE TO 244-TX VAULT DUE TO LIMITED AMOUNT OF INFORMATION AVAILABLE FOR THIS EFFORT.
	WBS	330001	A 20% CONTINGENCY WAS APPLIED TO WHC CONSTRUCT COST PER WHC DIRECTION.
WHC "OTHER COST"			
900	WBS	500001	A 20% CONTINGENCY WAS APPLIED TO WHC OTHER COST PER WHC DIRECTION.
	WBS	500003	A 25% CONTINGENCY WAS APPLIED TO THE "OTHER COST" ASSOCIATED WITH WORK PERFORMED BY THE ONSITE CONTRACTOR (KEH) DUE TO THE COST WERE BASED ON A PERCENTAGE OF DIRECT ENGINEERING AND CONSTRUCTION.

AVERAGE PROJECT CONTINGENCY 23 %

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. Z031SAB1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #2 PUMP OUT-NEW PIPING
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/23/93 10:38:10
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	DEFINITIVE DESIGN (ONSITE)	515000	0.00	0	0	0	0
111000	CONCEPTUAL DESIGN (ONSITE)	135000	0.00	0	0	0	0
112000	WHC ENGINEERING	607100	20.00	121420	0	0	121420
120000	ENGINEERING INS'ECTION (ONSITE)	200000	0.00	0	0	0	0
310001	TRANSFER LINE TO 244-TX VAULT	2058772	0.00	0	0	0	0
330001	WHC CONSTRUCTION	356500	20.00	71300	0	0	71300
500001	WHC OTHER PROJECT COST	1015900	20.00	203180	0	0	203180
500003	WHC "OTHER COST" FOR KEH CONST.	945000	0.00	0	0	0	0
PROJECT TOTAL		5,833,272		395,900	0	0	395,900

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. Z031SAC1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3 PUMP OUT TANK TRUCK
DOE_R01 - PROJECT COST SUMMARY

DATE 03/23/93 10:48:08
BY GDR

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	1,340,000	25	330,000	1,670,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	1,900,000	32	600,000	2,500,000
900	WHC "OTHER COST"	1,910,000	20	380,000	2,290,000
	(ADJUSTED TO MEET DOE 5100.4)	+50,000		-10,000	+40,000
	PROJECT TOTAL	5,200,000	25	1,300,000	6,500,000

TYPE OF ESTIMATE	STUDY ESTIMATE	MARCH 23, 1993
ARCHITECT ENGINEER	[signature]	
OPERATING CONTRACTOR		

REMARKS:

LIQUID RETRIEVAL ALTERNATIVES

OPTION #3-PUMP OUT-USING TANK TRUCK

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 2031SAC1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3 PUMP OUT TANK TRUCK
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

DATE 03/23/93 10:48:11
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN (ONSITE)	350000	0	350000	4.74	16590	366590	30	109977	476567
111000	CONCEPTUAL DESIGN (ONSITE)	95000	0	95000	1.63	1549	96549	30	28965	125513
112000	WHC ENGINEERING	607100	121420	728520	0.00	0	728520	20	145704	874224
120000	ENGINEERING INSPECTION (ONSITE)	140000	0	140000	7.92	11088	151088	30	45326	196414
SUBTOTAL 12	ENGR/INSPECTION (ONSITE)	140000	0	140000	7.92	11088	151088	30	45326	196414
SUBTOTAL 1	ENGINEERING	1192100	121420	1313520	2.23	29227	1342747	25	329972	1672718
310001	PUMP OUT WITH TANK TRUCK	1390872	0	1390872	5.77	80253	1471125	35	514894	1986019
SUBTOTAL 31	FA CONST-ONSITE E/C	1390872	0	1390872	5.77	80253	1471125	35	514894	1986019
330001	WHC CONSTRUCTION	356500	71300	427800	0.00	0	427800	20	85560	513360
SUBTOTAL 33	CONSTRUCTION-O/C	356500	71300	427800	0.00	0	427800	20	85560	513360
SUBTOTAL 3	CONSTRUCTION	1747372	71300	1818672	4.41	80253	1898925	32	600454	2499379
500001	WHC PROJECT OTHER COST	1015900	203180	1219080	0.00	0	1219080	20	243816	1462896
500003	WHC "OTHER COST" FOR KEH CONST.	665000	0	665000	3.98	26467	691467	20	138293	829760
SUBTOTAL 5	OTHER PROJECT COST	1680900	203180	1884080	1.40	26467	1910547	20	382109	2292656
PROJECT TOTAL		4,620,372	395,900	5,016,272	2.71	135,947	5,152,219	25	1,312,535	6,464,753

1. DOCUMENTS AND DRAWINGS
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DOCUMENTS: ENGINEERING EVALUATION OF ALTERNATEIVES - MANAGING THE ASSUMED LEAK FROM SINGLE SHELL TANK 241-T-101 2/93.

DRAWINGS: SKETCHES

2. MATERIAL PRICES
===============

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES
===========

CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS
===

A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.

B.) WHC ENGINEERING, CONSTRUCTION, AND OTHER PROJECT COST INCLUDE ALL ADDERS. (ORG,G & A, AND CSP).

5. ESCALATION
==========

ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1992.

6. ROUNDING
=======================

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (H), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS
=======

A.) COSTS FOR WHC ENGINEERING, CONSTRUCTION, AND PROJECT OTHER COST FURNISHED BY WESTINGHOUSE.

B.) ALL WORK ASSOCIATED WITH THE CONTAINMENT APRON, TRUCK TANK, AND PIPING WILL BE PERFORMED BY THE ONSITE CONTRACTOR (KEH)

C.) WHC "OTHER COST" FOR THE WHC COST ASSOCIATED WITH THE WORK PERFORMED BY THE ONSITE CONTRACTOR (KEH), IS BASED ON 35% OF THE ONSITE ENGINEERING AND CONSTRUCTION COST.

D.) COST FOR KEH DEFINITIVE DESIGN IS BASED ON 25% OF DIRECT CONSTRUCTION.
COST FOR KEH ENGINEERING AND INSPECTION IS BASED ON 10% OF DIRECT CONSTRUCTION.

D.) CONCEPTUAL DESIGN COST BY KEH IS BASED ON 5% OF DIRECT ENGINEERING AND CONSTRUCTION COST OF THE ONSITE CONTRACTOR (KEH)

E.) NO ESCALATION WAS APPLIED TO WHC COST ON WORK PERFORMED IN 1993.

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. Z031SAC1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3 PUMP OUT TANK TRUCK
DOE_R04 - COST CODE ACCOUNT SUMMARY

DATE 03/23/93 10:48:15
BY GDR

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	DEFINITIVE DESIGN (ONSITE)	350000	0	350000	4.74	16590	366590	30	109977	476567
111000	CONCEPTUAL DESIGN (ONSITE)	95000	0	95000	1.63	1549	96549	30	28965	125513
112000	WHC ENGINEERING	607100	121420	728520	0.00	0	728520	20	145704	874224
120000	ENGINEERING INSPECTION (ONSITE)	140000	0	140000	7.92	11088	151088	30	45326	196414
TOTAL 000	ENGINEERING	1192100	121420	1313520	2.23	29227	1342747	25	329972	1672718
700	SPECIAL EQUIP/PROCESS SYSTEMS									
310001	PUMP OUT WITH TANK TRUCK	1390872	0	1390872	5.77	80253	1471125	35	514894	1986019
330001	WHC CONSTRUCTION	356500	71300	427800	0.00	0	427800	20	85560	513360
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	1747372	71300	1818672	4.41	80253	1898925	32	600454	2499379
900	WHC "OTHER COST"									
500001	WHC PROJECT OTHER COST	1015900	203180	1219080	0.00	0	1219080	20	243816	1462896
500003	WHC "OTHER COST" FOR KEH CONST.	665000	0	665000	3.98	26467	691467	20	138293	829760
TOTAL 900	WHC "OTHER COST"	1680900	203180	1884080	1.40	26467	1910547	20	382109	2292656
PROJECT TOTAL		4,620,372	395,900	5,016,272	2.71	135,947	5,152,219	25	1,312,535	6,464,753

WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. Z031SAC1

TEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3 PUMP OUT TANK TRUCK
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

PAGE 5 OF 7
DATE 03/23/93 10:48:19
BY GDR

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	ENGINEERING									
00	TECHNICAL SERVICES	1192100	121420	1313520	2.23	29227	1342747	25	329972	167271
	TOTAL ENGINEERING	1,192,100	121,420	1,313,520	2.23	29,227	1,342,747	25	329,972	1,672,71
	CONSTRUCTION									
15	MECHANICAL	1747372	71300	1818672	4.41	80253	1898925	32	600454	249937
20	WHC "OTHER COST"	1680900	203180	1884080	1.40	26467	1910547	20	382109	229265
	TOTAL CONSTRUCTION	3,428,272	274,480	3,702,752	2.88	106,720	3,809,472	26	982,563	4,792,03
	PROJECT TOTAL	4,620,372	395,900	5,016,272	2.71	135,947	5,152,219	25	1,312,535	6,464,75

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 7
COST CODE ACCOUNT SUMMARY — PAGE 6 OF 7

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20% TO 35% .

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING		
000	WBS 110000	A 30% CONTINGENCY WAS APPLIED TO THE ONSITE CONTRACTOR (KEH) DEFINITIVE DESIGN DUE TO COST ARE BASED ON A PERCENTAGE OF DIRECT CONSTRUCTION.
	WBS 111000	A 30% CONTINGENCY WAS APPLIED TO THE CONCEPTUAL DESIGN COST DUE TO COST WERE BASED ON A PERCENTAGE OF DIRECT ENGINEERING AND CONSTRUCTION.
	WBS 112000	A 20% CONTINGENCY WAS APPLIED TO WHC ENGINEERING PER WHC.
	WBS 120000	A 30% CONTINGENCY WAS APPLIED TO ONSITE ENGINEERING AND INSPECTION DUE TO COST ARE BASED ON A PERCENTAGE OF DIRECT CONSTRUCTION COST.
CONSTRUCTION		
700	WBS 310001	A 30% CONTINGENCY WAS USED ON THE CONTAINMENT APRON, TANK TRUCK, AND OTHER CONSTRUCTION PERFORMED BY THE ONSITE CONTRACTOR (KEH) DUE TO THE LIMITED AMOUNT OF DETAIL AVAILABLE FOR THIS EFFORT.
	WBS 330001	A 20% CONTINGENCY WAS APPLIED TO WHC CONSTRUCTION PER WHC.
WHC "OTHER COST"		
900	WBS 500001	A 20% CONTINGENCY WAS APPLIED TO WHC OTHER COST PER WHC.
	WBS 500003	A 30% CONTINGENCY WAS APPLIED TO THE "OTHER COST" ASSOCIATED WITH WORK PERFORMED BY THE ONSITE CONTRACTOR (KEH) DUE TO THE COST WERE BASED ON A PERCENTAGE OF DIRECT ENGINEERING AND CONSTRUCTION.

AVERAGE PROJECT CONTINGENCY 26 %

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 2031SAC1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3 PUMP OUT TANK TRUCK
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/23/93 10:48:23
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	DEFINITIVE DESIGN (ONSITE)	350000	0.00	0	0	0	0
111000	CONCEPTUAL DESIGN (ONSITE)	95000	0.00	0	0	0	0
112000	WHC ENGINEERING	607100	20.00	121420	0	0	121420
120000	ENGINEERING INSPECTION (ONSITE)	140000	0.00	0	0	0	0
310001	PUMP OUT WITH TANK TRUCK	1390872	0.00	0	0	0	0
330001	WHC CONSTRUCTION	356500	20.00	71300	0	0	71300
500001	WHC PROJECT OTHER COST	1015900	20.00	203180	0	0	203180
500003	WHC "OTHER COST" FOR KEH CONST.	665000	0.00	0	0	0	0
	PROJECT TOTAL	4,620,372		395,900	0	0	395,900

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. Z031SAD1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3A PUMP OUT RAILCAR
DOE_R01 - PROJECT COST SUMMARY

DATE 03/23/93 11:07:48
BY GDR

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	2,450,000	27	660,000	3,110,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	4,640,000	34	1,560,000	6,200,000
900	WHC "OTHER COST"	3,170,000	23	730,000	3,900,000
	(ADJUSTED TO MEET DOE 5100.4)	+40,000		-50,000	-10,000
	PROJECT TOTAL	10,300,000	29	2,900,000	13,200,000

TYPE OF ESTIMATE STUDY ESTIMATE MARCH 23, 1993	REMARKS:
ARCHITECT ENGINEER	LIQUID RETRIEVAL ALTERNATES
OPERATING CONTRACTOR	OPTION #3A-PUMP OUT-USING RAILCAR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN (ONSITE)	960000	0	960000	6.68	64128	1024128	30	307238	1331366
111000	CONCEPTUAL DESIGN (ONSITE)	260000	0	260000	2.46	6396	266396	30	79919	346315
112000	WHC ENGINEERING	607100	121420	728520	0.00	0	728520	20	145704	874224
SUBTOTAL 11	DEFINI⁻¹VE DESIGN	1827100	121420	1948520	3.62	70524	2019044	26	532861	2551905
120000	ENGINEERING INSPECTION (ONSITE)	384000	0	384000	13.11	50342	434342	30	130303	564645
SUBTOTAL 12	ENGR/INSPECTION (ONSITE)	384000	0	384000	13.11	50342	434342	30	130303	564645
SUBTOTAL 1	ENGINEERING	2211100	121420	2332520	5.18	120866	2453386	27	663164	3116550
310001	PUMP OUT RAILCAR & TANK	3836642	0	3836642	9.79	375607	4212249	35	1474288	5686536
SUBTOTAL 31	FA CONST-ONSITE E/C	3836642	0	3836642	9.79	375607	4212249	35	1474288	5686536
330001	WHC CONSTRUCTION	356500	71300	427800	0.00	0	427800	20	85560	513360
SUBTOTAL 33	CONSTRUCTION-O/C	356500	71300	427800	0.00	0	427800	20	85560	513360
SUBTOTAL 3	CONSTRUCTION	4193142	71300	4264442	8.81	375607	4640049	34	1559848	6199896
500001	WHC PROJECT OTHER COST	1015900	203180	1219080	0.00	0	1219080	20	243816	1462896
500003	WHC "OTHER COST" FOR KEH CONST.	1813000	0	1813000	7.49	135794	1948794	25	487198	2435992
SUBTOTAL 5	OTHER PROJECT COST	2828900	203180	3032080	4.48	135794	3167874	23	731014	3898888
PROJECT TOTAL		9,233,142	395,900	9,629,042	6.57	632,267	10,261,309	29	2,954,026	13,215,334

1. DOCUMENTS AND DRAWINGS

DOCUMENTS: ENGINEERING EVALUATION OF ALTERNATEIVES - MANAGING THE ASSUMED LEAK FROM SINGLE SHELL TANK 241-T-101 2/93.

DRAWINGS: SKETCHES

2. MATERIAL PRICES

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES

CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS

A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.
B.) COST FOR WHC ENGINEERING, CONSTRUCTION, AND OTHER PROJECT COST ADDERS ARE INCLUDED. (ORG, G&A, CSP).

5. ESCALATION

ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1992.

6. ROUNDING

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS

A.) COSTS WHC ENGINEERING, CONSTRUCTION, AND OTHER PROJECT COST WERE FURNISHED BY WESTINGHOUSE.
B.) ALL WORK ASSOCIATED WITH THE CONTAIMENT APRON, RAILCAR TANK, AND PIPING WILL BE PERFORMED BY THE ONSITE CONTRACTOR (KEH).
C.) WBS 500003 "OTHER COST" FOR THE WHC COST ASSOCIATED WITH THE WORK PERFORMED BY ONSITE CONTRACTOR (KEH), IS BASED ON 35% PERCENT OF DIRECT ONSITE ENGINEERING AND CONSTRUCTION COST.
D.) KEH DEFINITIVE DESIGN COST ARE BASED ON 25% OF DIRECT CONSTRUCTION COST.
E.) KEH ENGINEERING AND INSPECTION ARE BASED ON 10% OF DIRECT CONSTRUCTION COST.
D.) CONCEPTUAL DESIGN COST BY KEH IS BASED ON 5% PERCENT OF DIRECT ENGINEERING AND CONSTRUCTION COST OF THE ONSITE CONTRACTOR.
E.) NO ESCALATION WAS APPLIED TO WHC COST ON WORK PERFORMED IN 1993.

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3A PUMP OUT RAILCAR
DOE_R04 - COST CODE ACCOUNT SUMMARY

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	DEFINITIVE DESIGN (ONSITE)	960000	0	960000	6.68	64128	1024128	30	307238	1331366
111000	CONCEPTUAL DESIGN (ONSITE)	260000	0	260000	2.46	6396	266396	30	79919	346315
112000	WHC ENGINEERING	607100	121420	728520	0.00	0	728520	20	145704	874224
120000	ENGINEERING INSPECTION (ONSITE)	384000	0	384000	13.11	50342	434342	30	130303	564645
TOTAL 000	ENGINEERING	2211100	121420	2332520	5.18	120866	2453386	27	663164	3116550
700	SPECIAL EQUIP/PROCESS SYSTEMS									
310001	PUMP OUT RAILCAR & TANK	3836642	0	3836642	9.79	375607	4212249	35	1474288	5686536
330001	WHC CONSTRUCTION	356500	71300	427800	0.00	0	427800	20	85560	513360
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	4193142	71300	4264442	8.81	375607	4640049	34	1559848	6199896
900	WHC "OTHER COST"									
500001	WHC PROJECT OTHER COST	1015900	203180	1219080	0.00	0	1219080	20	243816	1462896
500003	WHC "OTHER COST" FOR KEH CONST.	1813000	0	1813000	7.49	135794	1948794	25	487198	2435992
TOTAL 900	WHC "OTHER COST"	2828900	203180	3032080	4.48	135794	3167874	23	731014	3898888
PROJECT TOTAL		9,233,142	395,900	9,629,042	6.57	632,267	10,261,309	29	2,954,026	13,215,334

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	ENGINEERING									
00	TECHNICAL SERVICES	2211100	121420	2332520	5.18	120866	2453386	27	663164	3116550
	TOTAL ENGINEERING	2,211,100	121,420	2,332,520	5.18	120,866	2,453,386	27	663,164	3,116,550
	CONSTRUCTION									
15	MECHANICAL	4193142	71300	4264442	8.81	375607	4640049	34	1559848	6199896
20	WHC "OTHER COST"	2828900	203180	3032080	4.48	135794	3167874	23	731014	3898888
	TOTAL CONSTRUCTION	7,022,042	274,480	7,296,522	7.01	511,401	7,807,923	29	2,290,862	10,098,784
	PROJECT TOTAL	9,233,142	395,900	9,629,042	6.57	632,267	10,261,309	29	2,954,026	13,215,334

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 7
COST CODE ACCOUNT SUMMARY — PAGE 5 OF 7

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 35 % .

