SOLID WASTE AND MATERIALS SYSTEMS ALTERNATIVES STUDY

VOLUME II

ENGINEERING ANALYSIS

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ENGINEERING ANALYSIS

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1.0 OBJECTIVE

This study is undertaken to provide alternative analysis in support of completion of Hanford Federal Facility Agreement and Consent Order (TPA) milestone M-33-00. The study defines alternatives in support of new TPA milestones for integrated storage, processing, and disposal of solid wastes and materials.

1.1 BACKGROUND AND SCOPE

A wide variety of solid radioactive waste and materials have been generated from past operations on the Hanford Site. Ongoing and planned activities, mostly associated with the cleanup of the Hanford Site, will generate additional solid radioactive waste and materials. Site planning activities must address the need for storage, treatment and disposal of these solid radioactive materials. The description of TPA milestone M-33-00 states that the solid materials to be addressed may include:

Unirradiated uranium	Cs/Sr Capsules
Contaminated soil	Contaminated processing equipment
N Reactor fuel	Special Nuclear Material
D&D generated wastes	Vitrified HLW waste canisters
	Radioactive/hazardous solid wastes

Each of these materials have been assessed regarding integration of planning for storage, processing and disposal. In addition to the specifically identified wastes and materials investigation of other candidate radioactive solid waste and materials was undertaken. This was done to identify all potential wastes and materials that could fit within the scope of TPA Milestone M-33-00.

Of particular interest has been the management of highly radioactive wastes and materials and oversized solid radioactive wastes, due to the specialized handling requirements of such materials. Previous site planning for disposition of remote-handled waste and other difficult to handle solid waste and materials was based on the existence of separate facilities to perform distinct portions of the work. A formal systems engineering approach to determine common functions and requirements associated with management and disposition of these wastes and materials was not originally undertaken. This study provides analysis of alternatives that fulfill the functions for the waste and materials of concern.

1.2 PURPOSE AND NEED

This engineering study provides supporting information for completion of TPA milestone M-33-00-T4. The study examines the radioactive solid wastes and materials that are within the scope of TPA milestone M-33-00. The storage, processing and disposal needs of the various portions of the inventory are examined and alternatives are developed to compare configurations of new facilities and modified existing facilities.

has remained current since the assessment completed for ERDA-1538.

Site planning activities adequately address future needs for continued disposal of these solid radioactive materials. For this reason, low level waste is not addressed in this study.

1.3.1.2 Buried TRU Contaminated Waste (buried prior to 1970).

In the Environmental Impact Statement Disposal of Hanford Defense High-Level, Transuranic and Tank Waste (HDW-EIS) (DOE/EIS-0113) the Department of Energy made a comprehensive effort to identify and select the means for permanently disposing of existing and future defense wastes at the Hanford Site. A wide range of methods was examined for permanently disposing of among other wastes, pre-1970 buried suspect TRU-contaminated solid waste. It was decided in the HDW-EIS Record of Decision to conduct additional development

Various common waste and material classifications is presented in Section 1.6 of this document.

Each of these materials were considered regarding the relative integration to the proposed scope of providing storage, treatment and disposal for the range of materials addressed. Certain materials were not included in the primary scope of the alternatives addressed under this study in Section 6. These are identified below. Not including these materials in the scope of the study could affect the relative performance of alternatives and thus the outcome of the engineering analysis.

1.3.1 Materials Not Addressed in the Set of Alternatives

The following waste and material classifications were not considered in the set of alternatives examined in Section 6: low level waste, buried TRU contaminated waste (buried prior to 1970), TRU contaminated soil, special nuclear material, spent nuclear fuel. The reasoning for not including these materials within the scope of the alternatives is discussed below.

1.3.1.1 Low Level Waste.

Several alternatives were evaluated in the Final Environmental Statement Waste Management Operations, Hanford Reservation (ERDA-1538) to assess the environmental impact of continuing waste management operations at the Hanford Reservation. The ongoing practice described in ERDA-1538 is to place solid radioactive waste into the ground at several locations in the 200 Areas after minimal processing. The assessment from ERDA-1538 showed these burials do not and are not expected to have an offsite environmental impact. This strategy has remained current since the assessment completed for ERDA-1538.

Site planning activities adequately address future needs for continued disposal of these solid radioactive materials. For this reason, low level waste is not addressed in this study.

1.3.1.2 Buried TRU Contaminated Waste (buried prior to 1970).

In the Environmental Impact Statement Disposal of Hanford Defense High-Level, Transuranic and Tank Waste (HDW-EIS) (DOE/EIS-0113) the Department of Energy made a comprehensive effort to identify and select the means for permanently disposing of existing and future defense wastes at the Hanford Site. A wide range of methods was examined for permanently disposing of among other wastes, pre-1970 buried suspect TRU-contaminated solid waste. It was decided in the HDW-EIS Record of Decision to conduct additional development

ultimate disposition warranted not including it within the scope of this study. It is suggested that impacts of treatment, storage, and disposal of this material be addressed at some future point in time.

