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WIPP Conceptual Design Report

Addendum J: Conceptual Design Report of Support Equipment in the High Level Waste Facility of the Waste Isolation Pilot Plant By Aerojet Manufacturing Company, Fullerton, California (AMCO 1948-76-01).

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FOREWORD

Subsequent to the completion of this report, the layout for the remote handling waste facility was changed. A review was accomplished to determine what changes were necessary to the conceptual design, the time-motion study and the cost estimate. The decontamination ("decon") station was modified to include an option for either high-pressure water or wire-brush decontamination at each station. The previous design had two separate systems without the option for either method. The time-motion study was revised to account for the new layout, which provides dead-end access to the hot cell (the old layout provided passthrough access). Finally, the cost estimate was reviewed for the new layout. All necessary changes are reflected in the main report or in the cost-estimate addendum. No changes have been made to this addendum.

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IN THE HIGH LEVEL WASTE FACILITY OF THE WASTE
ISOLATION PILOT PLANT

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TABLE OF CONTENTS

	PAGE
INTRODUCTION	1
SECTION 1 REVIEW AND EVALUATION	2
A. Design Criteria	2
1. Rate of Waste Receival	2
2. Canister Decontamination	2
2.1 Decontamination Method Evaluation	3
2.2 Recommendation	7
3. Shipping Casks	8
4. Safety Systems/Features	8
5. Assumptions	8
B. Concept Designs	9
1. Overpack Weld Equipment	9
2. Cask Vehicle and Pallet	9
3. Cask Elevator	9
4. Canister Decontamination Equipment	9
C. Hot Cell	10
1. Layout	10
2. Time and Motion Study	10
SECTION 2 DESIGN DESCRIPTIONS	12
A. Overpack Weld Equipment	12
B. Cask Vehicle	14
C. Cask Elevator	15
D. Pallets	15

TABLE OF CONTENTS (cont'd)

	PAGE
E. Decontamination Equipment	16
1. High Pressure Water Decontamination System	16
2. Wire Brush Decontamination System	17
F. Hot Cell	19
1. Main Cell	19
2. Clean Cell	22
3. Air Lock	23
4. Cell Equipment	23
SECTION 3 SCHEDULES & COST ESTIMATES	25
Equipment Schedules	29
Cost Summary	30
APPENDICES	
APPENDIX A Concept Drawings	
APPENDIX B Cost Backup Data	

INTRODUCTION

The Aerojet Manufacturing Company (AMCO) received a contract in November 1976 to provide consulting services in assisting Holmes and Narver, Incorporated, with the conceptual designs, cost estimates, and schedules of equipment used to handle waste casks, to decontaminate waste canisters and to overpack damaged or highly contaminated waste canisters for the Waste Isolation Pilot Plant (WIPP). Also, the layout of the hot cell in which canister handling, overpack and decontamination takes place was to be reviewed along with the Time and Motion Study of the cell operations.

This report has been prepared to present the results of the efforts and contains all technical and planning data developed during the program. The contents of this report are presented in three sections:

SECTION 1

This section contains the comments on the existing design criteria, equipment conceptual designs, hot cell design and Time and Motion Studies of projected hot cell activities.

SECTION 2

This section contains the design descriptions of the equipment concepts and justification for varying from the existing concept (if a variation occurred). Drawings of each concept are provided in Appendix A. These design descriptions and drawings were used as the basis for the cost estimates.

SECTION 3

This section contains the schedule projections and cost estimates for the equipment described in Section 2. Detail cost estimate backup data is provided in Appendix B.

SECTION 1
REVIEW AND EVALUATION

A. DESIGN CRITERIA

The existing design criteria has been reviewed to verify that facilities and equipment can be designed to meet the criteria. The following comments and recommendations resulted from the review:

1. Rate of Waste Receival

The receival rate of 77 canisters per week appears feasible for cask and canister handling operations for this facility on a one shift basis. Any increases in receival will require extra shift operations. One shift per day should be established as a maintenance shift.

2. Canister Decontamination

Since waste must be shipped from other facilities to the WIPP, the waste must be canisterized at the shipping location. The canister must be decontaminated by the shipper prior to installation into a shipping cask. This decontamination could be done by electropolishing which improves the outer finish on the canister and makes subsequent decontamination easier and more efficient. Canisters filled with molten waste will be prestressed during the filling operation and liquid quenching during decontamination will cause little or no further damage.

2. (continued)

Decontamination of either hot or cold canisters will create large quantities of water vapors that must be contained. Since air cooling high level waste canisters may only lower the surface temperature to 200°F, it may be more practical to decontaminate hot canisters rather than trying to partially cool them.

The 4-foot by 12-foot space suggested for decontamination will not be sufficient. It is recommended that the decontamination take place in cells located below the hot cell. Two decontamination cells have been conceived, each cell being 8-feet wide by 20-feet long by 17-feet high. Access to these cells must be made available from the main hot cell and the clean hot cell. In the main cell, a floor space of 16-feet by 8-feet is required and in the clean cell, a space 16-feet by 6-feet is required. (See Drawing 94296-A3 for the layout.)

2.1 Decontamination Method Evaluation

The design criteria listed Battelle Northwest Laboratories and the Atlantic Richfield Company in Hanford as having had experience with decontamination of high-level waste canisters.

In the evaluation, AMCO obtained information from the following:

Battelle Northwest Laboratories	- Wire brushing, high
Richland, Washington	pressure water,
	chemical and electro-
	polishing.

2.1 (continued)

Atlantic Richfield Company - Richland, Washington	Electro-polishing and high pressure water.
Electromatic Incorporated - Hollywood, California	Electro-Polishing (this company pioneered electro- polishing for Sandia)
Turco Product Division - Los Angeles, California	Chemical
Spiral Brush Industries Hudson, Ohio	Wire brushes

The following assumptions were used in this evaluation:

- A. The canisters will be decontaminated prior to shipment.
- B. The shipping cask will be decontaminated to a non-smearable level prior to usage.
- C. Fresh coolant will be used for each shipment.
- D. The waste canister exterior surfaces may be contaminated by the following means:
 - o Liquid coolant transfer from leaking canister in the same cask shipment.
 - o Direct transfer from dirty cask or coolant to canister.
 - o Direct transfer from hot cell equipment to canister.
 - o Airborne transfer in hot cell.

The cleaning approaches which were considered and the impact each would have on the facility and cycle time are:

A. Mechanical	<u>Size</u>	<u>Cycle Time</u>
1. Wire brushing and water.	1 cell	1 - 16 hours
2. High-pressure water spray.	1 cell	20 min.

2.1 (continued)	<u>Size</u>	<u>Cycle Time</u>
B. Chemical		
1. Two-step.	2 lines of 4 tanks.	2 hours
2. Three-step.	2 lines of 5 tanks.	2 ½ hours
C. Electro-polishing (deplating)	3 tanks.	20 min.

Evaluation of the three methods provide the following comparison:

A-1 Wire Brushing with Water

Advantages:

1. Reasonable space and handling requirements.
2. No radioactive chemicals to complicate disposal.
3. Moderate heat load, reasonable power requirements.

Disadvantages:

1. Top head coverage is inferior
2. Brush maintenance is expensive and time-consuming.
3. Debris from brushes and worn brushes require disposal.
4. Unpredictable cycle time.

A-2 High Pressure Water Spray

Advantages:

1. Simple equipment and operation.
2. Low tankage and ducting maintenance since no chemicals are used.
3. No chemicals to complicate disposal.
4. Water can be recycled.
5. Least material in filters and lowest disposal cost.
6. Can be done with cask vertical.

A-2 (continued)

Disadvantages:

1. Will not remove oven stains and welding scale.
2. Requires a smooth surface finish and a thorough cleaning to have been done at the reprocessing plant.
3. Does not remove metal or improve surface finish.

B. Chemical Cleaning (Two and Three Step)

Advantages:

1. Established procedures which should be effective in this application.
2. Good coverage with uniform cleaning action.

Disadvantages:

1. Two and 1/2 hour cycle time requires 2 lines of 5 tanks each.
2. Equipment size will reflect on hot cell size.
3. High temperature in process baths will cause cooling and venting problems.
4. Support points must be shifted to clean 100% of surface.

C. Electro-Polishing (Deplating)

Advantages

1. Improved finish will lessen dirt adherence and increase resistance to chemical attack.
2. Controlled removal of material.
3. Compatible cycle time of 15 - 20 minutes will enable single line to handle 77 units in 40 hours.

C. (continued)

Disadvantages

1. Acid electrolyte will cause high maintenance.
2. Large special power requirement (10,000 amps at 10 VDC).
3. Requires pre-treatment degreasing and post-treatment rinse.
4. Requires cooling coils in electrolyte.
5. Process will require extensive development for high-speed, large item cleaning.
6. Support points and electrodes must be shifted to clean 100% of surface.

2.2 Recommendation

High pressure water spray is recommended as the decontamination method to clean expected smearable contamination on 99 + % of the casks. The backup or second cleaning station is recommended to have wire brushes with low pressure water. The occasional use of the slower method can be continued on extra shifts as necessary to handle a bad batch of canisters from a contaminated multi-element cask. The wire brush unit can be held on standby with little cost until it is needed. The water clean-up and disposal system will be similar to that of the high-pressure system and can be used as a spare.

The major reasons for the high pressure water system recommendation are:

- (1) Based on the information available, the high pressure water spray method will provide satisfactory decontamination. Even though it appears that

2.2 (1) (continued)

high pressure water will remove smearable contamination, it is recommended that a development program be conducted to verify this method. The development program could provide sufficient data to eliminate the backup wire brush station allowing two full time operating stations to be in the facility. The development program will also provide the design criteria that will be required for design of the plant equipment.

- (2) To avoid the high investment and operational costs of the electro-polish or chemical clean-up systems. The cost differences are due to increased space requirements (horizontal handling and multiple tanks), heat and vapor removal from hot liquids tankage, high maintenance due to corrosive chemicals, and high chemical waste disposal costs.

3. Shipping Cask

The reference casks are adequate for the conceptual design, however, prior to starting preliminary design the cask configuration should be well defined.

4. Safety Systems/Features

Radiation monitors are required at all locations in the facility, not only in air lock entrances and exists.

5. Assumptions

During a meeting between AMCO and Holmes and Narver personnel on November 8, 1976, decontamination of all canisters became one of the design criteria.

B. CONCEPT DESIGNS

1. Overpack Weld Equipment

No concept for this equipment was furnished to AMCO. Section 2 contains a description of the equipment recommended by AMCO.

2. Cask Vehicle on Pallet

The Holmes and Narver cask vehicle concept is satisfactory. Special attention to the wheel and rail design for fatigue and seismic loading will be necessary.

3. Cask Elevator

The Holmes and Narver cask elevator concept is satisfactory. AMCO has developed the concept further in Section 2 for seismic loading.

4. Canister Decontamination Equipment

No concept for this equipment was furnished to AMCO. Section 2 contains a description of the equipment recommended by AMCO.