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING			
000	WBS	110000	A 30% CONTINGENCY WAS APPLIED TO THE ONSITE CNTRACTOR (KEH) DEFINITIVE DESIGN DUE TO COST ARE BASED ON A PERCENTAGE OF DIRECT CONSTRUCTION.
	WBS	111000	A 30% CONTINGENCY WAS APPLIED TO THE CONCEPTUA DESIGN COST DUE TO COST WERE BASED ON A PERCENTAGE OF DIRECT ENGINEERING AND CONSTRUCTION.
	WBS	112000	A 20% CONTINGENCY WAS APPLIED TO WHC ENGINEERING COST PER WHC.
	WBS	120000	A 30% CONTINGENCY WAS APPLIED TO ONSITE ENGINEERING AND INSPECTION DUE TO COST ARE BASED ON A PERCENTAGE OF DIRECT CONSTRUCTION COST.
CONSTRUCTION			
700	WBS	310001	A 30% CONTINGENCY WAS USED ON THE CONTAINMENT APRON, RAILCAR TANK, AND OTHER CONSTRUCTION PERFORMED BY THE ONSITE CONTRACTOR (KEH) DUE TO THE LIMITED AMOUNT OF DETAIL AVAILABLE FOR THIS EFFORT.
	WBS	330001	A 20% CONTINGENCY WAS APPLIED TO WHC CONSTRUCTION COST PER WHC.
WHC "OTHER COST"			
900	WBS	500001	A 20% CONTINGENCY WAS APPLIED TO WHC OTHER COST PER WHC.
	WBS	500003	A 35% CONTINGENCY WAS APPLIED TO THE "OTHER COST" ASSOCIATED WITH WORK PERFORMED BY THE ONSITE CONTRACTOR (KEH) DUE TO THE COST WERE BASED ON A PERCENTAGE OF DIRECT ENGINEERING AND CONSTRUCTION.

AVERAGE PROJECT CONTINGENCY 29 %

%

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. Z031SAD1

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-T-101
STUDY ESTIMATE - OPTION #3A PUMP OUT RAILCAR
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/23/93 11:08:04
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	DEFINITIVE DESIGN (ONSITE)	960000	0.00	0	0	0	0
111000	CONCEPTUAL DESIGN (ONSITE)	260000	0.00	0	0	0	0
112000	WHC ENGINEERING	607100	20.00	121420	0	0	121420
120000	ENGINEERING INSPECTION (ONSITE)	384000	0.00	0	0	0	0
310001	PUMP OUT RAILCAR & TANK	3836642	0.00	0	0	0	0
330001	WHC CONSTRUCTION	356500	20.00	71300	0	0	71300
500001	WHC PROJECT OTHER COST	1015900	20.00	203180	0	0	203180
500003	WHC "OTHER COST" FOR KEH CONST.	1813000	0.00	0	0	0	0
PROJECT TOTAL		9,233,142		395,900	0	0	395,900

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 241TA4

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-1-101
STUDY ESTIMATE - OPTION #4 PUMP OUT-BLADDER
DOE_R01 - PROJECT COST SUMMARY

DATE 03/23/93 10:23:16
BY GDR

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	1,140,000	35	400,000	1,540,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	3,910,000	35	1,370,000	5,280,000
900	WHC OTHER PROJECT COST	1,170,000	35	410,000	1,580,000
	(ADJUSTED TO MEET DOE 5100.4)	-20,000		+20,000	
	PROJECT TOTAL	6,200,000	35	2,200,000	8,400,000

TYPE OF ESTIMATE	STUDY ESTIMATE	MARCH 23, 1993
ARCHITECT ENGINEER		
OPERATING CONTRACTOR		

REMARKS:

LIQUID RETRIEVAL ALTERNATIVE

OPTION #4-PUMP OUT-USING INTERNAL BLADDERS

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	KEH DEFINITIVE DESIGN	713000	0	713000	6.29	44848	757848	35	265247	1023094
111000	KEH CONCEPTUAL DESIGN	148000	0	148000	2.05	3034	151034	35	52862	203896
SUBTOTAL 11	DESIGN ENGINEERING	861000	0	861000	5.56	47882	908882	35	318109	1226990
120000	KEH ENGR/INSPECTION	204000	0	204000	13.11	26744	230744	35	80761	311505
SUBTOTAL 12	ENGINEERING/INSPECTION	204000	0	204000	13.11	26744	230744	35	80761	311505
SUBTOTAL 1	ENGINEERING	1065000	0	1065000	7.01	74626	1139626	35	398870	1538495
310001	NEW RISER PITS	620505	0	620505	9.79	60747	681252	35	238438	919691
310002	INSTALL NEW RISERS	760544	0	760544	9.79	74457	835001	35	292250	1127252
310003	INSTALL PUMPS	330262	0	330262	9.79	32333	362595	35	126908	489503
310004	INSTALL BLADDERS	137937	0	137937	9.79	13504	151441	35	53004	204445
310005	BURN OUT	1516495	0	1516495	9.79	148465	1664960	35	582736	2247696
310006	STEP OFF PADS	187200	0	187200	9.79	18327	205527	35	71934	277461
SUBTOTAL 31	ONSITE CONTRACTOR	3552943	0	3552943	9.79	347833	3900776	35	1365270	5266048
330000	BURIAL FEE	11714	0	11714	9.79	1147	12861	35	4501	17362
SUBTOTAL 33	CONSTRUCTION-O/C	11714	0	11714	9.79	1147	12861	35	4501	17362
SUBTOTAL 3	CONSTRUCTION	3564657	0	3564657	9.79	348980	3913637	35	1369771	5283410
500001	WHC OTHER PROJECT COST	1085000	0	1085000	7.49	81267	1166267	35	408193	1574460
SUBTOTAL 5	OTHER PROJECT COST	1085000	0	1085000	7.49	81267	1166267	35	408193	1574460
PROJECT TOTAL		5,714,657	0	5,714,657	8.83	504,873	6,219,530	35	2,176,834	8,396,365

1. DOCUMENTS AND DRAWINGS

DOCUMENTS: MANAGING THE ASSUMED LEAK FROM SINGLE-SHELL TANK 241-T-101, DATED FEBRUARY, 1993.

DRAWINGS: N/A

2. MATERIAL PRICES

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES

CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS

A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.

5. ESCALATION

ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1992.

6. ROUNDING

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE 1-11, DATED 10-31-84.

7. REMARKS

A.) DEFINITIVE DESIGN BY ONSITE ENGINEERING IS BASED ON 35% OF THE DIRECT CONSTRUCTION COST LESS BURNOUT.
B.) CONCEPTUAL DESIGN BY ONSITE ENGINEERING IS BASED ON 5% OF THE DIRECT ENGINEERING AND CONSTRUCTION COST LESS BURN-OUT.
C.) ONSITE ENGINEERING AND INSPECTION IS BASED ON 10% OF DIRECT CONSTRUCTION COST LESS BURNOUT.
D.) OTHER PROJECT COST BY WHC ARE BASED ON 35% OF THE DIRECT ENGINEERING AND CONSTRUCTION COST LESS BURNOUT.
E.) ASSUMED ALL WORK TO BE ON MASK.
F.) ASSUMED BURNOUT AT 100 HR.
G.) USED COST PROVIDED BY WHC ON CORE DRILLING FOR NEW RISERS, BASED ON INFORMATION FROM A SIMILAR JOB IN WEST VALLEY.
H.) ASSUMED PIT SIZE TO BE 8'X 8'X 8'.
I.) ESTIMATE DOES NOT INCLUDE ANY REMOVAL OF EQUIPMENT ARE BLADDERS AFTER TANK IS PUMPED INTO THE BLADDERS.

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	KEH DEFINITIVE DESIGN	713000	0	713000	6.29	44848	757848	35	265247	1023094
111000	KEH CONCEPTUAL DESIGN	148000	0	148000	2.05	3034	151034	35	52862	203896
120000	KEH ENGR/INSPECTION	204000	0	204000	13.11	26744	230744	35	80761	311505
TOTAL 000	ENGINEERING	1065000	0	1065000	7.01	74626	1139626	35	398870	1538495
700	SPECIAL EQUIP/PROCESS SYSTEMS									
310001	NEW RISER PITS	620505	0	620505	9.79	60747	681252	35	238438	919691
310002	INSTALL NEW RISERS	760544	0	760544	9.79	74457	835001	35	292250	1127252
310003	INSTALL PUMPS	330262	0	330262	9.79	32333	362595	35	126908	489503
310004	INSTALL BLADDERS	137937	0	137937	9.79	13504	151441	35	53004	204445
310005	BURN OUT	1516495	0	1516495	9.79	148465	1664960	35	582736	2247696
310006	STEP OFF PADS	187200	0	187200	9.79	18327	205527	35	71934	277461
330000	BURIAL FEE	11714	0	11714	9.79	1147	12861	35	4501	17362
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	3564657	0	3564657	9.79	348980	3913637	35	1369771	5283410
900	WHC OTHER PROJECT COST									
500001	WHC OTHER PROJECT COST	1085000	0	1085000	7.49	81267	1166267	35	408193	1574460
TOTAL 900	WHC OTHER PROJECT COST	1085000	0	1085000	7.49	81267	1166267	35	408193	1574460
PROJECT TOTAL		5,714,657	0	5,714,657	8.83	504,873	6,219,530	35	2,176,834	8,396,365

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 241TA4

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-1-101
STUDY ESTIMATE - OPTION #4 PUMP OUT-BLADDER
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

DATE 03/23/93 10:23:31
BY GDR

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	ENGINEERING									
00	TECHNICAL SERVICES	1065000	0	1065000	7.01	74626	1139626	35	398870	1538495
	TOTAL ENGINEERING	1,065,000	0	1,065,000	7.01	74,626	1,139,626	35	398,870	1,538,495
	CONSTRUCTION									
00	TECHNICAL SERVICES	1085000	0	1085000	7.49	81267	1166267	35	408193	1574460
01	GENERAL REQUIRMENTS	1715409	0	1715409	9.79	167939	1883348	35	659171	2542519
03	CONCRETE	1381049	0	1381049	9.79	135204	1516253	35	530688	2046943
15	MECHANICAL	468199	0	468199	9.79	45837	514036	35	179912	693948
	TOTAL CONSTRUCTION	4,649,657	0	4,649,657	9.25	430,247	5,079,904	35	1,777,964	6,857,870
	PROJECT TOTAL	5,714,657	0	5,714,657	8.83	504,873	6,219,530	35	2,176,834	8,396,365

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 7
COST CODE ACCOUNT SUMMARY — PAGE 4 OF 7

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 35 % .

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING		
000	WBS 110000 THRU 120000	A 35% CONTINGENCY WAS APPLIED TO ALL ENGINEERING DUE TO COST ARE BASED ON A PERCENTAGE OF DIRECT CONSTRUCTION OR DIRECT CONSTRUCTION AND ENGINEERING.
CONSTRUCTION		
700	WBS 310001 THRU 330001	A 35% CONTINGENCY WAS APPLIED TO ALL CONSTRUCTION AND BURIAL FEES DUE TO THE LIMITED INFORMATION AVAILABLE FOR THIS ENGINEERING STUDY.
OTHER PROJECT COST		
900	WBS 500001	A 35% CONTINGENCY WAS APPLIED TO OTHER PROJECT COST BY WHC DUE TO THE COST ARE BASED ON A PERCENTAGE OF DIRECT ENGINEERING AND CONSTRUCTION.

AVERAGE PROJECT CONTINGENCY 35%.

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241-T
FILE NO. 241TA4

** IEST - INTERACTIVE ESTIMATING **
ALTERNATIVES FOR SINGLE SHELL TANK 241-1-101
STUDY ESTIMATE - OPTION #4 PUMP OUT-BLADDER
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/23/93 10:23:35
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	KEH DEFINITIVE DESIGN	713000	0.00	0	0	0	0
111000	KEH CONCEPTUAL DESIGN	148000	0.00	0	0	0	0
120000	KEH ENGR/INSPECTION	204000	0.00	0	0	0	0
310001	NEW RISER PITS	620505	0.00	0	0	0	0
310002	INSTALL NEW RISERS	760544	0.00	0	0	0	0
310003	INSTALL PUMPS	330262	0.00	0	0	0	0
310004	INSTALL BLADDERS	137937	0.00	0	0	0	0
310005	BURN OUT	1516495	0.00	0	0	0	0
310006	STEP OFF PADS	187200	0.00	0	0	0	0
330000	BURIAL FEE	11714	0.00	0	0	0	0
500001	WHC OTHER PROJECT COST	1085000	0.00	0	0	0	0
PROJECT TOTAL		5,714,657		0	0	0	0

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241TUNL
FILE NO. 241TUNL

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #1 UNLIMITED SLUICING
DOE_R01 - PROJECT COST SUMMARY

DATE 03/22/93 14:33:10
BY GDR

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	25,420,000	34	8,580,000	34,000,000
600	UTILITIES	1,300,000	35	460,000	1,760,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	37,210,000	30	11,200,000	48,410,000
810	DEMOLITION	4,280,000	36	1,540,000	5,820,000
900	OTHER COSTS (ADJUSTED TO MEET DOE 5100.4)	24,390,000	30	7,320,000	31,710,000
	PROJECT TOTAL	92,600,000	31	29,100,000	121,700,000

TYPE OF ESTIMATE	STUDY ESTIMATE	MARCH 22, 1993
ARCHITECT ENGINEER	Mof	
OPERATING CONTRACTOR		

REMARKS:

TOTAL RETRIEVAL ALTERNATIVE
OPTION #1 UNLIMITED SLUICING

WHC-EP-0873
Rev. 0

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
111000	KEH ENGINEERING STUDY	780000	0	780000	0.00	0	780000	35	273000	1053000
112000	KEH CONCEPTUAL DESIGN	1670000	0	1670000	4.74	79158	1749158	35	612205	2361363
113000	KEH DEFINITIVE DESIGN	8000000	0	8000000	10.91	872800	8872800	35	3105480	11978280
114000	WHC D & D DESIGN	1210800	0	1210800	10.91	132098	1342898	35	470014	1812913
121000	KEH ENGINEERING/INSPECTION	4800000	0	4800000	16.43	788640	5588640	35	1956024	7544664
122000	WHC ENGR/INSPEC. D & D	691900	0	691900	10.91	75486	767386	35	268585	1035971
	SUBTOTAL 1 ENGINEERING	17152700	0	17152700	11.36	1948182	19100882	35	6685308	25786191
210160	T-101 PROCESS EQUIPMENT	512050	0	512050	10.91	55865	567915	35	198770	766685
210180	T-101 ELEC EQUIP.	934879	0	934879	10.91	101995	1036874	35	362906	1399780
210190	T-101 HVAC SKIDS	4005848	0	4005848	10.91	437038	4442886	25	1110722	5553608
	SUBTOTAL 2101 T-101 PROCUREMENT	5452777	0	5452777	10.91	594898	6047675	28	1672398	7720073
210260	101-FY PROCESS EQUIPMENT	517440	0	517440	10.91	56453	573893	35	200862	774755
	SUBTOTAL 2102 103-FY PROCUREMENT	517440	0	517440	10.91	56453	573893	35	200862	774755
	SUBTOTAL 21 KEH PROCUREMENT	5970217	0	5970217	10.91	651351	6621568	28	1873260	8494828
	SUBTOTAL 2 PROCUREMENT	5970217	0	5970217	10.91	651351	6621568	28	1873260	8494828
310110	GREENHOUSE T-101	105481	0	105481	16.43	17331	122812	25	30703	153514
310120	UPGRADE EXIST.PITS T-101	120719	0	120719	16.43	19834	140553	35	49194	189747
310140	JUMPERS T-101	57196	0	57196	16.43	9397	66593	35	23308	89901
310150	MTD.BASE/WASHDOWN/SLIDE VALVE	312427	0	312427	16.43	51332	363759	35	127316	491074
310160	INSTALL PROCESS EQUIP.T-101	52752	0	52752	16.43	8667	61419	35	21497	82916
310170	PIPING INSIDE T-101 FARM	422850	0	422850	16.43	69474	492324	35	172313	664638
310180	ELECTRICAL IN T-101 FARM	739197	0	739197	16.43	121450	860647	35	301226	1161872
310190	HVAC IN T-101 FARM	985884	0	985884	16.43	161981	1147865	30	344359	1492224
	SUBTOTAL 3101 T-101 SLUICING	2796506	0	2796506	16.43	459466	3255972	33	1069916	4325888
310210	GREEN HOUSE 103-FY	77844	0	77844	16.43	12790	90634	25	22658	113292
310220	UPGRADE EXIST.PITS 103-FY	47864	0	47864	16.43	7864	55728	40	22291	78019
310240	JUMPERS 103-FY	42897	0	42897	16.43	7048	49945	35	17481	67426

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241TUNL
FILE NO. 241TUNL

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #1 UNLIMITED SLUICING
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

DATE 03/22/93 14:33:15
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
310250	MTD. BASE/WASHDOWN/SLIDE VALVES	115949	0	115949	16.43	19050	134999	35	47250	182249
310260	INSTALL PROCESS EQUIP. 103-FY	40849	0	40849	16.43	6711	47560	35	16646	64207
310270	PIPING INSIDE 103-FY FARM	352308	0	352308	16.43	57884	410192	35	143567	553759
310280	103-FY ELEC EQUIPMENT	130650	0	130650	16.43	21467	152117	35	53241	205355
	SUBTOTAL 3102 103 FY TANK FARM	808361	0	808361	16.43	132814	941175	34	323134	1264307
310320	TRANSFER PIPING T-101 TO 103-FY	22284725	0	22284725	16.43	3661380	25946105	30	7783832	33729937
	SUBTOTAL 3103 ENCASED PIPE T-101/103-FY	22284725	0	22284725	16.43	3661380	25946105	30	7783832	33729937
310400	CONTROL RM/LUNCH RM/CHANGE RM	238451	0	238451	16.43	39178	277629	40	111051	388680
	SUBTOTAL 3104 CONTROL RM./LUNCH/CHANGE RM	238451	0	238451	16.43	39178	277629	40	111051	388680
310510	BURN OUT T-101	753152	0	753152	16.43	123743	876895	35	306913	1183808
310520	BURN OUT 103-FY	232969	0	232969	16.43	38277	271246	35	94936	366182
	SUBTOTAL 3105 BURN OUT	986121	0	986121	16.43	162020	1148141	35	401849	1549990
310600	STEP OFF PAD	276108	0	276108	16.43	45365	321473	30	96442	417914
	SUBTOTAL 3106 STEP OFF PAD SUPPORT	276108	0	276108	16.43	45365	321473	30	96442	417914
	SUBTOTAL 31 KEH CONSTRUCTION	27390272	0	27390272	16.43	4500223	31890495	31	9786224	41676714
330110	PRE-TRANSFER DEMO. T-101	460343	0	460343	4.74	21820	482163	35	168757	650921
330120	PRE-TRANSFER DEMO. 103-FY	115885	0	115885	4.74	5493	121378	35	42483	163861
	SUBTOTAL 3301 PRE TRANSFER DEMOLITION	576228	0	576228	4.74	27313	603541	35	211240	814782
330210	POST-TRANSFER DEMO. T-101	1527428	0	1527428	28.08	428902	1956330	35	684715	2641045
330220	POST-TRANSFER DEMO. 103-FY	617988	0	617988	28.08	173531	791519	35	277032	1068551
	SUBTOTAL 3302 POST TRANSFER DEMOLITION	2145416	0	2145416	28.08	602433	2747849	35	961747	3709596

Rev.

WBS DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
330410 BURIAL FEES - PRE TRANSFER	141120	0	141120	4.74	6689	147809	40	59124	206933
330420 BURIAL FEES - POST TRANSFER	606875	0	606875	28.08	170411	777286	40	310914	1088200
SUBTOTAL 3304 TOTAL BURIAL FEES	747995	0	747995	23.68	177100	925095	40	370038	1295133
SUBTOTAL 33 CONSTRUCTION-O/C	3469639	0	3469639	23.25	806846	4276485	36	1543025	5819511
SUBTOTAL 3 CONSTRUCTION	30859911	0	30859911	17.20	5307069	36166980	31	11329249	47496225
400000 WHC PROJECT MANAGEMENT	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
SUBTOTAL 4 PROJECT INTEGRATION	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
500010 WHC (OTHER COST)	20800000	0	20800000	17.25	3588000	24388000	30	7316400	31704400
SUBTOTAL 5 OTHER PROJECT COST	20800000	0	20800000	17.25	3588000	24388000	30	7316400	31704400
PROJECT TOTAL	80,168,828	0	80,168,828	15.50	12,423,687	92,592,515	31	29,098,743	121,691,255

1. DOCUMENTS AND DRAWINGS

DOCUMENTS: ENGINEERING EVALUATION OF ALTERNATEIVES - MANAGING THE ASSUMED LEAK FROM SINGLE SHELL TANK 241T-101 2/93.

DRAWINGS: IN SAME DOCUMENT AS ABOVE

2. MATERIAL PRICES

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES

CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS

A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.

5. ESCALATION

ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1992.

6. ROUNDING

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS

1.) KEH DEFINITIVE DESIGN, FOR WORK PERFORMED BY KEH CONSTRUCTION, IS BASED ON 25% OF DIRECT PROCUREMENT AND CONSTRUCTION COSTS, LESS BURN-OUT COST.
2.) KEH E/I, ON WORK PERFORMED BY KEH CONSTRUCTION, IS BASED ON 15% OF DIRECT PROCUREMENT AND CONSTRUCTION COSTS, LESS BURNOUT.
3.) WHC DEFINITIVE DESIGN, FOR WORK PERFORMED BY WHC CONSTRUCTION, IS BASED ON 35% OF DIRECT D & D CONSTRUCTION COSTS, LESS BURIAL FEE ALLOWANCES.
4.) WHC E/I, ON WORK PERFORMED BY WHC CONSTRUCTION, IS BASED ON 20% OF DIRECT D & D CONSTRUCTION COSTS, LESS BURIAL FEE ALLOWANCES.
5.) KEH CONCEPTUAL DESIGN IS BASED ON 5% OF THE TOTAL ESTIMATED DIRECT COST OF KEH ENGINEERING AND CONSTRUCTION COST, LESS BURN-OUT.
6.) WBS 5 (OTHER COST) COST ARE BASED ON 35% OF THE TOTAL DIRECT COST OF ENGINEERING, CONSTRUCTION, PROCUREMENT, AND ARE BASED ON A STUDY ESTIMATE ON C-106 RETREVIAL.

7. REMARKS (CONTINUED)

7.) ASSUME THAT (2) TRANSFER PUMPS AND (1) HEEL PUMP WILL HAVE TO BE REMOVED AT T-101.
8.) THE EXISTING PITS AT T-101 AND 103-FY WILL BE UPGRADED PRIOR TO EQUIPMENT INSTALLATION. UPGRADING WILL INCLUDE LINING THE PITS WITH AN EPOXY SEALANT.
9.) WHC D & D OVERHEAD COSTS WERE APPLIED TO LABOR AT 52% BASED ON PROJECT W-151, DATED 04/30/90.
10.) WHC D & D OVERHEAD COSTS WERE APPLIED TO DIRECT MATERIAL PURCHASES AT 17.40%.
11.) KEH PROCUREMENT COSTS FOR THE HVAC EQUIPMENT ARE BASED ON A VENDOR SUPPLIED BUDGET ESTIMATE. HOWEVER, COSTS FOR SHIELDING WERE NOT INCLUDED IN THIS VENDOR QUOTE.
12.) KEH PROCUREMENT COSTS FOR TRANSFER PUMPS, SLUICE MAST AND SLUICE PUMP WERE ALLOWANCES EXTRACTED FROM PREVIOUS COST ESTIMATES THAT USED SIMILAR EQUIPMENT.
13.) BURN-OUT ALLOWANCES FOR SEALING OF THE PIT INTERIORS WITHIN T-101 TANK FARM WERE ASSUMED BY KEH (100 MR).
14.) BURN-OUT ALLOWANCES FOR SEALING OF THE PIT INTERIORS WITHIN 102-FY TANK FARM WERE ASSUMED BY KEH (50 MR).
15.) ALL BURN-OUT ALLOWANCES APPLY TO WORK PERFORMED BY KEH CONSTRUCTION ONLY. WORK PERFORMED BY WHC CONSTRUCTION ON THE PRE-TRANSFER & POST-TRANSFER D & D DOES NOT HAVE BURN-OUT ALLOWANCES CALCULATED.
16.) COSTS FOR THE WASHDOWN ASSEMBLIES, USED FOR RISERS, WERE EXTRACTED FROM AN EXISTING COST ESTIMATE FOR PROJECT W-151.
17.) COSTS FOR THE RECEIVER ASSEMBLIES, USED FOR EQUIPMENT REMOVAL, WERE EXTRACTED FROM AN EXISTING COST ESTIMATE FOR PROJECT W-151.
18.) BURIAL FEES, FOR LOW LEVEL WASTE, WERE BASED ON $72 PER CUBIC FOOT. ITEMS TO BE BURIED INCLUDE REMOVED PUMPS, ENCASED PIPE, HVAC EQUIPMENT, PIPING, VALVES, ETC.
19.) BURIAL FEES, FOR HAZARDOUS WASTE, WERE BASED ON $42 PER CUBIC YARD. (STEEL SHIELDING ONLY)
20.) THE CONCRETE TRENCH WAS ESTIMATED TO BE NON-CONTAMINATED AND WAS TRANSPORTED TO LAND FILL WITHOUT ANY BURIAL COST.
21.) IT WAS ASSUMED THAT A PORTABLE GREENHOUSE/GLOVEBOX WOULD BE USED FOR REMOVAL OF THE ENCASED PIPE.
22.) THE CONCRETE TRENCH WAS ESTIMATED AT 18" THICK WITH 120 LBS OF REBAR PER CUBIC YARD.
23.) THE USE OF CARBON STEEL, 4" THICK, WAS ESTIMATED FOR SHIELDING REQUIREMENTS AROUND THE SCRUBBER SKID AND FILTER HOUSING SKID.
24.) THIS ESTIMATE DID NOT ALLOW FOR SHIELDING AROUND THE FANS AND FILTER ROOM SKIDS AS REQUESTED BY WHC.
25.) ALL ENCASED PIPING, WITHIN THE TANK FARMS, WAS ROUTED IN THE CONCRETE TRENCH LOCATED ABOVE GRADE.
26.) THIS ESTIMATE DID NOT ALLOW FOR SHIELDING AROUND THE INTERCONNECTING DUCTS AT THE HVAC SKIDS AS REQUESTED BY WHC.
27.) ALL CONSTRUCTION ACTIVITIES BY KEH FORCES WERE FIGURED WITH 15% SWP ALLOWANCES EXCEPT THE AREAS WHERE MASK WORK WOULD BE REQUIRED AND THE INSTALLATION OF THE ENCASED PIPE FROM T-101 TO 103-FY.
28.) ASSUMPTIONS WERE MADE ON ALL QUANTITIES WHEN THE ESTIMATE WAS BASED ON FLOW DIAGHRAMS & SKETCHES.
29.) ASSUMED (2) TRANSFER PUMPS WILL NEED TO BE REMOVED FROM 103-FY TANK FARM.
30.) THE T-101 PITS WILL BE SEALED WITH POLYURETHANE FOAM ONCE POST TRANSFER DEMOLITION HAS BEEN COMPLETED.
31.) THE HVAC PROCURED SKIDS WILL INCLUDE INSTRUMENTAION AND MUX.
32.) ELECTRICAL SKIDS WILL FURNISH POWER TO THE HVAC SKIDS BY SURFACE DUCTS AND CABLE.
33.) THE ESCALATION PERCENTAGES WERE BASED ON A PRELIMINARY SCHEDULE.
34.) THE ESTIMATE REFLECTS (3) ENCASED LINES BETWEEN TANK T-101 AND 103-FY, ONE TRANSFER LINE FROM T-101 TO 103-FY AND ONE RETURN WITH ONE SPARE.

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
111000	KEH ENGINEERING STUDY	780000	0	780000	0.00	0	780000	35	273000	1053000
112000	KEH CONCEPTUAL DESIGN	1670000	0	1670000	4.74	79158	1749158	35	612205	2361363
113000	KEH DEFINITIVE DESIGN	8000000	0	8000000	10.91	872800	8872800	35	3105480	11978280
114000	WHC D & D DESIGN	1210800	0	1210800	10.91	132098	1342898	35	470014	1812913
121000	KEH ENGINEERING/INSPECTION	4800000	0	4800000	16.43	788640	5588640	35	1956024	7544664
122000	WHC ENGR/INSPEC. D & D	691900	0	691900	10.91	75486	767386	35	268585	1035971
400000	WHC PROJECT MANAGEMENT	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
	TOTAL 000 ENGINEERING	22538700	0	22538700	12.77	2877267	25415967	34	8579834	33995802
600	UTILITIES									
210180	T-101 ELEC EQUIP.	934879	0	934879	10.91	101995	1036874	35	362906	1399780
310180	ELECTRICAL IN T-101 FARM	156342	0	156342	16.43	25687	182029	35	63710	245739
310280	103-FY ELEC EQUIPMENT	66371	0	66371	16.43	10905	77276	35	27046	104322
310400	CONTROL RM/LUNCH RM/CHANGE RM	4429	0	4429	16.44	728	5157	40	2063	7219
	TOTAL 600 UTILITIES	1162021	0	1162021	11.99	139315	1301336	35	455725	1757060
700	SPECIAL EQUIP/PROCESS SYSTEMS									
210160	T-101 PROCESS EQUIPMENT	512050	0	512050	10.91	55865	567915	35	198770	766685
210190	T-101 HVAC SKIDS	4005848	0	4005848	10.91	437038	4442886	25	1110722	5553608
210260	101-FY PROCESS EQUIPMENT	517440	0	517440	10.91	56453	573893	35	200862	774755
310110	GREENHOUSE T-101	105481	0	105481	16.43	17331	122812	25	30703	153514
310120	UPGRADE EXIST.PITS T-101	120719	0	120719	16.43	19834	140553	35	49194	189747
310140	JUMPERS T-101	57196	0	57196	16.43	9397	66593	35	23308	89901
310150	MTD.BASE/WASHDOWN/SLIDE VALVE	312427	0	312427	16.43	51332	363759	35	127316	491074
310160	INSTALL PROCESS EQUIP.T-101	52752	0	52752	16.43	8667	61419	35	21497	82916
310170	PIPING INSIDE T-101 FARM	422850	0	422850	16.43	69474	492324	35	172313	664638
310180	ELECTRICAL IN T-101 FARM	582855	0	582855	16.43	95763	678618	35	237516	916133
310190	HVAC IN T-101 FARM	985884	0	985884	16.43	161981	1147865	30	344359	1492224
310210	GREEN HOUSE 103-FY	77844	0	77844	16.43	12790	90634	25	22658	113292
310220	UPGRADE EXIST.PITS 103-FY	47864	0	47864	16.43	7864	55728	40	22291	78019
310240	JUMPERS 103-FY	42897	0	42897	16.43	7048	49945	35	17481	67426
310250	MTD. BASE/WASHDOWN/SLIDE VALVES	115949	0	115949	16.43	19050	134999	35	47250	182249

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
310260	INSTALL PROCESS EQUIP. 103-FY	40849	0	40849	16.43	6711	47560	35	16646	64207
310270	PIPING INSIDE 103-FY FARM	352308	0	352308	16.43	57884	410192	35	143567	553759
310280	103-FY ELEC EQUIPMENT	64279	0	64279	16.43	10562	74841	35	26195	101033
310320	TRANSFER PIPING T-101 TO 103-FY	22284725	0	22284725	16.43	3661380	25946105	30	7783832	33729937
310400	CONTROL RM/LUNCH RM/CHANGE RM	234022	0	234022	16.43	38450	272472	40	108988	381461
310510	BURN OUT T-101	753152	0	753152	16.43	123743	876895	35	306913	1183808
310520	BURN OUT 103-FY	232969	0	232969	16.43	38277	271246	35	94936	366182
310600	STEP OFF PAD	276108	0	276108	16.43	45365	321473	30	96442	417914
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	32198468	0	32198468	15.57	5012259	37210727	30	11203759	48414482
810 DEMOLITION										
330110	PRE-TRANSFER DEMO. T-101	460343	0	460343	4.74	21820	482163	35	168757	650921
330120	PRE-TRANSFER D MO. 103-FY	115885	0	115885	4.74	5493	121378	35	42483	163861
330210	POST-TRANSFER DEMO. T-101	1527428	0	1527428	28.08	428902	1956330	35	684715	2641045
330220	POST-TRANSFER DEMO. 103-FY	617988	0	617988	28.08	173531	791519	35	277032	1068551
330410	BURIAL FEES - PRE TRANSFER	141120	0	141120	4.74	6689	147809	40	59124	206933
330420	BURIAL FEES - POST TRANSFER	606875	0	606875	28.08	170411	777286	40	310914	1088200
TOTAL 810	DEMOLITION	3469639	0	3469639	23.25	806846	4276485	36	1543025	5819511
900 OTHER COSTS										
500010	WHC (OTHER COST)	20800000	0	20800000	17.25	3588000	24388000	30	7316400	31704400
TOTAL 900	OTHER COSTS	20800000	0	20800000	17.25	3588000	24388000	30	7316400	31704400
PROJECT TOTAL		80,168,828	0	80,168,828	15.50	12,423,687	92,592,515	31	29,098,743	121,691,255

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241TUNL .
FILE NO. 241TUNL

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #1 UNLIMITED SLUICING
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

DATE 03/22/93 14:33:24
BY GDR

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
ENGINEERING										
00	TECHNICAL SERVICES	17152700	0	17152700	11.36	1948182	19100882	35	6685308	25786191
19	WHC PROJECT MANAGEMENT	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
	TOTAL ENGINEERING	22,538,700	0	22,538,700	12.77	2,877,267	25,415,967	34	8,579,834	33,995,802
CONSTRUCTION										
01	GENERAL REQUIRMENTS	2426732	0	2426732	17.54	425659	2852391	35	1007173	3859562
03	CONCRETE	5144	0	5144	16.43	845	5989	35	2096	8085
13	SPECIAL CONSTRUCTION	368583	0	368583	16.43	60558	429141	38	164629	593770
15	MECHANICAL	32053916	0	32053916	16.27	5214445	37268361	30	11244940	48513303
16	ELECTRICAL	1975753	0	1975753	13.00	256913	2232666	35	783671	3016333
20	OTHER COST	20800000	0	20800000	17.25	3588000	24388000	30	7316400	31704400
	TOTAL CONSTRUCTION	57,630,128	0	57,630,128	16.56	9,546,420	67,176,548	31	20,518,909	87,695,453
	PROJECT TOTAL	80,168,828	0	80,168,828	15.50	12,423,687	92,592,515	31	29,098,743	121,691,255

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241TUNL
FILE NO.

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 UNLIMITED SLUICING
STUDY ESTIMATE
DOE_R06 - CONTINGENCY ANALYSIS BASIS SHEET

DATE 02/24/93 13:57:05
BY GDR

REFERENCE: ESTIMATE BASIS SHEET PAGE 5 OF 13
COST CODE ACCOUNT SUMMARY PAGE 7 OF 13

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE ASSOCIATED WITH EXPERIMENTAL/SPECIAL CONDITIONS SHOULD HAVE AN OVERALL RANGE OF 20% TO 50%.

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING

COST CODE 000

WBS 1.1.1.0.0.0
AN OVERALL AVERAGE OF 12% CONTINGENCY WAS APPLIED TO THE ENGINEERING STUDY ESTIMATE DUE TO THE COST TO DATE AND THE ESTIMATE TO COMPLETE CALCULATIONS.