C. HOT CELL

1. Layout

The hot cell as conceived by Holmes and Narver has no provisions to prevent the spread of contamination throughout the facility. In a long term operating facility, contamination level will build up regardless of how small the amount seems to be each time a transfer is made. The hot cell itself can be decontaminated but other areas, such as the mine and mine shaft, would be very difficult to decontaminate. AMCO has included in Section 2 of this report, a cell layout that should provide the necessary barriers to prevent the spread of contamination and still allow the required daily throughput of waste canisters. The existing cell also did not show exit air flow HEPA filters which do require considerable floor space. These have been included in the new layout.

2. Time and Motion Study

This study was reviewed with respect to the amount of time required to perform individual operations. The times used in the study for the various operations appear to be quite reasonable assuming that the operating personnel are experienced with at least two years of hot cell operating experience. One area where the time allocated appears to be erroneous is in the cask head removal and installation. Even though most of the head bolts have been removed during cask preparation and only a few are removed and reinstalled in the cell, the allotment of less than ten minutes for each operation seems to be low. However, the

2. (continued)

overall canister throughput of 15 per day requires only that one canister be processed every half hour and this does not seem unreasonable. Overpack operations should have little effect on the overall cell operation since this operation will be performed independently of other canister handling operations. The total time required to set up and weld the cover on the overpack canister will be between 1.5 and 2 hours each.

The Holmes and Narver Time and Motion Study that assumes waste is delivered in 110 ton casks with 100 percent of all canisters contaminated was used in this evaluation.

SECTION 2

DESIGN DESCRIPTIONS

A. OVERPACK WELD EQUIPMENT (DRAWING 92496-A1)

The overpack weld equipment consists of a containment vessel, a weld head assembly with control console, slide assemblies, a circular track, a vacuum-pressurization system, and the main control console.

The containment vessel is used to provide the helium atmosphere required for overpacking waste canisters. The weld head assembly, slide assemblies and circular track are located inside the containment vessel. The vessel has a 3-foot diameter lower section that is 9.5 feet long, then opens to a 6-foot diameter section that is 8-inches long. A 4-inch wide flange is located at the top of the upper section. A 6-foot diameter elliptical dished head, with a flange to mate to the flange on the upper body section, provides the removable top cover of the vessel. An "O" ring gasket is provided in the flange to provide the seal when the cover is in place. The top cover is removed and installed by an actuator and a rotating bearing that lifts the cover approximately 34 inches, then with the manipulator, it is rotated from the main vessel. The vessel will always be under negative pressure when the cover is in place.

Inside, located at the bottom of the lower section, is a tapered, stepped guide that centers the 26-inch and 18-inch overpack canisters in the vessel. Since the fuel waste canisters that fit inside the overpack canisters weigh from 3000 to 7000 pounds, no clamping of the overpack canister should be required.

The weld head consists of an automatic voltage control and torch mounted on a free-floating, self-centering slide assembly that is driven by a cam follower. It will be necessary for each overpack canister cover to have a groove machined

in the outer surface that is parallel to the open surface of the cover. The cam follower is placed in this groove to align the torch to the weld joint and as the weld head rotates around the canister, the torch is maintained in its proper vertical position with respect to the weld joint. The automatic voltage control maintains the torch at the proper horizontal distance from the weld joint. The weld head assembly is mounted onto a compound slide assembly that provides the necessary adjustments to align the cam follower to the groove and the torch in the canister. The compound slide assembly is mounted to a circular gear and is driven around the inside of the containment vessel. The control console for operating the welding operations is located in the hot cell operating gallery. It is approximately 3-feet wide by 5-feet high by 2-feet deep and contains the power supply and all controls for setting-up and monitoring the weld cycle, voltage, amperage, and current. The console contains selector switches for programmed or manual control, power on/off and arc start/weld simulate selection. The power input to the power supply is 277/480 volts AC + 10 percent, 3-phase, 60 Hz and has a DC power output of 100 to 400 amperes.

The vacuum-pressurization system consists of a vacuum pump, an in-cell filter, and the necessary valves and piping to interconnect all the components. The in-cell filter will be an in-line HEPA filter that is remotely replaceable using in-cell equipment and is used to prevent any contamination from being removed from the cell by the vacuum pump. The vacuum pump will be a two-stage pump, capable of drawing ⁻⁶10 microns. The first stage will be a roughing stage, used primarily for the overpack weld containment vessel with the second stage being required for the leak check station (not discussed in this report). This allows one system to be used for both the weld station and leak check station.

A main control console has been provided in the operating gallery that contains all the switches and readout equipment required to operate the vacuum-pressurization

system and the containment vessel cover actuator. This console and the weld console will be interlocked.

B. CASK VEHICLE (DRAWING 94296-A2)

Two cask vehicles shall be provided to transfer solid waste shipping casks to and from various stations within the Upper Transfer Facility area. One vehicle will be stationed in the cask preparation area of the facility and the second vehicle within the cask decontamination area. Cask vehicles will transport casks in a vertical attitude only and will physically interface with any one of various pallets for the different sizes and weights of casks. The vehicles are 11-feet by 15-feet and have a capacity of 130 tons.

A pneumatic 9-foot diameter diaphragm, located within a circular cavity in the vehicle top plate section, lifts the pallet and cask .50-inch so that the pallet can clear the rails of the work stands or cask elevator. Once over the rails, the diaphragm is deflated and the loaded pallet is lowered 0.50-inch to engage the work stand rails. When the pallet is supported by the stand rails, the vehicle can be backed free of the pallet. A minimum of 50 psi shop air is required at the transfer stations for operation of the diaphragm.

The vehicle is driven by a 10 hp motor through a reducer up to a speed of approximately 2.5 mph. An SCR stepless drive unit and controller is mounted on the vehicle. A pendant controller is supplied for the walk-along operators. The 230 volt, 3-phase, 60 Hz power is provided through a 100-foot spring-powered cable reel located on the vehicle.

The vehicle is equipped with four pneumatic rail clamps supplied from an on-board air bottle. An air piston drives a cam over center where a spring load holds the clamp until the piston is operated in the reverse direction. Standard wheel loading will require hardened or crane-type rails and wheels.

C. HOT CELL CASK ELEVATOR (DRAWING 94296-A2)

A cantilever, rail-type drive-through cask elevator shall be provided to lift the solid waste shipping casks, mounted on a pallet, to mate with the hot cell floor opening adapter. The elevator is driven by a 25 hp dc electric motor through gear reducers into four 60-ton ballscrew jacks. Cantilevered loads are reacted by wall-mounted wide flange beams that provide track surfaces for the elevator rail roller assemblies.

Dual, redundant system, motor brakes provide elevator lockup for any position selected, other than the full-down position.

An SCR stepless drive unit and controller is located on the wall in the immediate vicinity of the elevator. Power supply is 230-volt, 3-phase, 60 Hz. The control console for actual elevator operation will be located in the hot cell operating gallery and contains interlocks to prevent raising the elevator until the cell floor plugs are removed. Control of the elevator for its lower six inches of travel is provided at the elevator location. Transfer of the pallet from the cask vehicle to the elevator is accomplished in the same manner as described previously for transfer of a pallet from the vehicle to a work stand.

D. PALLETS (DRAWING 94296-A2)

The solid waste shipping cask pallets are provided to give a common base to various casks for interfacing with facility work stands, unloading area/shipping area vehicles, and the hot cell elevator. Various sizes of risers, to be placed between the upright casks and pallets, will be provided to assure that all cask head heights are constant, as measured from the top of the pallet. This technique allows for a uniform 5-foot travel of the Hot Cell Cask Elevator. The pallets are equipped with tie-downs to lock the pallet/riser/cask combinations together for transfer and possible seismic events.

The pallets are 12-feet by 12-feet x 14-inches high, weighing approximately 9 tons. The risers used with the shorter casks increase the height and weight. Specific details of the risers will be developed when the cask details are available.

E. DECONTAMINATION EQUIPMENT

1. High-Pressure Water Decontamination System (Drawing 94296-A4)

The High-Pressure Water Decontamination System is in an air cell located below the hot cells. The unit consists of a stainless steel enclosure, 4-feet in diameter by 14-feet high, connected at the top to the station hatch via an inflatable seal. The enclosure and water-circulating system are rail-mounted on trapped wheels to permit horizontal movement from the main cell hatch to the clean cell hatch. The power and piping connections are made with flexible lines. The pumps, filters, and tankage are located at the bottom of the enclosure.

Because of the large quantities of steam that will be created, a 6-inch pipe located at the top of the enclosure is provided for water vapor passage to a vapor condenser. A blower at the unit returns air to the enclosure via a 3-inch pipe and maintains a circulation to carry vapor to the condenser. The condensate is piped to the water tank.

The enclosure contains vertical rollers to support the canister at the sides. Two of the rollers are mounted on scissor jacks which clamp the variable diameter canisters against the idler rollers. The bottom support is on two tapered rollers supporting the canister corner under the idler rollers. One tapered roller shaft is driven by an air motor or electric motor to rotate the canister by friction drive. It is necessary to clamp the canister with the scissor jack roller prior to degrappling. The arrangement permits the interchangeable handling of 16-inch to 26-inch canisters.

The high-pressure water manifold is rigidly mounted between the adjustable rollers and contains 12 nozzles covering the sides, top, and bottom of the canisters. The required water supply is 50 gpm at 1000 psi.

The bottom of the enclosure is funneled into a tank. The tank provides water cooling to 150°F and automatic level control from a make-up system. A booster pump, rated at 50 gpm at 100 psi, pumps the water from the tank through shielded coarse filters and then to a shielded absolute filter to a high-pressure triplex pump. The high-pressure pump discharges 1000 - 2000 psi water past a shielded radiation monitor to the flexible supply line for the enclosure manifold. A low-pressure pump transfers excess or contaminated water to the plant disposal system.

The control station is located in the hot cell operating gallery. It contains pump controls, pressure and temperature gages, remote reading radiation monitor, vapor condenser controls, enclosure position indicator, water tank level gage, adjustable roller clamping pressure, canister rotational speed indicator, inflatable seal controls and gages, hatch cover controls and indicators, and filter differential pressure gages.

2. Wire Brushing Decontamination System (Drawing No. 94926-A5)

The Wire Brushing Decontamination System is in a cell below the hot cells alongside the high-pressure water decontamination unit. The unit consists of a stainless steel enclosure, 5-feet in diameter by 14-feet high, connected at the top to the station hatch via an inflatable seal. The enclosure is rail-mounted on trapped wheels to permit horizontal movement from the main cell hatch to the clean cell hatch. The power and piping connections are made with flexible lines. The pump filters, strainers and tank are

located below the enclosure.

As in the high-pressure water system, a six-inch vent pipe carries the water vapor to a vapor condenser. A blower at the unit returns air to the enclosure via a 3-inch pipe and maintains a circulation. The condensate is piped to the sump.