WBS 1.1.2.0.0.0 THRU WBS 1.2.2.0.0.0
A 35% CONTINGENCY WAS APPLIED TO ALL REMAINING ENGINEERING FUNCTIONS DUE TO THE ALLOWANCES PROVIDED WERE BASED ON A PERCENTAGE OF CONSTRUCTION COSTS. ALSO, IT APPEARS THAT THE EVOLUTION OF DESIGN WILL INEVITABLY INCREASE DESIGN AND SCHEDULING COSTS DUE TO UNKNOWNS.

WBS 4.0.0.0.0.0
A 30% CONTINGENCY WAS APPLIED TO THE WHC PROJECT MANAGEMENT PORTION OF THE ENGINEERING ESTIMATE BY WESTINGHOUSE DIRECTION.

CONSTRUCTION

COST CODE 600

WBS 2.1.0.1.8.0
A 35% CONTINGENCY WAS APPLIED TO THE ELECTRICAL EQUIPMENT PROCUREMENT ITEMS DUE TO THE LIMITED AMOUNT OF INFORMATION AVAILABLE FOR THIS EFFORT.

WBS 3.1.0.1.8.0 & WBS 3.1.0.2.8.0
A 35% CONTINGENCY WAS ALSO APPLIED TO THE ELECTRICAL EQUIPMENT INSTALLATION DUE TO THE ASSUMPTIONS MADE FOR QUANTITIES AND INSTALLATION MATERIAL REQUIREMENTS.

WBS 3.1.0.4.0.0
A 40% CONTINGENCY WAS APPLIED TO THE CONTROL ROOM, CHANGE ROOM, AND LUNCH ROOM TRAILER ALLOWANCES DUE TO THE LIMITED INFORMATION AVAILABLE AT THIS TIME.

COST CODE 700

WBS 2.1.0.1.6.0 AND WBS 2.1.0.2.6.0
A 35% CONTINGENCY WAS APPLIED TO THE PUMPS, SLUICE MAST AND DISTRIBUTOR DISCHARGE SIPHON, DUE TO THE ALLOWANCES PROVIDED WERE EXTRACTED FROM PREVIOUS PARAMETRIC COST ESTIMATES FOR SIMILAR ITEMS.

WBS 2.1.0.1.9.0
A 25% CONTINGENCY WAS APPLIED TO THE HVAC EQUIPMENT DUE TO THE INFORMATION AND BUDGET QUOTE SUPPLIED BY A QUALIFIED VENDER.

WBS 3.1.0.1.1.0 & WBS 3.1.0.2.1.0
A 25% CONTINGENCY WAS APPLIED TO THE CONSTRUCTION COSTS OF BUILDING GREENHOUSE'S OVER THE PITS AND RISERS BECAUSE OF ASSUMPTIONS ASSOCIATED WITH THE SIZE AND STYLE REQUIRED.

WBS 3.1.0.1.2.0 & WBS 3.1.0.2.2.0
A 35% & 40% CONTINGENCY WAS APPLIED AGAINST THE CONSTRUCTION TASKS ASSOCIATED WITH THE UPGRADING OF THE EXISTING PITS BECAUSE OF UNKNOWN CONTAMINATION REQUIREMENTS AND LIMITED SCOPE DEFINITION.

WBS 3.1.0.1.4.0 & WBS 3.1.0.2.4.0
A 35% CONTINGENCY WAS APPLIED TO THE JUMPER FABRICATION COSTS DUE TO THE ALLOWANCES PROVIDED WERE EXTRACTED FROM PREVIOUS PARAMETRIC COST ESTIMATES FOR SIMILAR TASKS.

WBS 3.1.0.1.5.0 & WBS 3.1.0.2.5.0
A 35% CONTINGENCY WAS APPLIED TO THE WASHDOWN, MOUNTING BASE, AND SLIDE VALVE ASSEMBLY COSTS DUE TO THE ALLOWANCES PROVIDED WERE EXTRACTED FROM AN EXISTING CONCEPTUAL ESTIMATE WITH SIMILAR TASKS AND DIFFICULTIES.

WBS 3.1.0.1.6.0 & WBS 3.1.0.2.6.0
A 35% CONTINGENCY WAS APPLIED TO THE INSTALLATION OF THE TRANSFER EQUIPMENT DUE TO THE HIGHLY CONTAMINATED AREA WHERE CONSTRUCTION WILL MOST LIKELY BE DONE WITH REMOTELY OPERATED EQUIPMENT.

WBS 3.1.0.1.7.0 & WBS 3.1.0.2.7.0
A 35% CONTINGENCY WAS APPLIED TO ALL PIPING INSTALLATION COSTS WITHIN THE TANK FARM DUE TO THE TAKE-OFF QUANTITIES BEING EXTRACTED FROM FLOW DIAGRAMS WITHOUT DISTANCES REPRESENTED.

WBS 3.1.0.1.8.0 & WBS 3.1.0.2.8.0
A 35% CONTINGENCY WAS APPLIED TO ALL ELECTRICAL AND INSTRUMENTATION FUNCTIONS WITHIN THE TANK FARM DUE TO THE LIMITED AMOUNT OF INFORMATION AVAILABLE FOR THIS EFFORT.

WBS 3.1.0.1.9.0
A 30% CONTINGENCY WAS APPLIED TO THE INSTALLATION OF THE HVAC EQUIPMENT SKIDS AND INTERCONNECTING DUCTS DUE TO THE INSUFFICIENT INFORMATION SUPPLIED FOR SHIELDING REQUIREMENTS.

WBS 3.1.0.3.2.0
A 30% CONTINGENCY WAS APPLIED TO THE INSTALLATION OF ENCASED PIPING DUE TO THE UNKNOWNS ASSOCIATED WITH ROUTING OF PIPING IN EXISING TANK FARMS.

WBS 3.1.0.4.0.0
A 40% CONTINGENCY WAS APPLIED TO THE CONTROL ROOM, CHANGE ROOM, AND LUNCH ROOM TRAILER ALLOWANCES DUE TO THE LIMITED INFORMATION AVAILABLE AT THIS TIME.

WBS 3.1.0.5.1.0 & WBS 3.1.0.5.2.0
A 35% CONTINGENCY WAS APPLIED TO THE ESTIMATED "BURN-OUT" DOLLARS, DUE TO THE INCONSISTENT AND LIMITED DETAIL AVAILABLE FOR AREAS THAT ARE CONSIDERED CONTAMINATED. FUTURE ESTIMATES SHOULD REFLECT INFORMATION DETAILING MR READINGS FOR SPECIFIC CONSTRUCTION AREAS.

WBS 3.1.0.6.0.0
A 30% CONTINGENCY WAS APPLIED TO COSTS ASSOCIATED WITH THE "STEP OFF PADS", FOR KEH CONSTRUCTION FORCES DUE TO THE LIMITED INFORMATION AVAILABLE AT THIS TIME FOR SCHEDULING ACTIVITIES. COSTS FOR "STEP OFF PADS" ARE GENERALLY CALCULATED BY MAN-LOADING SCHEDULE DURATIONS FOR SPECIFIC TASKS.

COST CODE 810

WBS 3.3.0.1.1.0 & WBS 3.3.0.1.2.0
A 35% CONTINGENCY WAS APPLIED TO THE D&D OF THE EXISTING PRE-TRANSFER EQUIPMENT DUE TO THE ALLOWANCES INCLUDED WITHIN THIS ESTIMATE WERE BASED ON AN EXISTING CONCEPTUAL DESIGN ESTIMATE (W-151).

WBS 3.3.0.2.1.0 & WBS 3.3.0.2.2.0
A 35% CONTINGENCY WAS APPLIED TO THE D&D OF THE POST-TRANSFER EQUIPMENT, CONCRETE TRENCH, AND ENCASED PIPING, DUE TO THE POTENTIAL PROBLEMS ASSOCIATED WITH CONTAMINATION.

WBS 3.3.0.4.1.0 & WBS 3.3.0.4.2.0
A 40% CONTINGENCY WAS APPLIED TO THE COST ALLOWANCES FOR BURIAL FEES DUE TO THE UNKNOWNS ASSOCIATED WITH HANDLING CONTAMINATED MATERIAL AND THE POTENTIAL OF INCREASED VOLUMES OF DISPOSABLE MATERIAL THAT IS NOT REFLECTED WITHIN THIS ESTIMATE.

COST CODE 900

WBS 5.0.0.0.1.0
AN OVERALL AVERAGE 30% CONTINGENCY WAS APPLIED AGAINST ALL WHC EXPENSE FUNDED ITEMS BY THEIR REQUEST AND BECAUSE THE COST ARE BASED ON A PERCENTAGE OF THE TOTAL ESTIMATED COST.

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241TUNL
FILE NO. 241TUNL

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #1 UNLIMITED SLUICING
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/22/93 14:33:28
BY GDR

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
111000	KEH ENGINEERING STUDY	780000	0.00	0	0	0	0
112000	KEH CONCEPTUAL DESIGN	1670000	0.00	0	0	0	0
113000	KEH DEFINITIVE DESIGN	8000000	0.00	0	0	0	0
114000	WHC D & D DESIGN	1210800	0.00	0	0	0	0
121000	KEH ENGINEERING/INSPECTION	4800000	0.00	0	0	0	0
122000	WHC ENGR/INSPEC. D & D	691900	0.00	0	0	0	0
210160	T-101 PROCESS EQUIPMENT	512050	0.00	0	0	0	0
210180	T-101 ELEC EQUIP.	934879	0.00	0	0	0	0
210190	T-101 HVAC SKIDS	4005848	0.00	0	0	0	0
210260	101-FY PROCESS EQUIPMENT	517440	0.00	0	0	0	0
310110	GREENHOUSE T-101	105481	0.00	0	0	0	0
310120	UPGRADE EXIST.PITS T-101	120719	0.00	0	0	0	0
310140	JUMPERS T-101	57196	0.00	0	0	0	0
310150	MTD.BASE/WASHDOWN/SLIDE VALVE	312427	0.00	0	0	0	0
310160	INSTALL PROCESS EQUIP.T-101	52752	0.00	0	0	0	0
310170	PIPING INSIDE T-101 FARM	422850	0.00	0	0	0	0
310180	ELECTRICAL IN T-101 FARM	739197	0.00	0	0	0	0
310190	HVAC IN T-101 FARM	985884	0.00	0	0	0	0
310210	GREEN HOUSE 103-FY	77844	0.00	0	0	0	0
310220	UPGRADE EXIST.PITS 103-FY	47864	0.00	0	0	0	0
310240	JUMPERS 103-FY	42897	0.00	0	0	0	0
310250	MTD. BASE/WASHDOWN/SLIDE VALVES	115949	0.00	0	0	0	0
310260	INSTALL PROCESS EQUIP. 103-FY	40849	0.00	0	0	0	0
310270	PIPING INSIDE 103-FY FARM	352308	0.00	0	0	0	0
310280	103-FY ELEC EQUIPMENT	130650	0.00	0	0	0	0
310320	TRANSFER PIPING T-101 TO 103-FY	22284725	0.00	0	0	0	0
310400	CONTROL RM/LUNCH RM/CHANGE RM	238451	0.00	0	0	0	0
310510	BURN OUT T-101	753152	0.00	0	0	0	0
310520	BURN OUT 103-FY	232969	0.00	0	0	0	0
310600	STEP OFF PAD.	276108	0.00	0	0	0	0
330110	PRE-TRANSFER DEMO. T-101	460343	0.00	0	0	0	0
330120	PRE-TRANSFER DEMO. 103-FY	115885	0.00	0	0	0	0
330210	POST-TRANSFER DEMO. T-101	1527428	0.00	0	0	0	0
330220	POST-TRANSFER DEMO. 103-FY	617988	0.00	0	0	0	0
330410	BURIAL FEES - PRE TRANSFER	141120	0.00	0	0	0	0
330420	BURIAL FEES - POST TRANSFER	606875	0.00	0	0	0	0
400000	WHC PROJECT MANAGEMENT	5386000	0.00	0	0	0	0
500010	WHC (OTHER COST)	20800000	0.00	0	0	0	0
PROJECT TOTAL		80,168,828		0	0	0	0

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241TLIM
FILE NO. 241TLIM

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #2 LIMITED SLUICING
DOE_R01 - PROJECT COST SUMMARY

DATE 03/22/93 14:12:15
BY GDR

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	22,900,000	34	7,700,000	30,600,000
600	UTILITIES	1,300,000	35	460,000	1,760,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	32,330,000	31	9,890,000	42,220,000
810	DEMOLITION	4,410,000	36	1,590,000	6,000,000
900	OTHER COSTS	21,810,000	30	6,540,000	28,350,000
	(ADJUSTED TO MEET DOE 5100.4)	-50,000		+20,000	-30,000
	PROJECT TOTAL	82,700,000	32	26,200,000	108,900,000

TYPE OF ESTIMATE	STUDY ESTIMATE	MARCH 22, 1993
ARCHITECT ENGINEER	gdr	
OPERATING CONTRACTOR		

REMARKS:

TOTAL RETERIEVAL ALTERNATIVE
OPTION #2 LIMITED SLUICING

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
111000	KEH ENGINEERING STUDY	780000	0	780000	0.00	0	780000	35	273000	1053000
112000	KEH CONCEPTUAL DESIGN	1400000	0	1400000	4.74	66360	1466360	35	513226	1979586
113000	KEH DEFINITIVE DESIGN	6950000	0	6950000	10.91	758245	7708245	35	2697886	10406131
114000	WHC D & D DESIGN	1000000	0	1000000	10.91	109100	1109100	35	388185	1497285
121000	KEH ENGINEERING/INSPECTION	4200000	0	4200000	16.43	690060	4890060	35	1711521	6601581
122000	WHC ENGR/INSPEC. D & D	571000	0	571000	10.91	62296	633296	35	221654	854950
SUBTOTAL 1	ENGINEERING	14901000	0	14901000	11.32	1686061	16587061	35	5805472	22392533
210160	T-101 PROCESS EQUIPMENT	1104950	0	1104950	10.91	120550	1225500	34	418463	1643963
210180	T-101 ELEC EQUIP.	934879	0	934879	10.91	101995	1036874	35	362906	1399780
210190	T-101 HVAC SKIDS	4005848	0	4005848	10.91	437038	4442886	25	1110722	5553608
SUBTOTAL 2101	T-101 PROCUREMENT	6045677	0	6045677	10.91	659583	6705260	28	1892091	8597351
210260	101-FY PROCESS EQUIPMENT	409640	0	409640	10.91	44692	454332	35	159016	613348
SUBTOTAL 2102	103-FY PROCUREMENT	409640	0	409640	10.91	44692	454332	35	159016	613348
SUBTOTAL 21	KEH PROCUREMENT	6455317	0	6455317	10.91	704275	7159592	29	2051107	9210699
SUBTOTAL 2	PROCUREMENT	6455317	0	6455317	10.91	704275	7159592	29	2051107	9210699
310110	GREENHOUSE T-101	113573	0	113573	16.43	18660	132233	25	33058	165291
310120	UPGRADE EXIST.PITS T-101	1829902	0	1829902	16.43	300653	2130555	35	745694	2876249
310140	JUMPERS T-101	85794	0	85794	16.43	14096	99890	35	34961	134851
310150	MTD.BASE/WASHDOWN/SLIDE VALVE	590727	0	590727	16.43	97056	687783	35	240724	928508
310160	INSTALL PROCESS EQUIP.T-101	116050	0	116050	16.43	19067	135117	35	47291	182408
310170	PIPING INSIDE T-101 FARM	675292	0	675292	16.43	110950	786242	35	275185	1061427
310180	ELECTRICAL IN T-101 FARM	757769	0	757769	16.43	124502	882271	35	308794	1191064
310190	HVAC IN T-101 FARM	985884	0	985884	16.43	161981	1147865	30	344359	1492224
SUBTOTAL 3101	T-101 SLUICING	5154991	0	5154991	16.43	846965	6001956	34	2030066	8032022
310210	GREEN HOUSE 103-FY	77844	0	77844	16.43	12790	90634	25	22658	113292
310220	UPGRADE EXIST.PITS 103-FY	47864	0	47864	16.43	7864	55728	40	22291	78019
310240	JUMPERS 103-FY	42897	0	42897	16.43	7048	49945	35	17481	67426

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER3415/241TLIM
FILE NO. 241TLIM

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #2 LIMITED SLUICING
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

DATE 03/22/93 14:04:08
BY GDR

WBS DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
310250 MTD. BASE/WASHDOWN/SLIDE VALVES	115949	0	115949	16.43	19050	134999	35	47250	182249
310260 INSTALL PROCESS EQUIP. 103-FY	40849	0	40849	16.43	6711	47560	35	16646	64207
310270 PIPING INSIDE 103-FY FARM	352308	0	352308	16.43	57884	410192	35	143567	553759
310280 103-FY ELEC EQUIPMENT	130650	0	130650	16.43	21467	152117	35	53241	205355
SUBTOTAL 3102 103 FY TANK FARM	808361	0	808361	16.43	132814	941175	34	323134	1264307
310320 TRANSFER PIPING T-101 TO 103-FY	15270833	0	15270833	16.43	2508997	17779830	30	5333949	23113780
SUBTOTAL 3103 ENCASED PIPE T-101/103-FY	15270833	0	15270833	16.43	2508997	17779830	30	5333949	23113780
310400 CONTROL RM/LUNCH RM/CHANGE RM	238451	0	238451	16.43	39178	277629	40	111051	388680
SUBTOTAL 3104 CONTROL RM./LUNCH/CHANGE RM	238451	0	238451	16.43	39178	277629	40	111051	388680
310510 BURN OUT T-101	753152	0	753152	16.43	123743	876895	35	306913	1183808
310520 BURN OUT 103-FY	232969	0	232969	16.43	38277	271246	35	94936	366182
SUBTOTAL 3105 BURN OUT	986121	0	986121	16.43	162020	1148141	35	401849	1549990
310600 STEP OFF PAD	276108	0	276108	16.43	45365	321473	30	96442	417914
SUBTOTAL 3106 STEP OFF PAD SUPPORT	276108	0	276108	16.43	45365	321473	30	96442	417914
SUBTOTAL 31 KEH CONSTRUCTION	22734865	0	22734865	16.43	3735339	26470204	31	8296491	34766693
330110 PRE-TRANSFER DEMO. T-101	460343	0	460343	4.74	21820	482163	35	168757	650921
330120 PRE-TRANSFER DEMO. 103-FY	115885	0	115885	4.74	5493	121378	35	42483	163861
SUBTOTAL 3301 PRE TRANSFER DEMOLITION	576228	0	576228	4.74	27313	603541	35	211240	814782
330210 POST-TRANSFER DEMO. T-101	1632411	0	1632411	28.08	458381	2090792	35	731777	2822569
330220 POST-TRANSFER DEMO. 103-FY	617988	0	617988	28.08	173531	791519	35	277032	1068551
SUBTOTAL 3302 POST TRANSFER DEMOLITION	2250399	0	2250399	28.08	631912	2882311	35	1008809	3891120

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
330410	BURIAL FEES - PRE TRANSFER	141120	0	141120	4.74	6689	147809	40	59124	206933
330420	BURIAL FEES - POST TRANSFER	605570	0	605570	28.08	170044	775614	40	310246	1085860
SUBTOTAL 3304	TOTAL BURIAL FEES	746690	0	746690	23.67	176733	923423	40	369370	1292793
SUBTOTAL 33	CONSTRUCTION-O/C	3573317	0	3573317	23.39	835958	4409275	36	1589419	5998695
SUBTOTAL 3	CONSTRUCTION	26308182	0	26308182	17.38	4571297	30879479	32	9885910	40765388
400000	WHC PROJECT MANAGEMENT	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
SUBTOTAL 4	PROJECT INTEGRATION	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
500010	WHC (OTHER COST)	18600000	0	18600000	17.25	3208500	21808500	30	6542550	28351050
SUBTOTAL 5	OTHER PROJECT COST	18600000	0	18600000	17.25	3208500	21808500	30	6542550	28351050
PROJECT TOTAL		71,650,499	0	71,650,499	15.49	11,099,218	82,749,717	32	26,179,565	108,929,281

WHC-EP-0873
Rev. 0

1. DOCUMENTS AND DRAWINGS
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DOCUMENTS: ENGINEERING EVALUATION OF ALTERNATEIVES - MANAGING THE ASSUMED LEAK FROM SINGLE SHELL TANK 241T-101 2/93.

DRAWINGS: IN SAME DOCUMENT AS ABOVE

2. MATERIAL PRICES
===============
UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES
===========
CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH. FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS
==
A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.

5. ESCALATION
==========
ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1992.

6. ROUNDING
=====================
U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE 1-11, DATED 10-31-84.

7. REMARKS
=======
1.) KEH DEFINITIVE DESIGN, FOR WORK PERFORMED BY KEH CONSTRUCTION, IS BASED ON 25% OF DIRECT PROCUREMENT AND CONSTRUCTION COSTS, LESS BURN-OUT COST.
2.) KEH E/I, ON WORK PERFORMED BY KEH CONSTRUCTION, IS BASED ON 15% OF DIRECT PROCUREMENT AND CONSTRUCTION COSTS, LESS BURNOUT.
3.) WHC DEFINITIVE DESIGN, FOR WORK PERFORMED BY WHC CONSTRUCTION, IS BASED ON 35% OF DIRECT D & D CONSTRUCTION COSTS, LESS BURIAL FEE ALLOWANCES.
4.) WHC E/I, ON WORK PERFORMED BY WHC CONSTRUCTION, IS BASED ON 20% OF DIRECT D & D CONSTRUCTION COSTS, LESS BURIAL FEE ALLOWANCES.
5.) KEH CONCEPTUAL DESIGN IS BASED ON 5% OF THE TOTAL ESTIMATED DIRECT COST OF KEH ENGINEERING AND CONSTRUCTION COST,
6.) WBS 5 (OTHER COST) COST ARE BASED ON 35% OF THE TOTAL DIRECT COST OF ENGINEERING, CONSTRUCTION, PROCUREMENT, AND ARE BASED ON A STUDY ESTIMATE ON C-106 RETREVIAL.

7. REMARKS (CONTINUED)
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7.) ASSUME THAT (2) TRANSFER PUMPS AND (1) HEEL PUMP WILL HAVE TO BE REMOVED AT T-101.
8.) THE EXISTING PITS AT T-101 AND 103-FY WILL BE UPGRADED PRIOR TO EQUIPMENT INSTALLATION. UPGRADING WILL INCLUDE LINING THE PITS WITH AN EPOXY SEALANT.
9.) WHC D & D OVERHEAD COSTS WERE APPLIED TO LABOR AT 52% BASED ON PROJECT W-151, DATED 04/30/90.
10.) WHC D & D OVERHEAD COSTS WERE APPLIED TO DIRECT MATERIAL PURCHASES AT 17.40%.
11.) KEH PROCUREMENT COSTS FOR THE HVAC EQUIPMENT ARE BASED ON A VENDOR SUPPLIED BUDGET ESTIMATE. HOWEVER, COSTS FOR SHIELDING WERE NOT INCLUDED IN THIS VENDOR QUOTE.
12.) KEH PROCUREMENT COSTS FOR TRANSFER PUMPS, SLUICE MAST AND SLUICE PUMP WERE ALLOWANCES EXTRACTED FROM PREVIOUS COST ESTIMATES THAT USED SIMILAR EQUIPMENT.
13.) BURN-OUT ALLOWANCES FOR SEALING OF THE PIT INTERIORS WITHIN T-101 TANK FARM WERE ASSUMED BY KEH (100 HR).
14.) BURN-OUT ALLOWANCES FOR SEALING OF THE PIT INTERIORS WITHIN 102-FY TANK FARM WERE ASSUMED BY KEH (50 HR).
15.) ALL BURN-OUT ALLOWANCES APPLY TO WORK PERFORMED BY KEH CONSTRUCTION ONLY. WORK PERFORMED BY WHC CONSTRUCTION ON THE PRE-TRANSFER & POST-TRANSFER D & D DOES NOT HAVE BURN-OUT ALLOWANCES CALCULATED.
16.) COSTS FOR THE WASHDOWN ASSEMBLIES, USED FOR RISERS, WERE EXTRACTED FROM AN EXISTING COST ESTIMATE FOR PROJECT W-151.
17.) COSTS FOR THE RECEIVER ASSEMBLIES, USED FOR EQUIPMENT REMOVAL, WERE EXTRACTED FROM AN EXISTING COST ESTIMATE FOR PROJECT W-151.
18.) BURIAL FEES, FOR LOW LEVEL WASTE, WERE BASED ON $72 PER CUBIC FOOT. ITEMS TO BE BURIED INCLUDE REMOVED PUMPS, ENCASED PIPE, HVAC EQUIPMENT, PIPING, VALVES, ETC.
19.) BURIAL FEES, FOR HAZARDOUS WASTE, WERE BASED ON $42 PER CUBIC YARD. (STEEL SHIELDING ONLY)
20.) THE CONCRETE TRENCH WAS ESTIMATED TO BE NON-CONTAMINATED AND WAS TRANSPORTED TO LAND FILL WITHOUT ANY BURIAL COST.
21.) IT WAS ASSUMED THAT A PORTABLE GREENHOUSE/GLOVEBOX WOULD BE USED FOR REMOVAL OF THE ENCASED PIPE.
22.) THE CONCRETE TRENCH WAS ESTIMATED AT 18" THICK WITH 120 LBS OF REBAR PER CUBIC YARD.
23.) THE USE OF CARBON STEEL, 4" THICK, WAS ESTIMATED FOR SHIELDING REQUIREMENTS AROUND THE SCRUBBER SKID AND FILTER HOUSING SKID.
24.) THIS ESTIMATE DID NOT ALLOW FOR SHIELDING AROUND THE FANS AND FILTER ROOM SKIDS AS REQUESTED BY WHC.
25.) ALL ENCASED PIPING, WITHIN THE TANK FARMS, WAS ROUTED IN THE CONCRETE TRENCH LOCATED ABOVE GRADE.
26.) THIS ESTIMATE DID NOT ALLOW FOR SHIELDING AROUND THE INTERCONNECTING DUCTS AT THE HVAC SKIDS AS REQUESTED BY WHC.
27.) ALL CONSTRUCTION ACTIVITIES BY KEH FORCES WERE FIGURED WITH 15% SWP ALLOWANCES EXCEPT THE AREAS WHERE MASK WORK WOULD BE REQUIRED AND THE INSTALLATION OF THE ENCASED PIPE FROM T-101 TO 103-FY.
28.) ASSUMPTIONS WERE MADE ON ALL QUANTITIES WHEN THE ESTIMATE WAS BASED ON FLOW DIAGRAMS & SKETCHES.
29.) ASSUMED (2) TRANSFER PUMPS WILL NEED TO BE REMOVED FROM 103-FY TANK FARM.
30.) THE T-101 PITS WILL BE SEALED WITH POLYURETHANE FOAM ONCE POST TRANSFER DEMOLITION HAS BEEN COMPLETED.
31.) THE HVAC PROCURED SKIDS WILL INCLUDE INSTRUMENTAION AND MUX.
32.) ELECTRICAL SKIDS WILL FURNISH POWER TO THE HVAC SKIDS BY SURFACE DUCTS AND CABLE.
33.) THE ESCALATION PERCENTAGES WERE BASED ON A PRELIMINARY SCHEDULE.
34.) THE ESTIMATE REFLECTS (2) ENCASED LINES BETWEEN TANK T-101 AND 103-FY, ONE TRANSFER LINE FROM T-101 TO 103-FY AND ONE SPARE.
35.) FOUR NEW SLUICE PITS WITH NEW 18" RISERS ARE INCLUDED IN THIS ESTIMATE.

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
111000	KEH ENGINEERING STUDY	780000	0	780000	0.00	0	780000	35	273000	1053000
112000	KEH CONCEPTUAL DESIGN	1400000	0	1400000	4.74	66360	1466360	35	513226	1979586
113000	KEH DEFINITIVE DESIGN	6950000	0	6950000	10.91	758245	7708245	35	2697886	10406131
114000	WHC D & D DESIGN	1000000	0	1000000	10.91	109100	1109100	35	388185	1497285
121000	KEH ENGINEERING/INSPECTION	4200000	0	4200000	16.43	690060	4890060	35	1711521	6601581
122000	WHC ENGR/INSPEC. D & D	571000	0	571000	10.91	62296	633296	35	221654	854950
400000	WHC PROJECT MANAGEMENT	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
TOTAL 000	ENGINEERING	20287000	0	20287000	12.89	2615146	22902146	34	7699998	30602144
600	UTILITIES									
210180	T-101 ELEC EQUIP.	934879	0	934879	10.91	101995	1036874	35	362906	1399780
310180	ELECTRICAL IN T-101 FARM	156342	0	156342	16.43	25687	182029	35	63710	245739
310280	103-FY ELEC EQUIPMENT	66371	0	66371	16.43	10905	77276	35	27046	104322
310400	CONTROL RM/LUNCH RM/CHANGE RM	4429	0	4429	16.44	728	5157	40	2063	7219
TOTAL 600	UTILITIES	1162021	0	1162021	11.99	139315	1301336	35	455725	1757060
700	SPECIAL EQUIP/PROCESS SYSTEMS									
210160	T-101 PROCESS EQUIPMENT	1104950	0	1104950	10.91	120550	1225500	34	418463	1643963
210190	T-101 HVAC SKIDS	4005848	0	4005848	10.91	437038	4442886	25	1110722	5553608
210260	101-FY PROCESS EQUIPMENT	409640	0	409640	10.91	44692	454332	35	159016	613348
310110	GREENHOUSE T-101	113573	0	113573	16.43	18660	132233	25	33058	165291
310120	UPGRADE EXIST.PITS T-101	1829902	0	1829902	16.43	300653	2130555	35	745694	2876249
310140	JUMPERS T-101	85794	0	85794	16.43	14096	99890	35	34961	134851
310150	MTD.BASE/WASHDOWN/SLIDE VALVE	590727	0	590727	16.43	97056	687783	35	240724	928508
310160	INSTALL PROCESS EQUIP.T-101	116050	0	116050	16.43	19067	135117	35	47291	182408
310170	PIPING INSIDE T-101 FARM	675292	0	675292	16.43	110950	786242	35	275185	1061427
310180	ELECTRICAL IN T-101 FARM	601427	0	601427	16.43	98815	700242	35	245084	945325
310190	HVAC IN T-101 FARM	985884	0	985884	16.43	161981	1147865	30	344359	1492224
310210	GREEN HOUSE 103-FY	77844	0	77844	16.43	12790	90634	25	22658	113292
310220	UPGRADE EXIST.PITS 103-FY	47864	0	47864	16.43	7864	55728	40	22291	78019
310240	JUMPERS 103-FY	42897	0	42897	16.43	7048	49945	35	17481	67426
310250	MTD. BASE/WASHDOWN/SLIDE VALVES	115949	0	115949	16.43	19050	134999	35	47250	182249

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
310260	INSTALL PROCESS EQUIP. 103-FY	40849	0	40849	16.43	6711	47560	35	16646	64207
310270	PIPING INSIDE 103-FY FARM	352308	0	352308	16.43	57884	410192	35	143567	553759
310280	103-FY ELEC EQUIPMENT	64279	0	64279	16.43	10562	74841	35	26195	101033
310320	TRANSFER PIPING T-101 TO 103-FY	15270833	0	15270833	16.43	2508997	17779830	30	5333949	23113780
310400	CONTROL RM/LUNCH RM/CHANGE RM	234022	0	234022	16.43	38450	272472	40	108988	381461
310510	BURN OUT T-101	753152	0	753152	16.43	123743	876895	35	306913	1183808
310520	BURN OUT 103-FY	232969	0	232969	16.43	38277	271246	35	94936	366182
310600	STEP OFF PAD	276108	0	276108	16.43	45365	321473	30	96442	417914
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	28028161	0	28028161	15.34	4300299	32328460	31	9891873	42220332
810	DEMOLITION									
330110	PRE-TRANSFER DEMO. T-101	460343	0	460343	4.74	21820	482163	35	168757	650921
330120	PRE-TRANSFER DEMO. 103-FY	115885	0	115885	4.74	5493	121378	35	42483	163861
330210	POST-TRANSFER DEMO. T-101	1632411	0	1632411	28.08	458381	2090792	35	731777	2822569
330220	POST-TRANSFER DEMO. 103-FY	617988	0	617988	28.08	173531	791519	35	277032	1068551
330410	BURIAL FEES - PRE TRANSFER	141120	0	141120	4.74	6689	147809	40	59124	206933
330420	BURIAL FEES - POST TRANSFER	605570	0	605570	28.08	170044	775614	40	310246	1085860
TOTAL 810	DEMOLITION	3573317	0	3573317	23.39	835958	4409275	36	1589419	5998695
900	OTHER COSTS									
500010	WHC (OTHER COST)	18600000	0	18600000	17.25	3208500	21808500	30	6542550	28351050
TOTAL 900	OTHER COSTS	18600000	0	18600000	17.25	3208500	21808500	30	6542550	28351050
PROJECT TOTAL		71,650,499	0	71,650,499	15.49	11,099,218	82,749,717	32	26,179,565	108,929,281

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #2 LIMITED SLUICING
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
ENGINEERING										
00	TECHNICAL SERVICES	14901000	0	14901000	11.32	1686061	16587061	35	5805472	22392533
19	WHC PROJECT MANAGEMENT	5386000	0	5386000	17.25	929085	6315085	30	1894526	8209611
	TOTAL ENGINEERING	20,287,000	0	20,287,000	12.89	2,615,146	22,902,146	34	7,699,998	30,602,144
CONSTRUCTION										
01	GENERAL REQUIRMENTS	2433519	0	2433519	17.53	426621	2860140	35	1008860	3868999
03	CONCRETE	5144	0	5144	16.43	845	5989	35	2096	8085
13	SPECIAL CONSTRUCTION	2077766	0	2077766	16.43	341377	2419143	36	861129	3280272
15	MECHANICAL	26225795	0	26225795	16.18	4243824	30469619	30	9273693	39743316
16	ELECTRICAL	2021275	0	2021275	13.01	262905	2284180	35	791239	3075415
20	OTHER COST	18600000	0	18600000	17.25	3208500	21808500	30	6542550	28351050
	TOTAL CONSTRUCTION	51,363,499	0	51,363,499	16.52	8,484,072	59,847,571	31	18,479,567	78,327,137
	PROJECT TOTAL	71,650,499	0	71,650,499	15.49	11,099,218	82,749,717	32	26,179,565	108,929,281

REFERENCE: ESTIMATE BASIS SHEET — PAGE 5 OF 13
COST CODE ACCOUNT SUMMARY — PAGE 7 OF 13

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE ASSOCIATED WITH EXPERIMENTAL/SPECIAL CONDITIONS SHOULD HAVE AN OVERALL RANGE OF 20% TO 50%.

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING

COST CODE 000

WBS 1.1.1.0.0.0
AN OVERALL AVERAGE OF 12% CONTINGENCY WAS APPLIED TO THE ENGINEERING STUDY ESTIMATE DUE TO THE COST TO DATE AND THE ESTIMATE TO COMPLETE CALCULATIONS.

WBS 1.1.2.0.0.0 THRU WBS 1.2.2.0.0.0
A 35% CONTINGENCY WAS APPLIED TO ALL REMAINING ENGINEERING FUNCTIONS DUE TO THE ALLOWANCES PROVIDED WERE BASED ON A PERCENTAGE OF CONSTRUCTION COSTS. ALSO, IT APPEARS THAT THE EVOLUTION OF DESIGN WILL INEVITABLY INCREASE DESIGN AND SCHEDULING COSTS DUE TO UNKNOWNS.

WBS 4.0.0.0.0.0
A 30% CONTINGENCY WAS APPLIED TO THE WHC PROJECT MANAGEMENT PORTION OF THE ENGINEERING ESTIMATE BY WESTINGHOUSE DIRECTION.

CONSTRUCTION

COST CODE 600

WBS 2.1.0.1.8.0
A 35% CONTINGENCY WAS APPLIED TO THE ELECTRICAL EQUIPMENT PROCUREMENT ITEMS DUE TO THE LIMITED AMOUNT OF INFORMATION AVAILABLE FOR THIS EFFORT.