The enclosure contains vertical brushes with alternate overlapping circumferential coverage. The brushes have fixed mountings with bearings between 2-foot-long brushes. The brushes are motor-driven by angle gear drives from an 1800 rpm, 25 hp, 23-volt, 3-phase, 60 Hz motor. Two different brush diameters of 6 and 8 inches with counter-rotation of the brushes provides a steady rotation of the canister. Opposing the brushes are two horizontally-adjustable idler rollers with actuators pressing the canister against the brushes. In loading, the canisters are held by the grapple until the idler rollers are clamped. The canister is supported axially by two tapered roller bearings mounted below the brushes and supporting the canister corner in one sector only. The bottom brush load is adjustable and rotates in the same direction as the top brush producing counterbalancing rotational moments. As in the high-pressure spray unit, the design permits interchangeable decontamination of 16 to 26-inch canister assemblies.

The brushes are each accompanied by a pair of low-pressure water spray nozzles to cool the brushes and carry away debris. The nozzles are fixed on a manifold that is supplied by a flexible line at the top enclosure section.

The enclosure is circumferentially split near the top for maintenance of the brush units. The top section, the spray manifold, and the brush units are removed as one group for maintenance work in the hot cell.

The bottom of the enclosure funnels into a coarse filter which discharges to the tank.

Water is pumped from the tank and feeds the water spray manifold through a one micron filter and a shielded radiation monitor. A low-pressure pump transfers excess or contaminated water to the plant contaminated liquid systems.

The control station is located in the hot cell operating gallery. It contains pump control, pressure and temperature gages, remote reading radiation monitor, vapor condenser controls, enclosure position indicator, water tank level gage, adjustable roller clamping pressure, canister rotational speed indicator, inflatable seal controls and gages, strainer and filter differential pressure gages.

F. HOT CELL (SEE DRAWING NO. 94296-A3)

One of the building within the high level waste facility is a hot cell that is used to remove waste canisters from waste casks, decontaminate the canisters, overpack damaged canisters and transfer decontaminated canisters to the mine shaft room. To accomplish these tasks, the hot cell has been presented as two cells interconnected by two air locks that also contain the decontamination equipment.

1. Main Cell

The main cell is 65-feet long by 50-feet wide by 40-feet high. The clean cell is located inside the main cell. The primary operating area of the main cell is only 47-feet long. This area is serviced by a

10-ton crane that spans the 47-foot length and a bridge-mounted electro-mechanical manipulator that spans the 50-foot width. A 20-ton crane, located at the top of the main cell, spans the 50-foot width and covers the entire 65-foot length. This crane has the capability to travel into the hoist maintenance room (not discussed in this description).

Floor plugs are located in approximately the center of the operating area. All waste canisters are brought into the cell from waste shipping casks through these floor plug locations. Space has been left on both sides of the floor plugs to allow set-down of the floor plugs and shipping cask covers when removed. To prevent the spread of contamination to the cask tunnel, all casks should be bagged to the cell. Bagging equipment has been developed and is commercially available. A bagging ring must be included in the cell design at the floor plugs in the cask tunnel. Since the cask vehicle and pallet have to be designed to handle the 110-ton casks, it is recommended that 25-ton casks received by trucks be clustered in groups of four in the cask preparation area and then four at one time can be taken to the hot cell. This will decrease the handling operations in the hot cell and the number of times a cask has to be mated to the hot cell. Drawing 94296-A2 shows a cluster of four 25-ton casks on the cask vehicle. Special adapters will be required to cluster the casks for mating to the cell.

Sixteen HEPA filters have been provided in the exit air system. Each filter is 24-inches square by 11.5-inches deep and rated for 1500 CFM at 1-inch W.G. pressure differential. The filters are located in the floor in two banks with eight filters in each bank. The filters are covered with a grating to protect them from objects that may be dropped in the cell. The exit line from each bank must contain a shut-off valve which will allow the

changeout of a bank of filters while still maintaining air circulation in the cell. Air flow rate through the cell should be reduced during filter changeout. The filters are commercially available.

Three shielded viewing windows have been provided to allow visibility in the cell during operations. The windows are located to provide optimum viewing of cask unloading, canister transfer into air locks and overpack and leak check operations.

Masterslave manipulators are required at the overpack station and should be located over the viewing window at that station.

Canister storage pits have been provided for eight 24-inch diameter canisters, eight 16-inch diameter canisters, two 26-inch diameter overpack canisters, and two 18-inch diameter overpack canisters. Sufficient space has been allocated to provide a cooling duct around each canister.

Two air locks have been provided. Access to these air locks will be through remotely operated hatches. A maintenance plug has also been provided over each air lock to allow removal of a decontamination chamber for maintenance.

A weld station and leak check station for overpacking damaged or highly contaminated canisters have been provided. Both stations are cylinders that are embedded in the cell floor approximately 8-feet.

A small tools transfer lock from the operating gallery into the cell has been provided to allow transfer of small items into the cell.

Since it is planned that most transfer operations in the cell are pre-programmed, lighting in the cell can be at a minimum; however, sufficient lights should be provided so that during maintenance operations more lighting is available. Also, extra lights should be provided at the weld-leak

check station and should be controllable from that operating window. This will permit clear viewing during weld set-up and leak check. The lamps should be tungsten iodine, pencil size, self-cleaning units which develop a minimum of 21 lumens/watt throughout its expected life time (2000 hrs) with insignificant efficiency loss. The lights should be modified commercial units to allow remote replacement of the lamps.

The apparent extra space in the cell must be provided to store equipment such as spare grapples, plug lifting fixtures and the empty overpack canisters. Since crane hooks cannot cover the entire cell, the outer three-foot perimeter is not readily usable.

2. Clean Cell

The clean cell is located within the main cell and provides the interface with the mine shaft. The cell is 50-feet wide, 16-feet long, and 21-feet high. The cell is serviced by a 10-ton crane that spans the 16-foot length and a bridge-mounted manipulator that spans 40-feet of the 50-foot width. The mine shaft enclosure is located in one corner of the cell and essentially reduces the cell width to 40-feet. Remotely operated hatches have been provided for access to the air locks. One viewing window has been provided to view operations as required and perform maintenance in the cell. Four HEPA filters have been provided in this cell. The filter rating and installation are the same as in the main cell. Lighting needs to be of sufficient intensity to perform maintenance tasks in the cell. A plug is located in the cell ceiling which is accessible by the main cell 20-ton crane and provides the capability to remove equipment from the clean cell for maintenance.

If a requirement should exist to check each canister for contamination, this check should be made in the clean cell.

The primary method to accomplish this task would be to swipe the canister and take a reading of the swipe. Equipment could be installed in this cell to accomplish this task. A pair of masterslave manipulators would be required and rather than removing the swipe from the cell, it could be placed in a shielded pig located against the operating gallery wall inside the cell. The pig could have a slot that mates with a radiation detector in the wall. Containment would not be breached as a thin metal window would be located between the detector and the pig slot. All detection equipment would be in the operating gallery for easy maintenance. This equipment could be added at a later date, but provisions for the detector and masterslaves should be made during the design and construction phases.

3. Air Lock

Two air locks have been provided and are located under the floor of the main cell and clean cell. The air locks are 20-feet long, 8-feet wide and 17-feet high. Personnel access has been provided to each air lock. The outer walls around the air locks are 2-feet thick with a 1-foot thick wall between the air locks. The personnel access is through a movable shielded door at the front of each air lock. Each air lock contains a decontamination chamber. The support equipment for each decontamination chamber is located in equipment rooms off both sides of the air locks.

4. Cell Equipment

All the equipment located inside the cells where it will be exposed to high radiation levels must be designed to be remotely maintainable and replaceable. To assure longer life of items containing electrical components or greases, special radiation resistance products should be used. This type of product is available commercially, but some items require lengthy procurement periods.

Design of all cell equipment must be based on a service life which assumes two-shift, year-round operation.

SECTION 3

SCHEDULES AND COST ESTIMATES

SCHEDULE AND ESTIMATE BASIS

The cost and schedule estimates for the weld overpack equipment, the cask vehicle, the cask elevator, the cask pallet, and the canister decontamination equipment were prepared using the following basis:

- a. Assumes equipment concepts and design criteria have been completed and approved prior to the start of preliminary design.
- b. Preliminary design consists of a preliminary design layout where the equipment is defined dimensionally and functionally. Design specifications will be drafted and approaches to all final design analysis will be completed. Essentials of the design will be set so that detail design of the equipment can be started. Major changes after completion of preliminary design will involve a change of scope and rescheduling the design effort.
- c. Detail design will be completed in two phases. Phase One includes the final design layout and specifications of the equipment. All general arrangement, sizes and interfaces will be frozen at the end of Phase One. During Phase Two, the final design work will be completed on fabrication and installation drawings, test specifications and procedures, qualification test plans and shipping, handling and installation instructions.
- d. Fabrication liaison consists of subcontractor liaison, checkout and testing, document changes and preparation of as-built drawings.

The schedules were prepared using a bar chart format to illustrate the different design phases and fabrication for each equipment item. The schedules show the elapsed time necessary to accomplish the work for each equipment item.

The cost estimates were based on the best information available at this time which is preliminary in nature and subject to changes. The following assumptions form an integral part of the pricing data:

- a. Current AMCO engineering manhour costs and productivity rates were used for all design work. The hourly rates used for design drafting, quality engineering, management, etc., are based on the approximate average rates in effect at AMCO in December, 1976.

These rates include all expenses such as fringe benefits, office space, office equipment and supplies, relocation, communications, clerical, travel, other overhead items and profit.

The productivity rates were based on an estimate of the number of drawing sheets ("E" size drawings) required, which is determined by comparison with similar existing designs and engineering judgement. The following factors are used in relating drawings to hours:

Preliminary design required approximately 200 hours per sheet for all effort.

Detail design requires 87 to 111 hr./sheet as follows:

Design and Drafting	55 hr./sheet
Engineering	7 hr./sheet
Drawing Check	14 hr./sheet
Stress (general design)	8 hr./sheet
Stress (code vessel design if required)	24 hr./sheet
Manufacturing Review	0.5 hr./sheet
Quality Engineering	2.5 hr./sheet

- b. State-of-the-art designs were used wherever possible with costs adjusted to meet the different design requirements and for inflation to December, 1976.
- c. Equipment fabrication, assembly and in-shop testing will be performed on a fixed price build-to-print basis.
- d. The cost estimates are based on 1976 costs with no provisions to cover anticipated escalation to the date of procurement.
- e. The equipment will be designed and fabricated in conformance with appropriate commercial national codes and standards.
- f. Contingency factors were applied to each equipment item to reflect an assessment of uncertainties in available information. Engineering contingency is a reserve for unrecognized costs, an allowance for the uncertainty of the estimate due to the conceptual nature of the information. This is not an allowance for escalation or anticipated changes.

Uncertainties in fabrication cost information depend upon how much of

the data was obtained by informal quotes, engineers' personal experience, catalog price lists, etc.

- g. These cost estimates do not include any items not delivered with the equipment items, such as interconnecting wiring, plumbing and cell penetrations.