WBS 3.1.0.1.8.0 & WBS 3.1.0.2.8.0
A 35% CONTINGENCY WAS ALSO APPLIED TO THE ELECTRICAL EQUIPMENT INSTALLATION DUE TO THE ASSUMPTIONS MADE FOR QUANTITIES AND INSTALLATION MATERIAL REQUIREMENTS.

WBS 3.1.0.4.0.0
A 40% CONTINGENCY WAS APPLIED TO THE CONTROL ROOM, CHANGE ROOM, AND LUNCH ROOM TRAILER ALLOWANCES DUE TO THE LIMITED INFORMATION AVAILABLE AT THIS TIME.

COST CODE 700

WBS 2.1.0.1.6.0 AND WBS 2.1.0.2.6.0
A 35% CONTINGENCY WAS APPLIED TO THE PUMPS, SLUICE MAST AND DISTRIBUTOR DISCHARGE SIPHON, DUE TO THE ALLOWANCES PROVIDED WERE EXTRACTED FROM PREVIOUS PARAMETRIC COST ESTIMATES FOR SIMILAR ITEMS.

WBS 2.1.0.1.9.0
A 25% CONTINGENCY WAS APPLIED TO THE HVAC EQUIPMENT DUE TO THE INFORMATION AND BUDGET QUOTE SUPPLIED BY A QUALIFIED VENDER.

WBS 3.1.0.1.1.0 & WBS 3.1.0.2.1.0
A 25% CONTINGENCY WAS APPLIED TO THE CONSTRUCTION COSTS OF BUILDING GREENHOUSE'S OVER THE PITS AND RISERS BECAUSE OF ASSUMPTIONS ASSOCIATED WITH THE SIZE AND STYLE REQUIRED.

WBS 3.1.0.1.2.0 & WBS 3.1.0.2.2.0
A 35% & 40% CONTINGENCY WAS APPLIED AGAINST THE CONSTRUCTION TASKS ASSOCIATED WITH THE UPGRADING OF THE EXISTING PITS BECAUSE OF UNKNOWN CONTAMINATION REQUIREMENTS AND LIMITED SCOPE DEFINITION.

WBS 3.1.0.1.4.0 & WBS 3.1.0.2.4.0
A 35% CONTINGENCY WAS APPLIED TO THE JUMPER FABRICATION COSTS DUE TO THE ALLOWANCES PROVIDED WERE EXTRACTED FROM PREVIOUS PARAMETRIC COST ESTIMATES FOR SIMILAR TASKS.

WBS 3.1.0.1.5.0 & WBS 3.1.0.2.5.0
A 35% CONTINGENCY WAS APPLIED TO THE WASHDOWN, MOUNTING BASE, AND SLIDE VALVE ASSEMBLY COSTS DUE TO THE ALLOWANCES PROVIDED WERE EXTRACTED FROM AN EXISTING CONCEPTUAL ESTIMATE WITH SIMILAR TASKS AND DIFFICULTIES.

WBS 3.1.0.1.6.0 & WBS 3.1.0.2.6.0
A 35% CONTINGENCY WAS APPLIED TO THE INSTALLATION OF THE TRANSFER EQUIPMENT DUE TO THE HIGHLY CONTAMINATED AREA WHERE CONSTRUCTION WILL MOST LIKELY BE DONE WITH REMOTELY OPERATED EQUIPMENT.

WBS 3.1.0.1.7.0 & WBS 3.1.0.2.7.0
A 35% CONTINGENCY WAS APPLIED TO ALL PIPING INSTALLATION COSTS WITHIN THE TANK FARM DUE TO THE TAKE-OFF QUANTITIES BEING EXTRACTED FROM FLOW DIAGRAMS WITHOUT DISTANCES REPRESENTED.

WBS 3.1.0.1.8.0 & WBS 3.1.0.2.8.0
A 35% CONTINGENCY WAS APPLIED TO ALL ELECTRICAL AND INSTRUMENTATION FUNCTIONS WITHIN THE TANK FARM DUE TO THE LIMITED AMOUNT OF INFORMATION AVAILABLE FOR THIS EFFORT.

WBS 3.1.0.1.9.0
A 30% CONTINGENCY WAS APPLIED TO THE INSTALLATION OF THE HVAC EQUIPMENT SKIDS AND INTERCONNECTING DUCTS DUE TO THE INSUFFICIENT INFORMATION SUPPLIED FOR SHIELDING REQUIREMENTS.

WBS 3.1.0.3.2.0
A 30% CONTINGENCY WAS APPLIED TO THE INSTALLATION OF ENCASED PIPING DUE TO THE UNKNOWNS ASSOCIATED WITH ROUTING OF PIPING FROM AN EXISTING TANK FARM, C-106, TO TANK FARM 102-AY.

WBS 3.1.0.4.0.0
A 40% CONTINGENCY WAS APPLIED TO THE CONTROL ROOM, CHANGE ROOM, AND LUNCH ROOM TRAILER ALLOWANCES DUE TO THE LIMITED INFORMATION AVAILABLE AT THIS TIME.

WBS 3.1.0.5.1.0 & WBS 3.1.0.5.2.0
A 35% CONTINGENCY WAS APPLIED TO THE ESTIMATED "BURN-OUT" DOLLARS, DUE TO THE INCONSISTENT AND LIMITED DETAIL AVAILABLE FOR AREAS THAT ARE CONSIDERED CONTAMINATED. FUTURE ESTIMATES SHOULD REFLECT INFORMATION DETAILING MR READINGS FOR SPECIFIC CONSTRUCTION AREAS.

WBS 3.1.0.6.0.0
A 30% CONTINGENCY WAS APPLIED TO COSTS ASSOCIATED WITH THE "STEP OFF PADS", FOR KEH CONSTRUCTION FORCES DUE TO THE LIMITED INFORMATION AVAILABLE AT THIS TIME FOR SCHEDULING ACTIVITIES. COSTS FOR "STEP OFF PADS" ARE GENERALLY CALCULATED BY MAN-LOADING SCHEDULE DURATIONS FOR SPECIFIC TASKS.

COST CODE 810

WBS 3.3.0.1.1.0 & WBS 3.3.0.1.2.0
A 35% CONTINGENCY WAS APPLIED TO THE D&D OF THE EXISTING PRE-TRANSFER EQUIPMENT DUE TO THE ALLOWANCES INCLUDED WITHIN THIS ESTIMATE WERE BASED ON AN EXISTING CONCEPTUAL DESIGN ESTIMATE (W-151).

WBS 3.3.0.2.1.0 & WBS 3.3.0.2.2.0
A 35% CONTINGENCY WAS APPLIED TO THE D&D OF THE POST-TRANSFER EQUIPMENT, CONCRETE TRENCH, AND ENCASED PIPING, DUE TO THE POTENTIAL PROBLEMS ASSOCIATED WITH CONTAMINATION.

WBS 3.3.0.4.1.0 & WBS 3.3.0.4.2.0
A 40% CONTINGENCY WAS APPLIED TO THE COST ALLOWANCES FOR BURIAL FEES DUE TO THE UNKNOWNS ASSOCIATED WITH HANDLING CONTAMINATED MATERIAL AND THE POTENTIAL OF INCREASED VOLUMES OF DISPOSABLE MATERIAL THAT IS NOT REFLECTED WITHIN THIS ESTIMATE.

COST CODE 900

WBS 5.0.0.0.1.0
AN OVERALL AVERAGE 30% CONTINGENCY WAS APPLIED AGAINST ALL WHC EXPENSE FUNDED ITEMS BY THEIR REQUEST.

** IEST - INTERACTIVE ESTIMATING **
TANK 241-T-101 TOTAL RETRIEVAL ALTERNATIVE
STUDY ESTIMATE OPTION #2 LIMITED SLUICING
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
111000	KEH ENGINEERING STUDY	780000	0.00	0	0	0	0
112000	KEH CONCEPTUAL DESIGN	1400000	0.00	0	0	0	0
113000	KEH DEFINITIVE DESIGN	6950000	0.00	0	0	0	0
114000	WHC D & D DESIGN	1000000	0.00	0	0	0	0
121000	KEH ENGINEERING/INSPECTION	4200000	0.00	0	0	0	0
122000	WHC ENGR/INSPEC. D & D	571000	0.00	0	0	0	0
210160	T-101 PROCESS EQUIPMENT	1104950	0.00	0	0	0	0
210180	T-101 ELEC EQUIP.	934879	0.00	0	0	0	0
210190	T-101 HVAC SKIDS	4005848	0.00	0	0	0	0
210260	101-FY PROCESS EQUIPMENT	409640	0.00	0	0	0	0
310110	GREENHOUSE T-101	113573	0.00	0	0	0	0
310120	UPGRADE EXIST.PITS T-101	1829902	0.00	0	0	0	0
310140	JUMPERS T-101	85794	0.00	0	0	0	0
310150	MTD.BASE/WASHDOWN/SLIDE VALVE	590727	0.00	0	0	0	0
310160	INSTALL PROCESS EQUIP.T-101 .	116050	0.00	0	0	0	0
310170	PIPING INSIDE T-101 FARM	675292	0.00	0	0	0	0
310180	ELECTRICAL IN T-101 FARM	757769	0.00	0	0	0	0
310190	HVAC IN T-101 FARM	985884	0.00	0	0	0	0
310210	GREEN HOUSE 103-FY	77844	0.00	0	0	0	0
310220	UPGRADE EXIST.PITS 103-FY	47864	0.00	0	0	0	0
310240	JUMPERS 103-FY	42897	0.00	0	0	0	0
310250	MTD. BASE/WASHDOWN/SLIDE VALVES	115949	0.00	0	0	0	0
310260	INSTALL PROCESS EQUIP. 103-FY	40849	0.00	0	0	0	0
310270	PIPING INSIDE 103-FY FARM	352308	0.00	0	0	0	0
310280	103-FY ELEC EQUIPMENT	130650	0.00	0	0	0	0
310320	TRANSFER PIPING T-101 TO 103-FY	15270833	0.00	0	0	0	0
310400	CONTROL RM/LUNCH RM/CHANGE RM	238451	0.00	0	0	0	0
310510	BURN OUT T-101	753152	0.00	0	0	0	0
310520	BURN OUT 103-FY	232969	0.00	0	0	0	0
310600	STEP OFF PAD	276108	0.00	0	0	0	0
330110	PRE-TRANSFER DEMO. T-101	460343	0.00	0	0	0	0
330120	PRE-TRANSFER DEMO. 103-FY	115885	0.00	0	0	0	0
330210	POST-TRANSFER DEMO. T-101	1632411	0.00	0	0	0	0
330220	POST-TRANSFER DEMO. 103-FY	617988	0.00	0	0	0	0
330410	BURIAL FEES - PRE TRANSFER	141120	0.00	0	0	0	0
330420	BURIAL FEES - POST TRANSFER	605570	0.00	0	0	0	0
400000	WHC PROJECT MANAGEMENT	5386000	0.00	0	0	0	0
500010	WHC (OTHER COST)	18600000	0.00	0	0	0	0
PROJECT TOTAL		71,650,499		0	0	0	0

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. Z031SAH1

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABLIZATION ALTERNATIVE
STUDY: OPTION 1-GEOMEMBRANE WALLS/JET GROUTING
DOE_R01 - PROJECT COST SUMMARY

DATE 03/22/93 07:00:24
BY GDR/KDE

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	2,650,000	20	530,000	3,180,000
	(ADJUSTED TO MEET DOE 5100.4)	50,000		-30,000	20,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	2,690,000	30	810,000	3,500,000
830	DRILLING	4,140,000	30	1,240,000	5,380,000
	(ADJUSTED TO MEET DOE 5100.4)	-30,000		50,000	20,000
	TOTAL ESTIMATED CONSTRUCTION COST	9,500,000		2,600,000	12,100,000
900	OTHER PROJECT COST	3,180,000	30	950,000	4,130,000
	(ADJUSTED TO MEET DOE 5100.4)	20,000		-50,000	-30,000
	TOTAL PROJECT COST	12,700,000	28	3,500,000	16,200,000

TYPE OF ESTIMATE	STUDY ESTIMATE	MARCH 22, 1993	REMARKS:
ARCHITECT ENGINEER	[signature]		
OPERATING CONTRACTOR			

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING) .

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN-ONSITE E/C	1406820	0	1406820	17.25	242676	1649496	20	329899	1979396
111000	CONCEPTUAL DESIGN-ONSITE E/C	281364	0	281364	5.52	15531	296895	20	59379	356274
120000	ENGINEERING/INSPECTION-ONSITE E/C	562728	0	562728	25.83	145353	708081	20	141616	849697
SUBTOTAL 1	ENGINEERING	2250912	0	2250912	17.93	403560	2654472	20	530894	3185367
210000	PROCUREMENT-ONSITE E/C	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
SUBTOTAL 2	PROCUREMENT	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
311000	SITE PREP	73485	0	73485	20.33	14939	88424	30	26528	114952
312000	JET GROUT CONE - HORIZONTAL WALL	2701959	0	2701959	20.33	549308	3251267	30	975380	4226648
313000	CLEANUP ACTIVITIES	88254	0	88254	20.33	17942	106196	30	31859	138054
SUBTOTAL 31	FA CONST-ONSITE E/C	2863698	0	2863698	20.33	582189	3445887	30	1033767	4479654
321000	VERTICAL WALL INSTALATION	460380	108784	569164	21.25	120947	690111	30	207033	897144
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	460380	108784	569164	21.25	120947	690111	30	207033	897144
SUBTOTAL 3	CONSTRUCTION	3324078	108784	3432862	20.48	703136	4135998	30	1240800	5376798
500001	OTHER PROJECT COST	2757367	0	2757367	15.34	422980	3180347	30	954104	4134451
SUBTOTAL 5	OTHER PROJECT COST	2757367	0	2757367	15.34	422980	3180347	30	954104	4134451
PROJECT TOTAL		10,635,557	108,784	10,744,341	17.85	1,917,765	12,662,106	28	3,533,185	16,195,292

1. DOCUMENTS AND DRAWINGS
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DOCUMENTS: WHC LETTER 9259343 DATED FEBRUARY 4, 1993

DRAWINGS: NONE

2. MATERIAL PRICES
===============
UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES
===========
CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS
==
A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.
B.) ONSITE CONTRACT ADMINISTRATION AND CONSTRUCTION MANAGEMENT COSTS, ASSOCIATED WITH THE OVERALL MANAGEMENT OF THE FIXED PRICE CONTRACTS, ARE INCLUDED AS A COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE (FOR BID PACKAGE PREP) BASED ON THE ESTIMATING FACTOR/BILLING SCHEDULE. THE TOTAL COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE ARE APPLIED AGAINST THE TOTAL FIXED PRICE CONTRACT AMOUNT WHICH IS REFLECTED ON THE KEH SUMMARY REPORT DOER07, INCLUDED WITH THIS ESTIMATE. (FINAL ESTIMATES MAY BE PARTIALLY MANLOADED AND INCLUDED WITHIN THE ESTIMATE DETAIL)
C.) FIXED PRICE CONTRACTOR OVERHEAD, PROFIT, BOND AND INSURANCE COSTS HAVE BEEN APPLIED AT THE FOLLOWING PERCENTAGES AND ARE REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL:
SUBCONTRACTS 20%

5. ESCALATION
==========
ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1993.

6. ROUNDING
=====================
U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE 1-11, DATED 10-31-84.

7. REMARKS
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A.) WORK INSIDE THE TANK FARM BY CF FORCES IS ASSUMED TO BE PERFORMED ON 25% SUPPLIED AIR. THE REMAINING 75% IS ASSUMED TO BE IN WHITES.
B.) IT IS ASSUMED THAT WORK ZONES WILL BE SET UP BY HPT'S PRIOR TO THE START OF CONSTRUCTION. AN ALLOWANCE OF 20 DAYS WAS USED FOR THIS ACTIVITY.
C.) AN ALLOWANCE IS USED FOR FINAL CLEANUP WITHIN THE TANK FARM AND THE DECON AND CLEANUP OF EQUIPMENT USED IN CONSTRUCTION.

D.) THE PLACEMENT OF THE HDPE WALL IS ASSUMED TO USE A SLURRY TRENCH METHOD. IT IS ASSUMED THAT THE WALL CANNOT BE PLACED BY THE USE OF VIBRATORY OR WATER JET METHODS OF INSTALLATION. THEREFORE THE WALL WILL BE CONSTRUCTED BY PLACING THE HDPE LINER IN A SLURRY TRENCH.
E.) ESTIMATE ASSUMES THAT THE PLACEMENT OF THE SLURRY TRENCH WILL NOT COMPROMISE THE INTEGRITY OF THE TANK OR NIEGHBORING TANKS.
F.) THE COST OF PLACING THE GEOMEMBRANE WALL IS A COMPOSITE USING AVAILABLE QUOTES FROM FIXED PRICE CONTRACTORS AND ADJUSTED TO REFLECT WORK ON THE HANFORD SITE.
G.) ESTIMATE ASSUMES THAT THIS WORK WILL BE DONE WITHOUT HINDERANCE FROM CONTAMINATION. IF SUBSURFACE CONTAMINATION IS ENCOUNTERED AND CF FORCES ARE BROUGHT IN TO DO THE WORK, THE COST OF CONSTRUCTION WILL INCREASE SUBSTANTIALLY.
H.) ENGINEERING AND OPC COSTS ARE BASED ON C-106 TOTAL RETRIEVAL ESTIMATE.
I.) OC PROJECT MANAGEMENT COSTS ARE INCLUDED IN THE OPC COSTS.
J.) AN ALLOWANCE WAS USED FOR PROCUREMENT OF EQUIPMENT RELATED TO THE INSTALLATION OF THE GEOMEMBRANE WALL.
K.) ESTIMATE CONTAINS NO ALLOWANCES FOR CHARACTERIZATION OR MONITORING WELLS.
L.) ESTIMATE HAS NO COST FOR DEMONSTRATION OR TESTING.
M.) AN ALLOWANCE FOR AN AUGER RIG IS USED TO SUPPLEMENT THE JET GROUT RIG WHEN UNDERGROUND OBSTRUCTIONS ARE ENCOUNTERED.
N.) IT IS ASSUMED THAT THE JET GROUT FLOOR WILL BE IN A CONE SHAPED CONFIGURATION UNDER THE TANK AND WILL BE ACCOMPLISHED BY SLANTED GROUT HOLES FOR THE JET GROUTING.
O.) THE GEOMEMBRANE WALL IS ASSUMED TO BE PLACED IN A CIRCULAR CONFIGURATION AROUND THE TANK.
P.) IT IS ASSUMED THAT THE JET GROUT CONE AND GEOMEMBRANE WALL WILL HAVE A COMPATIBLE INTERFACE.
Q.) ESTIMATE ASSUMES THAT THE CONSTRUCTION OF THE GEOMEMBRANE WALL BETWEEN TANKS IS FEASIBLE WITH THE LIMITED SPACE FOR CONSTRUCTION EQUIPMENT.
R.) NO ALLOWANCE FOR ESCORTS.

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	DEFINITIVE DESIGN-ONSITE E/C	1406820	0	1406820	17.25	242676	1649496	20	329899	1979396
111000	CONCEPTUAL DESIGN-ONSITE E/C	281364	0	281364	5.52	15531	296895	20	59379	356274
120000	ENGINEERING/INSPECTION-ONSITE E/C	562728	0	562728	25.83	145353	708081	20	141616	849697
TOTAL 000	ENGINEERING	2250912	0	2250912	17.93	403560	2654472	20	530894	3185367
700	SPECIAL EQUIP/PROCESS SYSTEMS									
210000	PROCUREMENT-ONSITE E/C	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
830	DRILLING									
311000	SITE PREP	73485	0	73485	20.33	14939	88424	30	26528	114952
312000	JET GROUT CONE - HORIZONTAL WALL	2701959	0	2701959	20.33	549308	3251267	30	975380	4226648
313000	CLEANUP ACTIVITIES	88254	0	88254	20.33	17942	106196	30	31859	138054
321000	VERTICAL WALL INSTALATION	460380	108784	569164	21.25	120947	690111	30	207033	897144
TOTAL 830	DRILLING	3324078	108784	3432862	20.48	703136	4135998	30	1240800	5376798
900	OTHER PROJECT COST									
500001	OTHER PROJECT COST	2757367	0	2757367	15.34	422980	3180347	30	954104	4134451
TOTAL 900	OTHER PROJECT COST	2757367	0	2757367	15.34	422980	3180347	30	954104	4134451
PROJECT TOTAL		10,635,557	108,784	10,744,341	17.85	1,917,765	12,662,106	28	3,533,185	16,195,292

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABLIZATION ALTERNATIVE
STUDY: OPTION 1-GEOMEMBRANE WALLS/JET GROUTING
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
ENGINEERING										
00	TECHNICAL SERVICES	2250912	0	2250912	17.93	403560	2654472	20	530894	3185367
	TOTAL ENGINEERING	2,250,912	0	2,250,912	17.93	403,560	2,654,472	20	530,894	3,185,367
CONSTRUCTION										
01	GENERAL REQUIRMENTS	700219	0	700219	20.33	142354	842573	30	252773	1095345
02	SITEWORK	2623859	108784	2732643	20.52	560782	3293425	30	988027	4281453
15	MECHANICAL	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
20	OPC	2757367	0	2757367	15.34	422980	3180347	30	954104	4134451
	TOTAL CONSTRUCTION	8,384,645	108,784	8,493,429	17.83	1,514,205	10,007,634	30	3,002,291	13,009,925
PROJECT TOTAL		10,635,557	108,784	10,744,341	17.85	1,917,765	12,662,106	28	3,533,185	16,195,292

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 9
COST CODE ACCOUNT SUMMARY — PAGE 5 OF 9

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 30% .

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING

COST CODE 000
WBS 110000, 111000, 120000 — A 20% CONTINGENCY WAS APPLIED TO THE ENGINEERING BECAUSE OF A LACK OF DETAIL REGARDING THE DESIGN, THE CONSTRUCTION AND THE FACT THAT IT IS BASED ON A PERCENTAGE OF CONSTRUCTION DOLLARS.

AVERAGE ENGINEERING CONTINGENCY 20%

CONSTRUCTION

COST CODE 700
WBS 210000 — A CONTINGENCY OF 30% WAS APPLIED TO PROCUREMENT AS THERE IS A LACK OF DETAIL CONCERNING THE EQUIPMENT REQUIRED FOR CONSTRUCTION AND THE EQUIPMENT REQUIREMENTS FOR THE OPERATION OF THE BARRIER.

WBS 321000 — A 30% CONTINGENCY WAS APPLIED TO THE FIXED PRICE CONSTRUCTION TO ACCOUNT FOR THE LACK OF DETAIL PROVIDED. POSSIBLE INTERUPRIONS DUE TO CONSTRUCTION WITHIN A TANK FARM, UNDEFINED SOIL CHARACTERISTICS THAT WOULD EFFECT CONSTRUCTION AND THE POSSIBILITY OF SUBSURFACE CONTAMINATION.

COST CODE 830
WBS 311000, 312000, 313000 — A CONTINGENCY OF 30% WAS APPLIED TO CF WORK TO ACCOUNT FOR LACK OF DETAIL AND THE POSSIBILITIES OF ENCOUNTERING SUBSURFACE CONTAMINATION.

AVERAGE CONSTRUCTION CONTINGENCY 30%

OTHER PROJECT COSTS

COST CODE 900
WBS 500001 A CONTINGENCY OF 30% WAS PLACED ON OTHER PROJECT COSTS AS IT IS A PERCENTAGE OF CONSTRUCTION AND IS DRIVEN BY THE SAME UNCERTAINTIES AS THE CONSTRUCTION.

AVERAGE PROJECT COST CONTINGENCY 30%

AVERAGE PROJECT CONTINGENCY 28%

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB. NO. ER-3415
FILE NO. 2031SAH1

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABLIZATION ALTERNATIVE
STUDY: OPTION 1-GEOMEMBRANE WALLS/JET GROUTING
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/22/93 07:00:36
BY GDR/KDE

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	DEFINITIVE DESIGN-ONSITE E/C	1406820	0.00	0	0	0	0
111000	CONCEPTUAL DESIGN-ONSITE E/C	281364	0.00	0	0	0	0
120000	ENGINEERING/INSPECTION-ONSITE E/C	562728	0.00	0	0	0	0
210000	PROCUREMENT-ONSITE E/C	2303200	0.00	0	0	0	0
311000	SITE PREP	73485	0.00	0	0	0	0
312000	JET GROUT CONE - HORIZONTAL WALL	2701959	0.00	0	0	0	0
313000	CLEANUP ACTIVITIES	88254	0.00	0	0	0	0
321000	VERTICAL WALL INSTALATION	460380	22.00	101284	7500	0	108784
500001	OTHER PROJECT COST	2757367	0.00	0	0	0	0
PROJECT TOTAL		10,635,557		101,284	7,500	0	108,784

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. Z031SA11

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABILIZATION ALTERNATIVE
STUDY: OPTION 2-SLURRY WALLS/JET GROUTING
DOE_R01 - PROJECT COST SUMMARY

DATE 03/22/93 07:01:27
BY GDR/KDE

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	2,640,000	20	530,000	3,170,000
	(ADJUSTED TO MEET DOE 5100.4)	-40,000		70,000	30,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	2,690,000	30	810,000	3,500,000
830	DRILLING	4,080,000	30	1,230,000	5,310,000
	(ADJUSTED TO MEET DOE 5100.4)	30,000		-40,000	-10,000
	TOTAL ESTIMATED CONSTRUCTION COST	9,400,000		2,600,000	12,000,000
900	OTHER PROJECT COST	3,160,000	30	950,000	4,110,000
	(ADJUSTED TO MEET DOE 5100.4)	40,000		-50,000	-10,000
	TOTAL PROJECT COST	12,600,000	28	3,500,000	16,100,000

TYPE OF ESTIMATE	STUDY ESTIMATE	MARCH 22, 1993
ARCHITECT ENGINEER		
OPERATING CONTRACTOR		

REMARKS:

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN-ONSITE E/C	1398075	0	1398075	17.25	241168	1639243	20	327849	1967092
111000	CONCEPTUAL DESIGN-ONSITE E/C	279615	0	279615	5.52	15435	295050	20	59010	354060
120000	ENGINEERING/INSPECTION-ONSITE E/C	559230	0	559230	25.83	144449	703679	20	140736	844415
SUBTOTAL 1	ENGINEERING	2236920	0	2236920	17.93	401052	2637972	20	527595	3165567
210000	PROCUREMENT-ONSITE E/C	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
SUBTOTAL 2	PROCUREMENT	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
311000	SITE PREP	73485	0	73485	20.33	14939	88424	30	26528	114952
312000	JET GROUT CONE - HORIZONTAL WALL	2701959	0	2701959	20.33	549308	3251267	30	975380	4226648
313000	CLEANUP ACTIVITIES	88254	0	88254	20.33	17942	106196	30	31859	138054
SUBTOTAL 31	FA CONST-ONSITE E/C	2863698	0	2863698	20.33	582189	3445887	30	1033767	4479654
321000	VERTICAL WALL INSTALLATION	425400	101088	526488	21.25	111879	638367	30	191510	829877
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	425400	101088	526488	21.25	111879	638367	30	191510	829877
SUBTOTAL 3	CONSTRUCTION	3289098	101088	3390186	20.47	694068	4084254	30	1225277	5309531
500001	OTHER PROJECT COST	2740226	0	2740226	15.40	421995	3162221	30	948666	4110887
SUBTOTAL 5	OTHER PROJECT COST	2740226	0	2740226	15.40	421995	3162221	30	948666	4110887
PROJECT TOTAL		10,569,444	101,088	10,670,532	17.85	1,905,204	12,575,736	28	3,508,925	16,084,661

1. DOCUMENTS AND DRAWINGS
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DOCUMENTS: WHC LETTER 9259343 DATED FEBRUARY 4, 1993

DRAWINGS: NONE

2. MATERIAL PRICES
===============
UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES
===========
CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS
==
A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.
B.) ONSITE CONTRACT ADMINISTRATION AND CONSTRUCTION MANAGEMENT COSTS, ASSOCIATED WITH THE OVERALL MANAGEMENT OF THE FIXED PRICE CONTRACTS, ARE INCLUDED AS A COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE (FOR BID PACKAGE PREP) BASED ON THE ESTIMATING FACTOR/BILLING SCHEDULE. THE TOTAL COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE ARE APPLIED AGAINST THE TOTAL FIXED PRICE CONTRACT AMOUNT WHICH IS REFLECTED ON THE KEH SUMMARY REPORT DOER07, INCLUDED WITH THIS ESTIMATE. (FINAL ESTIMATES MAY BE PARTIALLY MANLOADED AND INCLUDED WITHIN THE ESTIMATE DETAIL)
C.) FIXED PRICE CONTRACTOR OVERHEAD, PROFIT, BOND AND INSURANCE COSTS HAVE BEEN APPLIED AT THE FOLLOWING PERCENTAGES AND ARE REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL:
SUBCONTRACTS 20%

5. ESCALATION
=========
ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1993.

6. ROUNDING
====================
U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS
=======
A.) WORK INSIDE THE TANK FARM BY CF FORCES IS ASSUMED TO BE PERFORMED ON 25% SUPPLIED AIR. THE REMAINING 75% IS ASSUMED TO BE IN WHITES.
B.) IT IS ASSUMED THAT WORK ZONES WILL BE SET UP BY HPT'S PRIOR TO THE START OF CONSTRUCTION. AN ALLOWANCE OF 20 DAYS WAS USED FOR THIS ACTIVITY.
C.) AN ALLOWANCE IS USED FOR FINAL CLEANUP WITHIN THE TANK FARM AND THE DECON AND CLEANUP OF EQUIPMENT USED IN

D.) ESTIMATE ASSUMES THAT THE PLACEMENT OF THE SLURRY TRENCH WALL WILL NOT COMPROMISE THE INTEGRITY OF THE TANK OR THAT OF NIEGHBORING TANKS.
E.) IT IS ASSUMED THAT THE JET GROUT FLOOR WILL BE IN A CONE SHAPED CONFIGURATION UNDER THE TANK AND WILL BE ACCOMPLISHED BY SLANTED GROUT HOLES FOR THE JET GROUTING.
F.) THE SLURRY WALL IS ASSUMED TO BE PLACED IN A CIRCULAR CONGIGURATION AROUND THE TANK.
G.) IT IS ASSUMED THAT THE JET GROUT CONE AND SLURRY WALL WILL HAVE A COMPATIBLE INTERFACE.
H.) ESTIMATE ASSUMES THAT THE CONSTRUCTION OF THE SLURRY WALL BETWEEN TANKS IS FEASIBLE WITH THE LIMITED SPACE FOR CONSTRUCTION EQUIPMENT.
I.) THE COST OF PLACING THE SLURRY TRENCH WALL IS A COMPOSITE USING AVAILABLE QUOTES FROM FIXED PRICE CONTRACTORS AND ADJUSTED TO REFLECT WORK ON THE HANFORD SITE.
J.) ESTIMATE ASSUMES THAT THIS WORK WILL BE DONE WITHOUT HINDERANCE FROM CONTAMINATION. IF SUBSURFACE CONTAMINATION IS ENCOUNTERED AND CF FORCES ARE BROUGHT IN TO DO THE WORK, THE COST OF CONSTRUCTION WILL INCREASE SUBSTANTIALLY.
K.) ENGINEERING AND OPC COSTS ARE BASED ON C-106 TOTAL RETRIEVAL ESTIMATE.
L.) OC PROJECT MANAGEMENT COSTS ARE INCLUDED IN THE OPC COSTS.
M.) AN ALLOWANCE WAS USED FOR PROCUREMENT OF EQUIPMENT RELATED TO THE INSTALLATION OF THE GEOMEMBRANE WALL.
N.) ESTIMATE CONTAINS NO ALLOWANCES FOR CHARACTERIZATION OR MONITORING WELLS.
O.) ESTIMATE HAS NO COST FOR DEMONSTRATION OR TESTING.
P.) AN ALLOWANCE FOR AN AUGER RIG IS USED TO SUPPLEMENT THE JET GROUT RIG WHEN UNDERGROUND OBSTRUCTIONS ARE ENCOUNTERED.
Q.) ESTIMATE CONTAINS NO ALLOWANCE FOR ESCORTS.

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	DEFINITIVE DESIGN-ONSITE E/C	1398075	0	1398075	17.25	241168	1639243	20	327849	1967092
111000	CONCEPTUAL DESIGN-ONSITE E/C	279615	0	279615	5.52	15435	295050	20	59010	354060
120000	ENGINEERING/INSPECTION-ONSITE E/C	559230	0	559230	25.83	144449	703679	20	140736	844415
TOTAL 000	ENGINEERING	2236920	0	2236920	17.93	401052	2637972	20	527595	3165567
700	SPECIAL EQUIP/PROCESS SYSTEMS									
210000	PROCUREMENT-ONSITE E/C	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
830	DRILLING									
311000	SITE PREP	73485	0	73485	20.33	14939	88424	30	26528	114952
312000	JET GROUT CONE - HORIZONTAL WALL	2701959	0	2701959	20.33	549308	3251267	30	975380	4226648
313000	CLEANUP ACTIVITIES	88254	0	88254	20.33	17942	106196	30	31859	138054
321000	VERTICAL WALL INSTALLATION	425400	101088	526488	21.25	111879	638367	30	191510	829877
TOTAL 830	DRILLING	3289098	101088	3390186	20.47	694068	4084254	30	1225277	5309531
900	OTHER PROJECT COST									
500001	OTHER PROJECT COST	2740226	0	2740226	15.40	421995	3162221	30	948666	4110887
TOTAL 900	OTHER PROJECT COST	2740226	0	2740226	15.40	421995	3162221	30	948666	4110887
PROJECT TOTAL		10,569,444	101,088	10,670,532	17.85	1,905,204	12,575,736	28	3,508,925	16,084,66

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. Z031SA11

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABILIZATION ALTERNATIVE
STUDY: OPTION 2-SLURRY WALLS/JET GROUTING
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

DATE 03/22/93 07:01:37
BY GDR/KDE

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
ENGINEERING										
00	TECHNICAL SERVICES	2236920	0	2236920	17.93	401052	2637972	20	527595	3165567
	TOTAL ENGINEERING	2,236,920	0	2,236,920	17.93	401,052	2,637,972	20	527,595	3,165,567
CONSTRUCTION										
01	GENERAL REQUIRMENTS	700219	0	700219	20.33	142354	842573	30	252773	1095345
02	SITEWORK	2588879	101088	2689967	20.51	551714	3241681	30	972504	4214186
15	MECHANICAL	2303200	0	2303200	16.85	388089	2691289	30	807387	3498676
20	OPC	2740226	0	2740226	15.40	421995	3162221	30	948666	4110887
	TOTAL CONSTRUCTION	8,332,524	101,088	8,433,612	17.84	1,504,152	9,937,764	30	2,981,330	12,919,094
	PROJECT TOTAL	10,569,444	101,088	10,670,532	17.85	1,905,204	12,575,736	28	3,508,925	16,084,661

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 9
COST CODE ACCOUNT SUMMARY — PAGE 5 OF 9

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 30%.

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING

COST CODE 000
WBS 110000, 111000, 120000 — A 20% CONTINGENCY WAS APPLIED TO THE ENGINEERING BECAUSE OF A LACK OF DETAIL REGARDING THE DESIGN, THE CONSTRUCTION AND THE FACT THAT IT IS BASED ON A PERCENTAGE OF CONSTUCTION DOLLARS.

AVERAGE ENGINEERING CONTINGENCY 30%

CONSTRUCTION

COST CODE 700
WBS 210000 — A CONTINGENCY OF 30% WAS APPLIED TO PROCUREMENT AS THERE IS A LACK OF DETAIL CONCERNING THE EQUIPMENT REQUIRED FOR CONSTRUCTION AND THE EQUIPMENT REQUIREMENTS FOR THE OPERATION OF THE BARRIER.

WBS 321000 — A 30% CONTINGENCY WAS APPLIED TO THE FIXED PRICE CONSTRUCTION TO ACCOUNT FOR THE LACK OF DETAIL PROVIDED, POSSIBLE INTERUPTIONS DUE TO CONSTRUCTION WITHIN A TANK FARM, UNDEFINED SOIL CHARACTERISTICS THAT WOULD EFFECT CONSTRUCTION AND THE POSSIBILITY OF SUBSURFACE CONTAMINATION.