The design and fabrication cost estimates are rough-order-of-magnitude (ROM) and are provided for budgetary purposes in scoping the overall costs of the Waste Isolation Pilot Plant. When approved design criteria and design concepts are available, and the basis for design work is agreed upon, more definitive estimates can be provided.

A rough-order-of-magnitude (ROM) cost for the concept development recommended for the canister decontamination system has also been included in the cost summary.

COST ESTIMATES SUMMARY

Equipment	DECEMBER 1976 DOLLARS (X 1000)		
	Design	Fabrication	Total
Overpack Weld Equipment	134.3	171.0	305.3
Waste Cask Vehicle	77.3	73.3	150.6
Waste Cask Elevator	62.6	64.0	126.6
Waste Cask Pallet	28.3	30.0	58.3
Canister Decontamination Equipment			
High Pressure Water	183.8	133.0	316.8
Wire Brush	153.8	130.7	284.5
Cask Bagging Equipment		92.0	92.0
TOTAL	640.1	694.0	1334.1

Concept Development (Canister Decontamination)

100.0

APPENDIX A

CONCEPT DRAWINGS

APPENDIX A

DRAWING NUMBER

DRAWING TITLE

94296-A1 1 Sheet

Overpack Weld Equipment

94296-A2 2 Sheets

Cash Vehicle/Pallet/Elevator

94296-A3 3 Sheets

Hot Cell Layout

94296-A4 1 Sheet

High-Pressure Water Decon-
tamination System

94296-A5 1 Sheet

Wire Brushing Decontamination
System

AEROJET MANUFACTURING COMPANY
FULLERTON, CALIFORNIA 92631
CODE IDENT 12704

PROJ. NO. _____
ORDER NO. _____

PROJ. & W.D.	NO.	DATE	REVISION	BY	CK.	ERDA
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION SANDIA AREA OFFICE KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO						
HIGH LEVEL WASTE FACILITY OVERPACK WELD EQUIPMENT SANDIA LABORATORY WASTE ISOLATION PILOT PLANT MECHANICAL ABOVE GROUND						
CONTRACT NO. (A-2)		DRAWN		CHECKED		DATE
CONTRACT NO. (000071)		J. L. WILSON		J. L. WILSON		12-15-76
SCALE		1"=1'-0"		DATE		12-15-76
SUBMITTED		RECOMMENDED		APPROVED		
DWG. NO. 94296-A1		SHEET		OF

AEROJET MANUFACTURING COMPANY
 FULLERTON, CALIFORNIA 92631
 CODE IDENT 12764

PROJ. NO.	REV. NO.	DATE	BY	CR.	SRD
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION					
SANDIA AREA OFFICE					
KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO					
HIGH LEVEL WASTE FACILITY					
CASK ELEVATOR/VEHICLE/PALLET					
SANDIA LABORATORY					
WASTE ISOLATION PILOT PLANT					
MECHANICAL ABOVE GROUND					
CONTRACT NO. (A-4)	TILKINS				
CONTRACT NO. (COMPT)	12-1-76				
DRAWN	12-6-76				
CHECKED	12-6-76				
DATE	12-6-76				
SUBMITTED	RECOMMENDED	APPROVED			
DWD. NO. 94296-A2		SHEET 1 OF 2

SECTION A-A SHT 1
FLOOR PLATES OMITTED

130 TON CASK VEHICLE
FROM SHT 1

AEROJET MANUFACTURING COMPANY
FULLERTON, CALIFORNIA 92631
CODE IDENT 12784

PROJ. NO. _____
ORDER NO. _____

PROJ. & W.D.	NO.	DATE	REVISION	BY	CK.	ERDA APP.
<p align="center">U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION SANDIA AREA OFFICE KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO</p>						
HIGH LEVEL WASTE FACILITY			CONTRACT NO. (A-4)			
CASK ELEVATOR/VEHICLE/PALLET			CONTRACT NO. (CDD-74)			
SANDIA LABORATORY			DRAWN: <i>WILKINSON</i>			
WASTE ISOLATION PILOT PLANT			CHECKED: <i>WILKINSON</i>			
MECHANICAL ABOVE GROUND			SCALE: 1/8" = 1'-0"			
SUBMITTED			RECOMMENDED		APPROVED	
DWG. NO. 94296-A2			SHEET 2		OF 2	

SATISFACTION (2-75)

PLAN VIEW 0'-0" ELEVATION

AEROJET MANUFACTURING COMPANY
FULLERTON, CALIFORNIA 92631
CODE IDENT 12784

PROJ. NO. _____
ORDER NO. _____

PROJ. & W.D.	NO.	DATE	REVISION	BY	CK.	ERDA
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION SANDIA AREA OFFICE KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO						
HIGH LEVEL WASTE FACILITY HOT CELL SANDIA LABORATORY WASTE ISOLATION PILOT PLANT ARCHITECTURAL ABOVE GROUND						
CONTRACT NO. (A-2)		CONTRACT NO. (A-2)		DRAWN		DATE
CHECKED		CHECKED		SCALE		DATE
SUBMITTED		RECOMMENDED		APPROVED		DATE
DWG. NO. 94296A3		SHEET 1		OF 3		DATE 12-16-76

SECTION A - A SHT 1

AEROJET MANUFACTURING COMPANY
FULLERTON, CALIFORNIA 92631
FORM 11/81 17784

PROJ. NO. _____
SHEET NO. _____

PROJ. & W.D.	NO.	DATE	REVISION	BY	CK.	ERDA APP.
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION SANDIA AREA OFFICE KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO						
HIGH LEVEL WASTE FACILITY HOT CELL SANDIA LABORATORY WASTE ISOLATION PILOT PLANT ARCHITECTURAL ABOVE GROUND						
CONTRACT NO. (A-E)		CONTRACT NO. (A-E)		DRAWN		BYL/KOWSKI
CHECKED		DATE		SCALE		1/8" = 1'-0"
SUBMITTED		RECOMMENDED		APPROVED		DATE 12-17-76
CWC NO. 94296-A3		SHEET 2		OF 3

PLAN VIEW -14'-0" ELEVATION

AEROJET MANUFACTURING COMPANY
 FULLERTON, CALIFORNIA 92631
 CODE IDENT 12764

PROJ. & W.D.	NO.	DATE	REVISION	BY	CK.	ERDA APP.
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION SANDIA AREA OFFICE KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO						
HIGH LEVEL WASTE FACILITY HOT CELL SANDIA LABORATORY WASTE ISOLATION PILOT PLANT ARCHITECTURAL ABOVE GROUND						
SUBMITTED	RECOMMENDED	APPROVED	CONTRACT NO. (A-E) CONTRACT NO. (COST) DRAWN BY: [Signature] CHECKED BY: [Signature] SCALE: 1/8" = 1'-0" DATE: 12-17-70			
DWG. NO. 94296-A3			SHEET 3		OF 3

AEROJET MANUFACTURING COMPANY
 FULLERTON, CALIFORNIA 92631
 CODE IDENT 12764

PROJ. NO. _____
 ORDER NO. _____

PROJ. & W.D.	NO.	DATE	REVISION	BY	CK.	ERDA
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION SANDIA AREA OFFICE KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO						
HIGH LEVEL WASTE FACILITY DECON STATION-HIGH PRESS. H₂O SANDIA LABORATORY WASTE ISOLATION PILOT PLANT MECHANICAL ABOVE GROUND						
CONTRACT NO. (A-2)		CONTRACT NO. (CON-1)		DRAWN		BY (KOWSKI)
CHECKED		DATE		SCALE		DATE
SUBMITTED		RECOMMENDED		APPROVED		DATE
DWG. NO.		SHEET		OF		
94296-A4		1		1		
SATISFACTION (2-75)

AEROJET MANUFACTURING COMPANY
PULLERTON, CALIFORNIA 92631
CODE IDENT 12764

PROJ. NO. _____
ORDER NO. _____

PTG. & W.D.	NO.	DATE	REVISION	BY	CHK.	ENGR.
U.S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION SANDIA AREA OFFICE KIRTLAND AIR FORCE BASE EAST ALBUQUERQUE, NEW MEXICO						
HIGH LEVEL WASTE FACILITY DECON STATION - WIRE BRUSH SANDIA LABORATORY WASTE ISOLATION PILOT PLANT MECHANICAL ABOVE GROUND			CONTRACT NO. (A-6) DRAWN: WISLEE CHECKED: WISLEE SCALE: 3/8" = 1'-0" DATE: 12-21-76			
SUBMITTED		RECOMMENDED		APPROVED		
ORIG. NO. 94296-A5			SHEET 1		OF 1	

APPENDIX B

COST BACKUP DATA

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-17-76		SHEET NO. 1 of 5		
PROJECT NAME WIPP		DESCRIPTION OVERPACK WELD EQUIPMENT SUMMARY								
								ESTIMATOR M. J. Rieb		
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*						CHECKED BY		
DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
					LABOR	MATERIAL		C	P	
ENGINEERING										
PRELIMINARY DESIGN							38,158			
DETAIL DESIGN							67,280			
FABRICATION LIAISON							11,374			
CONTINGENCY 15%							17,522			
TOTAL ENGINEERING							134,334			
CONSTRUCTION										
FABRICATION							148,706			
CONTINGENCY 15%							22,306			
TOTAL CONSTRUCTION							171,012			
TOTAL							305,346			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-17-76	SHEET NO. 2			
PROJECT NAME <div style="font-size: 1.5em; font-weight: bold; text-align: center;">WIPP</div>		DESCRIPTION OVERPACK WELD EQUIPMENT								
		PRELIMINARY DESIGN				ESTIMATOR Ried				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*				CHECKED BY				
DESCRIPTION		QUANTITY	UNIT	UNIT \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER-MECHANICAL		320	hrs	27			8640			
DESIGN ENGINEER-ELECTRICAL		248	hrs	27			6696			
MECHANICAL DRAFTING (LAYOUT)		320	hrs	21			6720			
ELECTRICAL DRAFTING (SCHEMATICS)		292	hrs	21			6132			
DRAWING CHECK		142	hrs	22			3124			
QUALITY ENGINEER		42	hrs	31			1302			
TECHNICAL WRITER		120	hrs	22			2640			
STRESS/THERMAL		56	hrs	24			1344			
PROGRAM MANAGER		40	hrs	39			1560			
TOTAL							38158			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE: 12-17-76	SHEET NO. 3			
PROJECT NAME WIPP		DESCRIPTION OVERPACK WELD EQUIPMENT				ESTIMATOR RIBB				
		DETAIL DESIGN				CHECKED BY				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*								
DESCRIPTION		QUANTITY	UNIT	UNIT \$/hr	TOTAL COST		TOTAL	*DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL		306	hrs	27			8262			
DESIGN ENGINEER - ELECTRICAL		195	hrs	27			5265			
MECHANICAL DRAFTING		990	hrs	21			20790			
ELECTRICAL DRAFTING		715	hrs	21			15015			
DRAWING CHECK		465	hrs	22			10230			
QUALITY ENGINEER		62	hrs	31			1922			
TECHNICAL WRITER		—		22			—			
STRESS/THERMAL		144	hrs	24			3456			
PROGRAM MANAGER		60	hrs	39			2340			
TOTAL							67280			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET			
TITLE: HIGH LEVEL WASTE FACILITY						DATE: 12-17-76	SHEET NO. 4
PROJECT NAME <div style="font-size: 2em; font-weight: bold; text-align: center;">WIPP</div>		DESCRIPTION: OVERPACK WELD EQUIPMENT					
		FABRICATION & LIAISON				ESTIMATOR: RIES	
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*				CHECKED BY:	

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
				LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL	105		27			2835			
DESIGN ENGINEER - ELECTRICAL	44		27			1188			
MECHANICAL DRAFTING	131		21			2751			
ELECTRICAL DRAFTING	100		21			2100			
DRAWING CHECK	60		22			1320			
QUALITY ENGINEER	10		31			310			
TECHNICAL WRITER	—		22			—			
STRESS/THERMAL	20		24			480			
PROGRAM MANAGER	10		39			390			
TOTAL						11374			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET					
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76		SHEET NO. 1 of 5	
PROJECT NAME <div style="font-size: 24pt; font-weight: bold; text-align: center;">WIPP</div>		DESCRIPTION WASTE CASK VEHICLE					ESTIMATOR R. S. Foley		
		SUMMARY							
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*					CHECKED BY		

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	*DATES		REF.
				LABOR	MATERIAL		C	P	
ENGINEERING									
PRELIMINARY DESIGN						13,176			
DETAIL DESIGN						47,952			
FABRICATION LIAISON						6,074			
CONTINGENCY 15%						10,080			
TOTAL ENGINEERING						77,282			
CONSTRUCTION									
FABRICATION						63,710			
CONTINGENCY 15%						9,557			
TOTAL CONSTRUCTION						73,267			
TOTAL						150,549			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76	SHEET NO. 2			
PROJECT NAME <div style="font-size: 1.5em; font-weight: bold; text-align: center;">WIPP</div>		DESCRIPTION WASTE CASE VEHICLE				ESTIMATOR FOLEY				
		PRELIMINARY DESIGN				CHECKED BY				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*								
DESCRIPTION		QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL	* DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL		160	hrs	27			4320			
DESIGN ENGINEER - ELECTRICAL		40	hrs	27			1080			
MECHANICAL DRAFTING		160	hrs	21			3780			
ELECTRICAL DRAFTING		47	hrs	21			981			
DRAWING CHECK		50	hrs	22			1100			
QUALITY ENGINEER		15	hrs	31			465			
TECHNICAL WRITER		—	hrs	22			—			
STRESS/THERMAL		28	hrs	24			670			
PROGRAM MANAGER		20	hrs	39			780			
TOTAL							13176			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE: 12-20-76	SHEET NO. 3			
PROJECT NAME WIPP		DESCRIPTION								
		WASTE CASE VEHICLE								
		DETAIL DESIGN				ESTIMATOR				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*				CHECKED BY				
DESCRIPTION		QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL		133	hrs	27			3591			
DESIGN ENGINEER - ELECTRICAL		75	hrs	27			2025			
MECHANICAL DRAFTING		1045	hrs	21			21945			
ELECTRICAL DRAFTING		275	hrs	21			5775			
DRAWING CHECK		360	hrs	22			7920			
QUALITY ENGINEER		48	hrs	31			1488			
TECHNICAL WRITER		—	hrs	22			—			
STRESS / THERMAL		152	hrs	24			3648			
PROGRAM MANAGER		40	hrs	39			1560			
TOTAL							47,952			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76	SHEET NO. 4			
PROJECT NAME <div style="font-size: 1.5em; font-weight: bold; text-align: center;">WIPP</div>		DESCRIPTION WASTE CASE VEHICLE				ESTIMATOR FOLBY				
		FABRICATION LIAISON				CHECKED BY				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*								
DESCRIPTION		QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	*DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER- MECHANICAL		29	hrs	27			783			
DESIGN ENGINEER- ELECTRICAL		12	hrs	27			324			
MECHANICAL DRAFTING		121	hrs	21			2541			
ELECTRICAL DRAFTING		32	hrs	21			672			
DRAWING CHECK		41	hrs	22			902			
QUALITY ENGINEER		6	hrs	31			186			
TECHNICAL WRITER		—	hrs	22			—			
STRESS/THERMAL		18	hrs	24			432			
PROGRAM MANAGER		6	hrs	39			234			
TOTAL							6074			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET			
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76	SHEET NO. 5
PROJECT NAME WIPP		DESCRIPTION WASTE CASE VEHICLE				ESTIMATOR FOLEY	
		FABRICATION					
		ENTER DATES(FY) FUNDS COMMITTED AND PAID *				CHECKED BY	

DESCRIPTION	QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
				LABOR	MATERIAL		C	P	
MOTOR, BLADES, REDUCER					6939	6939			
Rail Clamps					21700	21700			
REEL					700	700			
DIAPHRAM					500	500			
STEEL					17871	17871			
LABOR				16000		16000			
				16000	47710	63710			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76		SHEET NO. 1 of 5		
PROJECT NAME <div style="font-size: 1.5em; font-weight: bold; text-align: center;">WIPP</div>		DESCRIPTION WASTE CASK ELEVATOR								
		SUMMARY						ESTIMATOR R. S. Foley		
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*						CHECKED BY		
DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
					LABOR	MATERIAL		C	P	
ENGINEERING										
PRELIMINARY DESIGN							15,044			
DETAIL DESIGN							34,456			
FABRICATION LIAISON							4,901			
CONTINGENCY 15%							8,160			
TOTAL ENGINEERING							62,562			
CONSTRUCTION										
FABRICATION							55,666			
CONTINGENCY 15%							8,350			
TOTAL CONSTRUCTION							64,016			
TOTAL							126,578			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET					
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76	SHEET NO. 2		
PROJECT NAME WIPP		DESCRIPTION WASTE CASK ELEVATOR							
		PRELIMINARY DESIGN				ESTIMATOR FOLEY			
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*				CHECKED BY			
DESCRIPTION	QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
				LABOR	MATERIAL		C	P	
DESIGN ENGINEER-MECHANICAL	160	hrs	27			4320			
DESIGN ENGINEER-ELECTRICAL	80	hrs	27			2160			
MECHANICAL DRAFTING	120	hrs	21			2520			
ELECTRICAL DRAFTING	94	hrs	21			1974			
DRAWING CHECK	50	hrs	22			1100			
QUALITY ENGINEER	18	hrs	31			558			
TECHNICAL WRITER	—	hrs	22			—			
STRESS/THERMAL	68	hrs	24			1632			
PROGRAM MANAGER	20	hrs	39			780			
TOTAL						15044			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76		SHEET NO. 3		
PROJECT NAME WIPP		DESCRIPTION WASTE CASE ELEVATOR						ESTIMATOR FOLEY		
		DETAIL DESIGN								
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*						CHECKED BY		
DESCRIPTION		QUANTITY	UNIT	UNIT COST/hr	TOTAL COST		TOTAL \$	* DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL		84	Hrs	27			2268			
DESIGN ENGINEER - ELECTRICAL		75	Hrs	27			2025			
MECHANICAL DRAFTING		660	Hrs	21			13860			
ELECTRICAL DRAFTING		275	Hrs	21			5775			
DRAWING CHECK		255	Hrs	22			5610			
QUALITY ENGINEER		34	Hrs	31			1054			
TECHNICAL WRITER		—	Hrs	22			—			
STRESS/THERMAL		96	Hrs	24			2304			
PROGRAM MANAGER		40	Hrs	39			1560			
TOTAL							34,456			