COST CODE 830
WBS 311000, 312000, 313000 — A CONTINGENCY OF 30% WAS APPLIED TO CF WORK TO ACCOUNT FOR LACK OF DETAIL AND THE POSSIBILITIES OF ENCOUNTERING SUBSURFACE CONTAMINATION.

OTHER PROJECT COST

COST CODE 900
WBS 500001

A CONTINGENCY OF 30% WAS PLACED ON OTHER PROJECT COSTS AS IT IS A PERCENTAGE OF CONSTRUCTION AND IS DRIVEN BY THE SAME UNCERTAINTIES AS THE CONSTRUCTION.

AVERAGE PROJECT COST CONTINGENCY 30%

AVERAGE PROJECT CONTINGENCY 28%

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. 2031SA11

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABILIZATION ALTERNATIVE
STUDY: OPTION 2-SLURRY WALLS/JET GROUTING
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/22/93 07:01:39
BY GDR/KDE

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	DEFINITIVE DESIGN-ONSITE E/C	1398075	0.00	0	0	0	0
111000	CONCEPTUAL DESIGN-ONSITE E/C	279615	0.00	0	0	0	0
120000	ENGINEERING/INSPECTION-ONSITE E/C	559230	0.00	0	0	0	0
210000	PROCUREMENT-ONSITE E/C	2303200	0.00	0	0	0	0
311000	SITE PREP	73485	0.00	0	0	0	0
312000	JET GROUT CONE - HORIZONTAL WALL	2701959	0.00	0	0	0	0
313000	CLEANUP ACTIVITIES	88254	0.00	0	0	0	0
321000	VERTICAL WALL INSTALLATION	425400	22.00	93588	7500	0	101088
500001	OTHER PROJECT COST	2740226	0.00	0	0	0	0
PROJECT TOTAL		10,569,444		93,588	7,500	0	101,088

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. Z031SAJ1

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABILIZATION ALTERNATIVE
STUDY: OPTION 3-GROUND FREEZING
DOE_R01 - PROJECT COST SUMMARY

DATE 03/22/93 07:27:15
BY GDR/KDE

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	4,130,000	20	830,000	4,960,000
	(ADJUSTED TO MEET DOE 5100.4)	-30,000		70,000	40,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	5,090,000	30	1,530,000	6,620,000
830	DRILLING	6,290,000	30	1,890,000	8,180,000
	(ADJUSTED TO MEET DOE 5100.4)	20,000		-20,000	0
	TOTAL ESTIMATED CONSTRUCTION COST	15,500,000		4,300,000	19,800,000
900	OTHER PROJECT COST	5,010,000	30	1,500,000	6,510,000
	(ADJUSTED TO MEET DOE 5100.4)	-10,000		0	-10,000
	TOTAL PROJECT COST	20,500,000	28	5,800,000	26,300,000

TYPE OF ESTIMATE	STUDY ESTIMATE	MARCH 22, 1993
ARCHITECT ENGINEER	[signature]	
OPERATING CONTRACTOR		

REMARKS:

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

241T101.EEA.1843

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN-ONSITE E/C	2189177	0	2189177	17.25	377633	2566810	20	513362	3080172
111000	CONCEPTUAL DESIGN-ONSITE E/C	437835	0	437835	5.52	24168	462003	20	92401	554404
120000	ENGINEERING/INSPECTION-ONSITE E/C	875671	0	875671	25.83	226186	1101857	20	220371	1322228
SUBTOTAL 1	ENGINEERING	3502683	0	3502683	17.93	627987	4130670	20	826134	4956804
210000	PROCUREMENT-ONSITE E/C	1698300	0	1698300	16.85	286164	1984464	30	595339	2579803
SUBTOTAL 2	PROCUREMENT	1698300	0	1698300	16.85	286164	1984464	30	595339	2579803
311000	SITE PREP	73485	0	73485	17.67	12984	86469	30	25941	112410
312000	PLACE BELOW GRADE PIPING	5183305	0	5183305	17.67	915890	6099195	30	1829759	7928953
313000	CLEANUP ACTIVITIES	88254	0	88254	17.67	15595	103849	30	31155	135003
SUBTOTAL 31	FA CONST-ONSITE E/C	5345044	0	5345044	17.67	944469	6289513	30	1886855	8176366
321000	ABOVE GRADE CONSTRUCTION	1713363	879138	2592501	19.87	515130	3107631	30	932289	4039920
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	1713363	879138	2592501	19.87	515130	3107631	30	932289	4039920
SUBTOTAL 3	CONSTRUCTION	7058407	879138	7937545	18.39	1459599	9397144	30	2819144	12216286
500001	OTHER PROJECT COST	4290786	0	4290786	16.78	719994	5010780	30	1503234	6514014
SUBTOTAL 5	OTHER PROJECT COST	4290786	0	4290786	16.78	719994	5010780	30	1503234	6514014
PROJECT TOTAL		16,550,176	879,138	17,429,314	17.75	3,093,744	20,523,058	28	5,743,851	26,266,907

1. DOCUMENTS AND DRAWINGS
=====================
DOCUMENTS: WHC LETTER 9259343 DATED FEBRUARY 4, 1993

DRAWINGS: NONE

2. MATERIAL PRICES
===============
UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL.

3. LABOR RATES
===========
CURRENT KEH BASE CRAFT RATES, AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92), INCLUDE FRINGE BENEFITS, LABOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE, PER HANFORD SITE STABILIZATION AGREEMENT, APPENDIX A (EFFECTIVE 9-2-91). NON CRAFT HOURLY RATES ARE BASED ON THE 1993 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEH FINANCE (EFFECTIVE 10-01-92).

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS
==
A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS, TECHNICAL SERVICES AND CRAFT OVERHEAD COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE, REVISION 14, DATED OCTOBER 01, 1992. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR, FOR THIS PROJECT, IS 93% FOR SHOP WORK AND 134% FOR FIELD WORK, WHICH IS REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL.
B.) ONSITE CONTRACT ADMINISTRATION AND CONSTRUCTION MANAGEMENT COSTS, ASSOCIATED WITH THE OVERALL MANAGEMENT OF THE FIXED PRICE CONTRACTS, ARE INCLUDED AS A COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE (FOR BID PACKAGE PREP) BASED ON THE ESTIMATING FACTOR/BILLING SCHEDULE. THE TOTAL COMPOSITE PERCENTAGE AND LUMP SUM ALLOWANCE ARE APPLIED AGAINST THE TOTAL FIXED PRICE CONTRACT AMOUNT WHICH IS REFLECTED ON THE KEH SUMMARY REPORT DOER07, INCLUDED WITH THIS ESTIMATE. (FINAL ESTIMATES MAY BE PARTIALLY MANLOADED AND INCLUDED WITHIN THE ESTIMATE DETAIL)
C.) FIXED PRICE CONTRACTOR OVERHEAD, PROFIT, BOND AND INSURANCE COSTS HAVE BEEN APPLIED AT THE FOLLOWING PERCENTAGES AND ARE REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL:
SUBCONTRACTS 15%

5. ESCALATION
==========
ESCALATION PERCENTAGES WERE CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, DATED FEBRUARY 1993.

6. ROUNDING
=====================
U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (GPP'S) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

7. REMARKS
=======
A.) WORK INSIDE THE TANK FARM IS ASSUMED TO BE PERFORMED ON 25% SUPPLIED AIR. THE REMAING 75% IS ASSUMED TO BE IN WHITES.
B.) IT IS ASSUMED THAT WORK ZONES WILL BE SET UP BY HPT'S PRIOR TO THE START OF CONSTRUCTION. AN ALLOWANCE OF 20 DAYS WAS USED FOR THIS ACTIVITY.
C.) AN ALLOWANCE IS USED FOR FINAL CLEANUP WITHIN THE TANK FARM AND THE DECON AND CLEANUP OF EQUIPMENT USED IN CONSTRUCTION.

D.) THE DEPTH OF THE FROZEN BARRIER AND THE CONFIGURATION OF THE BARRIER IS UNDEFINED. THERFORE, ALLOWANCES WERE USED FOR DRILLING DEPTHS, MATERIAL REQUIREMENTS AND REFRIGIRATION NEEDS.
E.) IT IS ASSUMED THAT VIBRATORY METHODS OF INSTALLATION FOR FREEZE WELLS IS NOT FEASIBLE IN CLOSE PROXIMITY TO THE TANKS. ESTIMATE ASSUMES THAT ALL UNDERGROUND PIPING WILL BE INSTALLED BY R/C AIR ROTARY DRILLING RIGS.
F.) ESTIMATE ASSUMES THE USE OF CARBON STEEL WELL CASING FOR THE FREEZE WELLS.
G.) ESTIMATE ASSUMES THE USE OF PVC PIPE FOR THE MONITORING WELLS, THE TEST WELLS AND THE INNER RETURN PIPING FOR THE FREEZE PIPE.
H.) ESTIMATE ASSUMES THE USE OF CARBON STEEL PIPE FOR THE ABOVE GROUND PIPING SYSTEM.
I.) IT IS ASSUMED TH.T UNDERGROUND OBSTRUCTIONS IN THE TANK FARM CAN BE AVOIDED BY PROPER PLACEMENT OF THE FREEZE WELLS.
J.) THE COST OF THE ABOVE GROUND PIPING AND REFRIGERATION EQUIPMENT INSTALLATION IS A COMPOSITE USING AVAILABLE QUOTES FROM FIXED PRICE CONTRACTORS AND ADJUSTED TO REFLECT WORK ON THE HANFORD SITE.
K.) ESTIMATE ASSUMES THAT THIS WORK WILL BE DONE WITHOUR HINDERANCE FROM CONTAMINATION. IF SURFACE CONTAMINATION IS ENCOUNTERED AND CF FORCES ARE BROUGHT IN TO DO THE WORK, THE COST OF CONSTRUCTION WILL INCREASE SUBSTANTIALLY.
L.) ENGINEERING AND OPC COSTS ARE BASED ON C-106 TOTAL RETRIEVAL ESTIMATE.
M.) OC PROJECT MANAGEMENT COSTS ARE INCLUDED IN THE OPC COSTS.
N.) ESTIMATE CONTAINS NO ALLOWANCE FOR CHARACTERIZATION WELLS.
O.) ESTIMATE HAS NO COST FOR DEMONSTRATION OR TESTING.
P.) NO ALLOWANCE FOR ESCORTS IS INCLUDED IN ESTIMATE.
Q.) WITH THE CLOSE PROXIMITY OF NEIGHBORING TANKS, THE INSTALLATION OF A FREEZE BARRIER OF ADEQUATE THICKNESS IS IN QUESTION.
R.) ESTIMATE CONTAINS THE COST FOR THE INITIAL FREEZE DOWN PERIOD OF THE BARRIER.
S.) ESTIMATE DOES NOT INCLUDE THE 30 YEAR POWER COSTS ASSOCIATED WITH MAINTAINING THE BARRIER OVER ITS LIFE SPAN.
T.) ESTIMATE INCLUDES AN 8% ROYALTY FOR CRYOCELL'S PATENT ON GROUND FREEZEING TECHNOLOGY. THIS IS IN THE INDIRECTS FOR THE FIXED PRICE CONSTRUCTION. THE ROYALTY APPLIES TO CONSTRUCTION COSTS FOR INSTALLING THE BARRIER.

COST CODE/WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	DEFINITIVE DESIGN-ONSITE E/C	2189177	0	2189177	17.25	377633	2566810	20	513362	3080172
111000	CONCEPTUAL DESIGN-ONSITE E/C	437835	0	437835	5.52	24168	462003	20	92401	554404
120000	ENGINEERING/INSPECTION-ONSITE E/C	875671	0	875671	25.83	226186	1101857	20	220371	1322228
TOTAL 000	, ENGINEERING	3502683	0	3502683	17.93	627987	4130670	20	826134	4956804
700	SPECIAL EQUIP/PROCESS SYSTEMS									
210000	PROCUREMENT-ONSITE E/C	1698300	0	1698300	16.85	286164	1984464	30	595339	2579803
321000	ABOVE GRADE CONSTRUCTION	1713363	879138	2592501	19.87	515130	3107631	30	932289	4039920
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEM	3411663	879138	4290801	18.67	801294	5092095	30	1527628	6619723
830	DRILLING									
311000	SITE PREP	73485	0	73485	17.67	12984	86469	30	25941	112410
312000	PLACE BELOW GRADE PIPING	5183305	0	5183305	17.67	915890	6099195	30	1829759	7928953
313000	CLEANUP ACTIVITIES	88254	0	88254	17.67	15595	103849	30	31155	135003
TOTAL 830	DRILLING	5345044	0	5345044	17.67	944469	6289513	30	1886855	8176366
900	OTHER PROJECT COST									
500001	OTHER PROJECT COST	4290786	0	4290786	16.78	719994	5010780	30	1503234	6514014
TOTAL 900	OTHER PROJECT COST	4290786	0	4290786	16.78	719994	5010780	30	1503234	6514014
PROJECT TOTAL		16,550,176	879,138	17,429,314	17.75	3,093,744	20,523,058	28	5,743,851	26,266,907

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. Z031SAJ1

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABILIZATION ALTERNATIVE
STUDY: OPTION 3-GROUND FREEZING
DOE_R05 - ESTIMATE SUMMARY BY CSI DIVISION

DATE 03/22/93 07:27:24
BY GDR/KDE

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	ENGINEERING									
00	TECHNICAL SERVICES	3502683	0	3502683	17.93	627987	4130670	20	826134	4956804
	TOTAL ENGINEERING	3,502,683	0	3,502,683	17.93	627,987	4,130,670	20	826,134	4,956,804
	CONSTRUCTION									
01	GENERAL REQUIRMENTS	862434	0	862434	17.67	152392	1014826	30	304448	1319273
02	SITEWORK	4482610	0	4482610	17.67	792077	5274687	30	1582407	6857093
15	MECHANICAL	3411663	879138	4290801	18.67	801294	5092095	30	1527628	6619723
20	OPC	4290786	0	4290786	16.78	719994	5010780	30	1503234	6514014
	TOTAL CONSTRUCTION	13,047,493	879,138	13,926,631	17.71	2,465,757	16,392,388	30	4,917,717	21,310,103
	PROJECT TOTAL	16,550,176	879,138	17,429,314	17.75	3,093,744	20,523,058	28	5,743,851	26,266,907

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. Z031SAJ1

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABILIZATION ALTERNATIVE
STUDY: OPTION 3-GROUND FREEZING
DOE_R06 - CONTINGENCY ANALYSIS BASIS SHEET

PAGE 7 OF 9
DATE 03/22/93 10:55:29
BY GDR/KDE

REFERENCE: ESTIMATE BASIS SHEET — PAGE 3 OF 9
COST CODE ACCOUNT SUMMARY — PAGE 5 OF 9

THE U.S. DEPARTMENT OF ENERGY - RICHLAND ORDER 5700.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-85, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A STUDY ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 20 TO 30%.

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING

COST CODE 000 WBS 110000, 111000, 120000	A 20% CONTINGENCY WAS APPLIED TO THE ENGINEERING BECAUSE OF A LACK OF DETAIL REGARDING THE DESIGN, THE CONSTRUCTION AND THE FACT THAT IT IS BASED ON A PERCENTAGE OF CONSTRUCTION DOLLARS.

AVERAGE ENGINEERING CONTINGENCY 20%

CONSTRUCTION

COST CODE 700 WBS 210000	A CONTINGENCY OF 30% WAS APPLIED TO PROCUREMENT AS THERE IS A LACK OF DETAIL CONCERNING THE EQUIPMENT REQUIRED FOR CONSTRUCTION AND THE EQUIPMENT REQUIREMENTS FOR THE OPERATION OF THE BARRIER.
WBS 321000	A 30% CONTINGENCY WAS APPLIED TO THE FIXED PRICE CONSTRUCTION TO ACCOUNT FOR THE LACK OF DETAIL PROVIDED, POSSIBLE INTERUPTIONS DUE TO CONSTRUCTION WITHIN A TANK FARM, UNDEFINED SOIL CHARACTERISTICS THAT WOULD EFFECT CONSTRUCTION AND THE POSSIBILITY OF SURFACE CONTAMINATION.
COST CODE 830 WBS 311000, 312000, 313000	A CONTINGENCY OF 30% WAS APPLIED TO CF WORK TO ACCOUNT FOR LACK OF DETAIL AND THE POSSIBILITIES OF ENCOUNTERING SUBSURFACE CONTAMINATION.

AVERAGE CONSTRUCTION CONTINGENCY 30%

OTHER PROJECT COSTS

COST CODE 900
WBS 500001 A CONTINGENCY OF 30% WAS PLACED ON OTHER PROJECT COSTS AS IT IS A PERCENTAGE OF CONSTRUCTION AND IS DRIVEN BY THE SAME UNCERTAINTIES AS THE CONSTRUCTION.

AVERAGE PROJECT COST CONTINGENCY 30%

AVERAGE PROJECT CONTINGENCY 28%

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. ER-3415
FILE NO. 2031SAJ1

** IEST - INTERACTIVE ESTIMATING **
241-T-101 EXTERNAL TANK STABILIZATION ALTERNATIVE
STUDY: OPTION 3-GROUND FREEZING
DOE_R07 - ONSITE INDIRECT COSTS BY WBS

DATE 03/22/93 07:27:26
BY GDR/KDE

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	DEFINITIVE DESIGN-ONSITE E/C	2189177	0.00	0	0	0	0
111000	CONCEPTUAL DESIGN-ONSITE E/C	437835	0.00	0	0	0	0
120000	ENGINEERING/INSPECTION-ONSITE E/C	875671	0.00	0	0	0	0
210000	PROCUREMENT-ONSITE E/C	1698300	0.00	0	0	0	0
311000	SITE PREP	73485	0.00	0	0	0	0
312000	PLACE BELOW GRADE PIPING	5183305	0.00	0	0	0	0
313000	CLEANUP ACTIVITIES	88254	0.00	0	0	0	0
321000	ABOVE GRADE CONSTRUCTION	1713363	16.00	274138	15000	590000	879138
500001	OTHER PROJECT COST	4290786	0.00	0	0	0	0
PROJECT TOTAL		16,550,176		274,138	15,000	590,000	879,138

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