55

AEROJET MANUFACTURING COMPANY

ESTIMATE WORK SHEET

TITLE: HIGH LEVEL WASTE FACILITY

DATE 12-20-76

SHEET NO. 9

PROJECT NAME

WIPP

DESCRIPTION

WASTE CASE ELEVATOR

FABRICATION LIAISON

ESTIMATOR

KOLBY

ENTER DATES(FY) FUNDS COMMITTED AND PAID*

CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	*DATES		REF.
				LABOR	MATERIAL		C	P	
DESIGN ENGINEER-MECHANICAL	24	Hrs	27			648			
DESIGN ENGINEER-ELECTRICAL	15	Hrs	27			405			
MECHANICAL DRAFTING	78	Hrs	21			1638			
ELECTRICAL DRAFTING	37	Hrs	21			777			
DRAWING CHECK	30	Hrs	22			660			
QUALITY ENGINEER	5	Hrs	31			155			
TECHNICAL WRITER	—	Hrs	22			—			
STRESS/THERMAL	16	Hrs	24			384			
PROGRAM MANAGER	6	Hrs	39			234			
TOTAL						4901			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET					
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76	SHEET NO. 5		
PROJECT NAME WIPP		DESCRIPTION WASTE GASK ELEVATOR							
		FABRICATION				ESTIMATOR FOLEY			
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*				CHECKED BY			
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
				LABOR	MATERIAL		C	P	
SCREW JACKS					18496	18496			
MOTOR & CONTROLS					15,000	15000			
CAM BEARINGS					660	660			
COUPLINGS					3080	3080			
SHAFTS					590	590			
PILLOW BLOCKS					240	240			
STEEL					7600	7600			
LABOR				9000		9000			
MISC (BOLT, NUTS, ETC)					1000	1000			
				9000	46,666	55,666			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE: 12-20-76	SHEET NO. 1 of 5			
PROJECT NAME WIPP		DESCRIPTION: WASTE CASK PALLET								
		SUMMARY				ESTIMATOR: R. S. Foley				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID *				CHECKED BY				
DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
					LABOR	MATERIAL		C	P	
ENGINEERING										
PRELIMINARY DESIGN							12,360			
- DETAIL DESIGN							12,348			
FABRICATION LIAISON							2,218			
CONTINGENCY 5%							1,346			
TOTAL ENGINEERING							28,272			
CONSTRUCTION										
FABRICATION							27,300			
CONTINGENCY 1 %							27,300			
TOTAL CONSTRUCTION							30,030			
TOTAL							58,302			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE: 12-20-76	SHEET NO. 2			
PROJECT NAME <div style="font-size: 1.5em; font-weight: bold; text-align: center;">WIPP</div>		DESCRIPTION WASTE CASK PALLET				ESTIMATOR FOLEY				
		PRELIMINARY DESIGN				CHECKED BY				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*								
DESCRIPTION		QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL		160	HRS	27			4320			
MECHANICAL DRAFTING		160	HRS	21			3360			
DRAWING CHECK		50	HRS	22			1100			
STRESS/THERMAL		120	HRS	24			2880			
QUALITY ENGINEER		10	HRS	31			310			
PROGRAM MANAGER		10	HRS	39			390			
							12360			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76		SHEET NO. 3		
PROJECT NAME WIPP		DESCRIPTION <i>WASTE CASE PALLET</i>								
		<i>DETAIL DESIGN</i>						ESTIMATOR <i>FOLBY</i>		
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*						CHECKED BY		
DESCRIPTION		QUANTITY	UNIT	UNIT \$/hr	TOTAL COST		TOTAL \$	*DATES		REF.
					LABOR	MATERIAL		C	P	
<i>DESIGN ENGINEER - MECHANICAL</i>		<i>42</i>	<i>hrs</i>	<i>27</i>			<i>1134</i>			
<i>MECHANICAL DRAFTING</i>		<i>330</i>	<i>hrs</i>	<i>21</i>			<i>6930</i>			
<i>DRAWING CHECK</i>		<i>90</i>	<i>hrs</i>	<i>22</i>			<i>1980</i>			
<i>STRESS/THERMAL</i>		<i>48</i>	<i>hrs</i>	<i>24</i>			<i>1152</i>			
<i>QUALITY ENGINEER</i>		<i>12</i>	<i>hrs</i>	<i>31</i>			<i>372</i>			
<i>PROGRAM MANAGER</i>		<i>20</i>	<i>hrs</i>	<i>39</i>			<i>780</i>			
<i>TOTAL</i>							<i>12348</i>			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY							DATE 12-20-76		SHEET NO. 9	
PROJECT NAME WIPP		DESCRIPTION WASTE CASE PALLET								
		FABRICATION LIAISON						ESTIMATOR FOLEY		
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*						CHECKED BY		
DESCRIPTION		QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL		20	hrs	27			520			
MECHANICAL DRAFTING		49	hrs	21			989			
DRAWING CHECK		14	hrs	22			320			
STRESS/THERMAL		17	hrs	24			320			
QUALITY ENGINEER		2	hrs	31			62			
PROGRAM MANAGER		3	hrs	39			107			
TOTAL							2218			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-20-76		SHEET NO. 5		
PROJECT NAME WIPP		DESCRIPTION <i>WASTE CASE PALLET</i>								
		<i>FABRICATION</i>						ESTIMATOR <i>FOLEY</i>		
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*						CHECKED BY		
DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
					LABOR	MATERIAL		C	P	
<i>TIE DOWN</i>						<i>1000</i>	<i>1000</i>			
<i>STEEL</i>						<i>13800</i>	<i>13800</i>			
<i>MISC (Paint, etc)</i>						<i>500</i>	<i>500</i>			
<i>LABOR</i>					<i>12000</i>		<i>12000</i>			
<i>TOTAL</i>					<i>12000</i>	<i>15300</i>	<i>27300</i>			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY							DATE 12-21-76		SHEET NO. 1 of 5	
PROJECT NAME WIPP		DESCRIPTION CANISTER DECONTAMINATION SYSTEM (HIGH PRESSURE WATER)								
		SUMMARY					ESTIMATOR R. S. Foley			
		ENTER DATES(FY) FUNDS COMMITTED AND PAID *					CHECKED BY			
DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	*DATES		REF.
					LABOR	MATERIAL		C	P	
ENGINEERING										
PRELIMINARY DESIGN							34,240			
DETAIL DESIGN							105,150			
FABRICATION LIAISON							13,813			
CONTINGENCY 20%							30,641			
TOTAL ENGINEERING							183,844			
CONSTRUCTION										
FABRICATION							110,850			
CONTINGENCY 20%							22,170			
TOTAL CONSTRUCTION							133,020			
TOTAL							316,864			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-21-76	SHEET NO. 2			
PROJECT NAME WIPP		DESCRIPTION <i>CANISTER DECONTAMINATION SYSTEM (HIGH PRESSURE WATER)</i>				ESTIMATOR <i>FOLEY</i>				
		<i>PRELIMINARY DESIGN</i>								
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*				CHECKED BY				
DESCRIPTION		QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	*DATES		REF.
					LABOR	MATERIAL		C	P	
<i>DESIGN ENGINEER - MECHANICAL</i>		<i>400</i>	<i>HRS</i>	<i>27</i>			<i>10800</i>			
<i>DESIGN ENGINEER - ELECTRICAL</i>		<i>160</i>	<i>HRS</i>	<i>27</i>			<i>4320</i>			
<i>MECHANICAL DRAFTING</i>		<i>400</i>	<i>HRS</i>	<i>21</i>			<i>8400</i>			
<i>ELECTRICAL DRAFTING</i>		<i>188</i>	<i>HRS</i>	<i>21</i>			<i>3948</i>			
<i>DRAWING CHECK</i>		<i>140</i>	<i>HRS</i>	<i>22</i>			<i>3080</i>			
<i>QUALITY ENGINEER</i>		<i>32</i>	<i>HRS</i>	<i>31</i>			<i>992</i>			
<i>TECHNICAL WRITER</i>		<i>-</i>	<i>HRS</i>	<i>22</i>			<i>-</i>			
<i>STRESS/THERMAL</i>		<i>80</i>	<i>HRS</i>	<i>24</i>			<i>1920</i>			
<i>PROGRAM MANAGER</i>		<i>20</i>	<i>HRS</i>	<i>39</i>			<i>780</i>			
<i>TOTAL</i>							<i>34240</i>			

AEROJET MANUFACTURING COMPANY

ESTIMATE WORK SHEET

TITLE: HIGH LEVEL WASTE FACILITY

DATE
12-21-76SHEET NO.
4

PROJECT NAME

WIPP

DESCRIPTION

CANISTER DECONTAMINATION SYSTEM (HIGH PRESSURE WATER)

FABRICATION LIAISON

ESTIMATOR

FOLEY

ENTER DATES(FY) FUNDS COMMITTED AND PAID*

CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	*DATES		REF.
				LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL	66	HRS	27			1782			
DESIGN ENGINEER - ELECTRICAL	40	HRS	27			1080			
MECHANICAL DRAFTING	244	HRS	21			5124			
ELECTRICAL DRAFTING	99	HRS	21			2079			
DRAWING CHECK	95	HRS	22			2090			
QUALITY ENGINEER	14	HRS	31			434			
TECHNICAL WRITER	—	HRS	22			—			
STRESS/THERMAL	38	HRS	24			912			
PROGRAM MANAGER	8	HRS	39			312			
TOTAL						13813			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET					
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-21-76	SHEET NO. 5		
PROJECT NAME WIPP	DESCRIPTION <i>CANISTER DECONTAMINATION SYSTEM (HIGH PRESSURE WATER)</i>					ESTIMATOR <i>FOLEY</i>			
	<i>FABRICATION</i>								
	ENTER DATES (FY) FUNDS COMMITTED AND PAID *					CHECKED BY			
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
				LABOR	MATERIAL		C	P	
<i>HARDWARE COSTS</i>						<i>104850</i>			
<i>ASSY & SHOP TEST</i>						<i>6000</i>			
<i>TOTAL</i>						<i>110850</i>			

AEROJET MANUFACTURING COMPANY

ESTIMATE WORK SHEET

TITLE: HIGH LEVEL WASTE FACILITY

DATE
12-21-76SHEET NO.
1 of 5

PROJECT NAME

WIPP

DESCRIPTION

CANISTER DECONTAMINATION SYSTEM (WIRE BRUSH)

SUMMARY

ESTIMATOR R. S. Foley

ENTER DATES(FY) FUNDS COMMITTED AND PAID*

CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
				LABOR	MATERIAL		C	P	
ENGINEERING									
PRELIMINARY DESIGN						26,820			
DETAIL DESIGN						89,484			
FABRICATION LIAISON						11,866			
CONTINGENCY 20%						25,634			
TOTAL ENGINEERING						153,804			
CONSTRUCTION									
FABRICATION						108,900			
CONTINGENCY 20%						21,780			
TOTAL CONSTRUCTION						130,680			
TOTAL						284,484			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET					
TITLE: HIGH LEVEL WASTE FACILITY						DATE 18-21-76		SHEET NO. 2	
PROJECT NAME WIPP		DESCRIPTION <i>CANISTER DECONTAMINATION SYSTEM (WIRE BRUSH)</i>						ESTIMATOR <i>FOLEY</i>	
		<i>PRELIMINARY DESIGN</i>							
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*						CHECKED BY	
DESCRIPTION	QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
				LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL	276	HRS	27			7452			
DESIGN ENGINEER - ELECTRICAL	160	HRS	27			4320			
MECHANICAL DRAFTING	276	HRS	21			5796			
ELECTRICAL DRAFTING	188	HRS	21			3948			
DRAWING CHECK	109	HRS	22			2398			
QUALITY ENGINEER	26	HRS	31			806			
TECHNICAL WRITER	—	HRS	22			—			
STRESS/THERMAL	55	HRS	24			1320			
PROGRAM MANAGER	20	HRS	39			780			
TOTAL						26,820			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-21-76	SHEET NO. 3			
PROJECT NAME WIPP		DESCRIPTION CANISTER DECONTAMINATION SYSTEM (WIRE BRUSH)				ESTIMATOR FOLEY				
		DETAIL DESIGN				CHECKED BY				
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*								
DESCRIPTION		QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
					LABOR	MATERIAL		C	P	
DESIGN ENGINEER - MECHANICAL		203	HRS	27			5481			
DESIGN ENGINEER - ELECTRICAL		240	HRS	27			6480			
MECHANICAL DRAFTING		1595	HRS	21			33495			
ELECTRICAL DRAFTING		880	HRS	21			18480			
DRAWING CHECK		675	HRS	22			14850			
QUALITY ENGINEER		90	HRS	31			2790			
TECHNICAL WRITER		—	HRS	22			—			
STRESS/THERMAL		232	HRS	24			5568			
PROGRAM MANAGER		60	HRS	39			2340			
TOTAL							89,484			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET					
TITLE: HIGH LEVEL WASTE FACILITY						DATE 12-21-76	SHEET NO. 9		
PROJECT NAME WIPP		DESCRIPTION CANISTER DECONTAMINATION SYSTEM (WIRE BRUSH)							
		FABRICATION LIAISON				ESTIMATOR KOLEY			
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*				CHECKED BY			
DESCRIPTION	QUANTITY	UNIT	UNIT COST \$/hr	TOTAL COST		TOTAL \$	* DATES		REF.
				LABOR	MATERIAL		C	P	
DESIGN ENGINEER- MECHANICAL	48	HRS	27			1296			
DESIGN ENGINEER- ELECTRICAL	40	HRS	27			1080			
MECHANICAL DRAFTING	181	HRS	21			3927			
ELECTRICAL DRAFTING	107	HRS	21			2247			
DRAWING CHECK	88	HRS	22			1936			
QUALITY ENGINEER	12	HRS	31			372			
TECHNICAL WRITER	—	HRS	22			—			
STRESS/THERMAL	29	HRS	24			696			
PROGRAM MANAGER	8	HRS	39			312			
TOTAL						11866			

AEROJET MANUFACTURING COMPANY				ESTIMATE WORK SHEET						
TITLE: HIGH LEVEL WASTE FACILITY							DATE 12-21-76		SHEET NO. 5	
PROJECT NAME WIPP		DESCRIPTION CANISTER DECONTAMINATION SYSTEM (WIRE BRUSH)								
		FABRICATION					ESTIMATOR KOLBY			
		ENTER DATES(FY) FUNDS COMMITTED AND PAID*					CHECKED BY			
DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
					LABOR	MATERIAL		C	P	
HARDWARE COSTS							100,900			
ASSY & SHOP TEST							8,000			
TOTAL							108,900			

AEROJET MANUFACTURING COMPANY

ESTIMATE WORK SHEET

TITLE: HIGH LEVEL WASTE FACILITY

DATE
12-17-76SHEET NO.
1 of 1

PROJECT NAME

WIPP

DESCRIPTION

HOT CELL - SUPPORT EQUIPMENT

CASK TO CELL BAGGING SYSTEM

ESTIMATOR
M. J. Rieb

ENTER DATES(FY) FUNDS COMMITTED AND PAID*

CHECKED BY

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST		TOTAL	* DATES		REF.
				LABOR	MATERIAL		C	P	
BAGGING SYSTEM					80,000	80,000			
CONTINGENCY 15%						12,000			
TOTAL					92,000	92,000			

AEROJET MANUFACTURING COMPANY

PAGE 1 OF 5

SUBJECT OVER ARK WELD EQUIPMENT		REV.	NO.
COST ESTIMATES		WORK ORDER	DATE 12-16-76
PREPARED BY Reb	CHECKED BY	APPROVED BY	SCALE

PRELIMINARY DESIGN

MECHANICAL

CONTAINMENT VESSEL (INCLUDES ALL PARTS EXCEPT WELD HEAD)	NO. DWGS 3
VACUUM-ARCS SYSTEM	<u>1</u>
TOTAL	4

(WELD HEAD / CONTROL CONSOLE SUB-CONTRACTED FOR DESIGN & FAB)

USE 200 hr/DWG	40% ME	:	320	hrs
4x200 = 800hrs	40% MD	:	320	hrs
	10% C	:	80	hrs
	39% QE	:	74	hrs
	7% STARS	:	56	hrs

ELECTRICAL

WIRING SCHEMATICS	NO. DWGS 2
BLOCK DIAGRAMS	1
CONTROL CONSOLE	<u>1</u>
	4

200 hr/plot x 3 = 600

BLOCK DIAGRAMS = 20%
620K3

40% EE	:	248
47% ED	:	292
10% C	:	62
39% QE	:	18

TECHWRITER	120 hrs	(PROG SPEC)
PROG MGR	40 hrs	

AEROJET MANUFACTURING COMPANY

PAGE 2 OF 5

SUBJECT OVERPACK WELD EQUIPMENT			REV.	NO.
COST ESTIMATES			DATE 12-16-76	
PREPARED BY <i>Paul</i>	CHECKED BY	APPROVED BY	SCALE	

DETAIL DESIGN

MECHANICAL

	NO DWGS
TOP ASSEMBLY	3
CONTAINMENT VESSEL	4
SLIDE ASSY'S	2
DOME OPENING MECH	3
VACUUM-PRESS SYSTEM	6
	18

87 hrs/day x 18 = 1566	7 hr/day	ME	=	126	hrs
	55	MD	=	990	hrs
	15	C	=	270	hrs
	8	STR	=	144	hrs
	2	QE	=	36	hrs

WELD EQUIP DESIGN ALIGNMENT ME = 180 hrs

ELECTRICAL

WIRING DIAGRAMS	6
WIRING SCHEMATICS	1
CONTROL CONSOLE	6
	13

87 x 13 = 1131	15 hrs/day	EE	=	195 HRS
	55	ED	=	715 HRS
	15	C	=	195 HRS
	2	QE	=	26 HRS

PROG MGR = 60 HRS

AEROJET MANUFACTURING COMPANY

PAGE 3 OF 5

SUBJECT OVER PACK WELD EQUIP				REV.	NO.
COST ESTIMATES			WORK ORDER		DATE 12-16-76
PREPARED BY <i>Lib</i>	CHECKED BY	APPROVED BY	APPROVED BY		SCALE

FABRICATION LIAISON

USE 10% OF TOTAL OF Prelim & Detail Designs.

ME	45	his ↓
EE	44	
MD	131	
ED	100	
C	60	
Q.E.	10	
SR	20	

WELDEQUIP LIA ME 60.

Program Mgv 10

AEROJET MANUFACTURING COMPANY

PAGE 4 OF 5

SUBJECT <i>OVERPACK WELD EQUIPMENT</i>		REV.	NO.
<i>COST ESTIMATES</i>		WORK ORDER	DATE 12-17-76
PREPARED BY <i>lit</i>	CHECKED BY	APPROVED BY	APPROVED BY
		SCALE	

FABRICATION

CONTAINMENT VESSEL

	WEIGHT LBS	WELDED LBS	PAINT LBS	INSTRUMENTS
LOWER CYLINDER 11' x 11' x 1/2" thick <i>100 hrs fab time</i>	2614	3268	2000	5000
UPPER CYLINDER 20' x 2' x 1/2" thick <i>40 hrs fab time</i>	864	1080	800	1864
BOTTOM OF LOWER CYL 3' x 3' x 1/2" thick <i>50 hrs fab time</i>	1382	1758	1000	2728
BOTTOM OF UPPER CYL 6.5' x 6.5' x 1/2" thick <i>120 hrs fab time</i>	2115	3069	2400	6369
FLANGE 5 2" x 7' x 7' x 1/2" thick <i>120 hrs fab time</i>	8328	10586	4800	15386
* COVER = 11' x 11' x 1/2" T	2614	3268	1100	4278
ACTUATOR BRACKETS (Carbon Steel)	2000	1000		
ACTUATOR (pneumatic) T-J (Hose Cylinder)		450		450
BENNING		450		450
CANISTER ALIGNMENT BRACKETS <i>Fab time 20 hrs</i>	100	125	1600	1725
CIRCULAR GEAR - Benning (Flex)		4000		4000
SCIDE ASSEMBLIES (SETCO 6") (2)		730		730
(SEICO 2") (1)		185		185
DRIVE MOTOR (Special for inert atmosphere & Radiation) (FFTP Experience)		150		150
ASSEMBLY OF COMPONENTS (INCLUDING INSPECTION) 280 hrs			5600	5600
GUIDE RAILS & FITTINGS <i>Fab time 160 hrs</i>	500	625	3200	3825
MISC (BOLTS, PHINT ETC)		1000		1000
TOTAL		32614	22500	55,114

Labor Rates \$20/hr

Carbon steel 50¢/lb

NEW CURRENT PRICE FOR SS PLATE

WHICH IS \$1.25/lb

* LUKENS STEEL CO. Catalog used for pricing of head forming

AEROJET MANUFACTURING COMPANY

PAGE 5 OF 5

SUBJECT <u>OVERPACK WELD EQUIPMENT</u>			REV.	NO.
<u>COST ESTIMATES</u>			WORK ORDER	DATE 12-17-76
PREPARED BY <i>Kel</i>	CHECKED BY	APPROVED BY	APPROVED BY	SCALE

WELD HEAD

INTERNAL

FROM PTFE FILE COST OF		
SIMILAR WELD HEAD IN 1973	32,000	32000
ESC 8.5%/yr for 3 years		8870
		40870

WELD CONTROL CONSOLE

FROM PTFE FILE COST OF		
SIMILAR CONSOLE IN 1973	29,000	29000
ESC 8.5%/year for 3 years		8042
		37042

VACUUM-PRESSURE SYSTEM

VACUUM PUMP - 2.5 GPM Capacity	2000	
TUBING, ALUMINUM FITTINGS	4000	
FILTER (HEPA TYPE) HOUSING FILTER	1000	
	7000	for SAREF Premium

CONTROL CONSOLE

FROM PTFE FILE COST OF		
SIMILAR CONSOLE IN 1975	8000	8000
ESC 8.5%/year 1 year		680
		8680

AEROJET MANUFACTURING COMPANY

PAGE 1 OF 3

SUBJECT WASTE COSK VEHICLE		REV.	NO.
COST ESTIMATES		WORK ORDER	DATE 12-17-76
PREPARED BY FOLEY	CHECKED BY	APPROVED BY	SCALE

PRELIMINARY DESIGN	MECHANICAL 400 HRS	ELECTRICAL 100 HRS
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DETAIL DESIGN ("E" Size DWGS)	19	5
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FABRICATION

MOTOR, BRAKES & REDUCER	QUOTE	6939
RAIL CLAMPS (4) FETE BLTC DATA		21700
REEL	QUOTE	700
DIAPHRAM	ENG EST	500
STEEL 23 829 #		17871
LABOR 800 HRS @ 20 ⁰⁰ hr.		<u>16000</u>
		45839

DETAIL DESIGN BREAKDOWN (MECHANICAL)

ASSEMBLY	3
CLAMPS	7
DIAPHRAM	1
WHEELS	1
STEEL	4
MISC	<u>3</u>
	19

AEROJET MANUFACTURING COMPANY

PAGE 2 OF 3

SUBJECT WASTE CASK VEHICLE COST ESTIMATES		REV.	NO.
PREPARED BY J. T. ZYLKOWSKI		WORK ORDER 498-01 1000	DATE 12-8-76
CHECKED BY	APPROVED BY	APPROVED BY	SCALE

$W10 \times 112 \text{ WF}$ $I_{xx} = 719$ $d = 11.38$
 $Z_{xx} = 126$ $w = 10.415$
 $r_{xx} = 4.67$

$W24 \times 84 \text{ WF}$ $I_{xx} = 2370$ $d = 24.09$
 $Z_{xx} = 197$ $w = 9.015$
 $r_{xx} = 9.79$

MAJOR FRAMEWORK

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PAGE 3 OF 3

PROJECT WASTE CASK VEHICLE COST ESTIMATES		REV.	NO.
PREPARED BY J. T. CYLKOWSKI		WORK ORDER 1948-01 1000	DATE 12-8-76
CHECKED BY	APPROVED BY	APPROVED BY	SCALE

$$\begin{aligned}
 8(12)(112) &= 10752^* = 10'' \text{ WF} \\
 108^2(.7854)(.2835) &= 2597^* = 1'' \text{ BLADDER SUPPORT PL} \\
 144^2(.2835) - 2600 &= 3282^* = 1'' \text{ TOP PL} \\
 80^*(39') &= 3120^* = \text{SPLIT } 24'' \text{ WF} \\
 24^2(.7854)(.2835)(6)(4) &= 3078^* = 4 \text{ CRANE WHEELS (24" DIA)} \\
 \text{UNDERCARRIAGE} &= 21000^* = \text{AXLE BLOCKS \& SUPPORTS} \\
 \hline
 &23829^*
 \end{aligned}$$

BLADDER

$$70'' \text{ EFFECTIVE DIA} = 8824 \text{ IN}^2$$

$$260000^* \text{ LOAD} = 30 \text{ PSI SHOP AIR}$$

AEROJET MANUFACTURING COMPANY

PAGE 1 OF 1

SUBJECT WASTE CASK ELEVATOR		REV.	NO.
COST ESTIMATES		WORK ORDER	DATE 12-17-76
PREPARED BY FOLEY	CHECKED BY	APPROVED BY	APPROVED BY SCALE

PRELIMINARY DESIGN

ELECTRICAL
200 HRS

MECHANICAL
400 HRS

DETAIL DESIGN (E" SIZE DWGS)

5 DWGS

12 DWGS

FABRICATION

SCREW JACKS (4 lgs)	\$4624 @ Quote	\$18,496
MOTOR & CONTROLS WITH BRAKES	RETIRED QUOTE	15,000
CAM BEARINGS (24)	QUOTE 2750 @	660
COUPLINGS (10)	QUOTE 308 @	3080
SHAFTS 15" long (4 lgs)	\$65 @ Eng est	260
SHAFTS 4 1/2' long (2 lgs)	\$165 @ Eng est	330
PILLOW BLOCKS (4)	5533 QUOTE	220
MISC (BOLTS, NUTS, PAINT, ETC)		1000

STEEL

W-10-112WF 36 FT	4032 #	
PLATES 10 (16x10x1)	464 #	
SIDE BEAM 75'x2.25'x 1/3	5637 #	
	10,133	7600

LABOR 450 HRS @ 20.00/hr		9000
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TOTAL 55,666

AEROJET MANUFACTURING COMPANY

PAGE 1 OF 3

SUBJECT <i>WASTE CASE PALLET</i>			REV.	NO.
<i>COST ESTIMATE</i>			WORK ORDER	DATE <i>12-17-76</i>
PREPARED BY <i>FOLEY</i>	CHECKED BY	APPROVED BY	APPROVED BY	SCALE

PRELIMINARY DESIGN

MECHANICAL

500 hrs

DETAIL DESIGN (NO E" SIZE DWGS)

6 SATS

FABRICATION

<i>Tie Down</i>	<i>EST</i>	
		<i>\$ 1000</i>
<i>STEEL</i>	<i>18,400 lbs</i>	<i>13,800</i>
<i>MISC (Paint, etc)</i>		<i>500</i>
<i>LABOR</i>	<i>600 hrs @ 20⁰⁰/hr</i>	<i>12,000</i>

(LABOR EST)

<i>WELDING</i>	<i>HRS</i>
	<i>150</i>
<i>RAIL MACHING</i>	<i>40</i>
<i>WELD PREP</i>	<i>100</i>
<i>CUTTING</i>	<i>150</i>
<i>INSPECTION</i>	<i>40</i>
<i>PAINTING</i>	<i>40</i>
<i>WELD DRESSING</i>	<i>20</i>
<i>GRIND TOP & BOTTOM</i>	<i>50</i>
<i>STRESS RELIEVE</i>	<i>30</i>
	<i>600</i>

AEROJET MANUFACTURING COMPANY

PAGE 2 OF 3

SUBJECT <div style="font-size: 1.2em; font-weight: bold;">WASTE CASE PALLET</div> <div style="font-size: 1.2em; font-weight: bold;">COST ESTIMATE</div>			REV.	NO.
WORK ORDER			DATE	
1948-01 1000			12-7-76	
PREPARED BY	CHECKED BY	APPROVED BY	APPROVED BY	SCALE
J. T. ZYLKOWSKI

$$\begin{array}{r}
 5879\# \\
 - 1003\# \text{ RECESS} \\
 \hline
 4876\#
 \end{array}$$

$$W = 2939 + 1440 + 4876 + 939 + 8196 = 18390$$

CHANNEL

$$I_{xx} = \frac{1.5(14^3) - [9.5^3(1.5-.5)]}{12} = \frac{4116 - 957.375}{12} = 271.55$$

$$A = 21 - 9.5 = 11.5 \text{ in}^2$$

$$W = 11.5(2835)144 = 469.5\#$$

$$Z = \frac{271.55}{7} = 38.8$$

$$\begin{array}{r}
 I_{LONG} = 1670(3) = 3210 \\
 162(2) = 324 \\
 271.55(2) = 543 \\
 \hline
 4077
 \end{array}$$

$$\begin{array}{r}
 Z_{LONG} = 163(3) = 489.0 \\
 38.8(2) = 77.6 \\
 27.0(2) = 54.0 \\
 \hline
 620.6
 \end{array}$$

AEROJET MANUFACTURING COMPANY

PAGE **3** OF **3**

SUBJECT WASTE CRASH PALLET COST ESTIMATE		REV.	NO.
PREPARED BY J. T. ZYLKOWSKI		WORK ORDER 1948-01 1000	DATE 12-7-76
CHECKED BY	APPROVED BY	APPROVED BY	SCALE

$$S_{MAX LONG} = - \frac{218.39 (10^3) 120}{8 (620.6)} = - \frac{26206.8 (10^3)}{4.9648 (10^3)} = - 5279 \text{ PSI}$$

$$Y_{LONG MAX} = .013 \frac{218.39 (10^3) (2.986) (10^4)}{29 (10^3) (4.077) (10^3)} = .013 \frac{652.11}{118.233} = .072"$$

AEROJET MANUFACTURING COMPANY

PAGE 1 OF 2

SUBJECT HIGH PRESSURE WATER DECONTAMINATION SYSTEM		REV.	NO.
COST ESTIMATES		WORK ORDER	DATE
PREPARED BY FOLEY	CHECKED BY	APPROVED BY	APPROVED BY
		SCALE	

DESIGN

	DESIGN (HRS)	DETAIL NO DWGS
ENCLOSURE	100	3
SPRAY MANIFOLD	100	3
ROLLER SYSTEM & PRELOADER	100	4
ROLLER DRIVE (BOTTOM)	100	4
HORIZONTAL SLIDE SYSTEM	100	6
PLUMBING & EQUIPMENT	500	
TRIPLEX PUMP		1
TRANSFER PUMP		1
BOOSTER PUMP		1
FILTER		1
SCREEN		1
RAD MONITOR		2
VAPOR CONDENSER		3
INFLATABLE SEAL		2
FLEXIBLE LINES		2
HARD PIPING		2
WATER TANK		1
TOTAL MECHANICAL	1000 HRS	37 DWGS
ELECTRICAL INCL CONTROL CONSOLE	400 HRS	16 DWGS

Page 2 of 2

Report Title				Program	
HIGH PRESSURE WATER DECON SYSTEM COST ESTIMATES				Work Order	
Prepared By	Date	Checked By	Date	Revision	Date
R.S. FOLEY	12-21				

HARDWARE

		Cost
ENCLOSURE	EST.	25000
SPRAY MANIFOLD (PRECISION HEADS)	EST.	1500
ROLLER SYSTEM	EST.	3000
INFLATABLE SEAL	FFTF PROVIDED	1000
VAPOR CONDENSER (A.H.P.)	EST.	4000
BOOSTER PUMP 3 H.P.	QUOTE	800
TRANSFER PUMP 1 H.P.	EST.	500
1/4 FILTER (2)	QUOTE	2400
COARSE FILTER	EST.	1000
HORIZONTAL DRIVE SYS	EST.	4000
TANK	EST.	1500
RADIATION MONITOR	EST.	1200
VALVES	EST.	2000
FLEXIBLE LINES (FURNISHED)	EST.	3000
CONTROL CONSOLE (ASSEMBLED)	HFET SUPPLY	3500
H.P. PUMP	QUOTE	13950
MISC	EST.	
TOTAL HARDWARE		5000
ASSEMBLY LABOR 300 hrs @ 20.00		104850
AND SHOP TEST		6000
		116000

AEROJET MANUFACTURING COMPANY

PAGE 1 OF 2

SUBJECT <i>WIRE BRUSH DECONTAMINATION SYSTEM</i>		REV.	NO.
<i>(COST ESTIMATES)</i>		WORK ORDER	DATE
PREPARED BY <i>Foley</i>	CHECKED BY	APPROVED BY	SCALE

DESIGN

	APPROXIMATE (HRS)	DETAIL NO DWGS
ENCLOSURE	100	3
SPRAY MANIFOLD	40	2
BRUSH DRIVE	200	4
ROLLER SYSTEM	100	2
HORIZONTAL TRANSFER	FROM H.P. WATER DECON	2
PLUMBING EQUIPMENT	250	
CIRCULATING PUMP		1
SCREEN		1
FILTER		1
RAD MOUNT	} Similar to or same as H.P. system	2
VAPOR CONDENSER		3
INFLATABLE SEAL		2
FLEXIBLE LINES		2
WATER TANK		1
HARD PIPING		2
WATER TANK		1
 TOTAL MECHANICAL	 690 HRS	 29 sheets
ELECTRICAL INCL CONTROL CONSOLE	400 HRS	16 sheets

Page 2 of 2

Report Title BRUSH AND WATER DECON SYSTEM COST Estimates				Program	
				Work Order	
Prepared By R.S. FOLEY	Date 12-21	Checked By	Date	Revision	Date

HARDWARE

ENCLOSURE	EST	30000
SPRAY MANIFOLD	EST	500
ROLLER SYSTEM	EST	2000
INFLATABLE SEAL	FFTF PROGRAMED	1100
VAPOR CONDENSER	EST	4000
CIRCULATING PUMP	QUOTE	800
TRANSFER PUMP	EST	500
1/4" FILTER (2)	QUOTE	2400
COARSE FILTER	EST	500
HORIZONTAL DRIVE SYS	EST	4000
TANK	EST	1500
RADIATION MONITOR	EST	1200
VALVES	EST	2000
FLEXIBLE LINES	EST	35000
CONTROL CONSOLE	FFTF SIMILAR	2400
BRUSHES	QUOTE	5000
BRUSH DRIVE	EST	3000
BRUSH LOADING	EST	5000
MISC	EST	
ASSEMBLY LABOR	400 hr @ 20 ⁰⁰	100900
AND SHOP TEST		8000
		<u>\$ 108,900</u>

AEROJET MANUFACTURING COMPANY

PAGE 1 OF 1

SUBJECT <i>HOT CELL SUPPORT EQUIPMENT</i>		REV.	NO.
<i>BAGGING EQUIPMENT</i>		WORK ORDER	DATE
PREPARED BY <i>M. J. RIEB</i>	CHECKED BY	APPROVED BY	SCALE

THE COST OF A BAGGING SYSTEM WAS OBTAINED FROM PERSONNEL AT AIRCRAFT MANUFACTURING PLANTS IN IDAHO. THESE PEOPLE USE THE BAGGING TECHNIQUE EVERY TIME THEY HAVE ANY TYPE OF CHECK TO THE HEE-N HOT CELL.

CURRENT COST

INCLUDES BAG WELDER,
ADAPTER COILS, BAGS, ETC

85,000