1.3.1.3 TRU Contaminated Soil.

Like the pre-1970 buried suspect TRU-contaminated solid waste described above the TRU contaminated soil was examined in the HDW-EIS. It was decided in the HDW-EIS Record of Decision to conduct additional development and evaluation before making decisions on final disposal of TRU contaminated soil. This development and evaluation effort will focus both on methods to retrieve and process these wastes for disposal as well as to stabilize and isolate the wastes near surface.

It is estimated that 32,000 m^3 of TRU contaminated soil is located at the Hanford Site. No decision has been made regarding disposition of this material based on a development and evaluation effort subsequent to the HDW-EIS. With this in mind it was considered that a stream of this magnitude with its own distinct characteristics could drive or significantly impact the design of facilities within the alternatives examined. The high level of uncertainty of the ultimate disposition warranted not including it within the scope of this study. It is suggested that impacts of treatment, storage, and disposal of this material be addressed at some future point in time.

1.3.1.4 Special Nuclear Material.

Although there may be a common "storage" function identified for special nuclear material (mainly plutonium) and some of the other materials under consideration, the specific requirements affecting that function are sufficiently distinct. The difference in requirements, rather than promote integration of plutonium and waste storage would in fact discourage it. The cost and complexity of dealing with requirements from: domestic safeguards and security, international (International Atomic Energy Agency) safeguards, criticality accident and nuclear safety analysis will negatively affect any integrated operations involving both plutonium and the materials included within the scope of the evaluation. The difference in requirements is an appropriate reason for dealing with special nuclear materials separately and outside the scope of this study.

The future of plutonium storage and disposition for Hanford as well as the nation is currently under evaluation in the national DOE Programmatic EIS for Storage and Disposition for Weapons Usable Material. Alternatives for

1.3.1.5 Spent Nuclear Fuel.

The future of spent nuclear fuel storage and disposition for Hanford as well as the nation is under evaluation in the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (SNF PEIS). Alternatives for spent nuclear fuel management include centralization, regionalization and decentralization. The preferred alternative in the SNF PEIS calls for existing defense production spent nuclear fuel at the Hanford Site remaining here. Site-specific NEPA documents are being prepared to implement the programmatic decisions made in the SNF PEIS. At Hanford the preparation of an Environmental Impact Statement for the Management of Spent Nuclear Fuel From the K-Basins at the Hanford Site is underway. Any decision on removal and subsequent management of K-Basins spent nuclear fuel would be made and implemented in a manner consistent with programmatic decisions on management of all of DOE's spent nuclear fuel.

In a November 1993 report entitled, "Spent Fuel Working Group Report on Inventory and Storage of the Department's Spent Nuclear Fuel and other Reactor Irradiated Nuclear Materials and their Environmental, Safety, and Health Vulnerabilities," DOE identified K-Basins storage problems as requiring priority attention. Similar findings have been reached by the Defense Nuclear Facilities Safety Board, in its recommendation 94-1, and by DOE stakeholders. DOE proposes to take expeditious action to reduce risks to public health and the environment by removing SNF from the K-Basins and, subsequently, to take action to manage the SNF in a safe and environmentally sound manner for up to 40 years until ultimate disposition decisions are made and implemented. These expeditious actions are underway and are already reflected in the scope of the TPA under milestone M-34.

1.3.2 Interfaces Between Materials Not Considered and this Study

Although not included within the scope of this study, potential interfaces exist between a subset of the materials excluded from the scope of this study and those materials within the scope of this study. The potential interfaces are with: buried TRU contaminated waste (buried prior to 1970), TRU contaminated soil, special nuclear material, spent nuclear fuel, vitrified low level tank waste, environmental restoration disposed mixed waste, transuranic tank waste, and contaminated sodium from the Fast Flux Test Facility. These materials or associated activities are not addressed within the scope of the alternatives in this study.

material is necessary impacts to storage and treatment facilities will have to be identified.

1.3.2.2 TRU Contaminated Soil.

A potential interface may also exist between TRU waste storage and processing and TRU contaminated soil depending on the ultimate decision made regarding disposition of this material. The Fiscal Year 1995 Hanford Mission Plan planning basis calling for "...contaminated materials disposed of in situ within the 200 Areas will be limited to hazardous constituents and radionuclides containing TRU components at concentrations below 100 nCi/g" would also apply to TRU contaminated soil sites. Further definition of this planning basis will be required to determine how radionuclide concentrations are to be determined. If future decisions determine that retrieval, processing, storage and off site disposal of this material is necessary impacts to storage and treatment facilities will have to be identified.

1.3.2.3 Special Nuclear Material.

Potential interfaces or conflicts may arise from future needs associated with special nuclear material processing and storage. Among these interfaces are competing uses for facilities, recategorization of special nuclear material as waste, and additional waste generation. Each of these are described below

In addition to uses this study has examined for the Fuels and Materials Examination Facility (FMEF), the FMEF is under consideration for use for plutonium storage and mixed plutonium oxide uranium oxide nuclear fuel fabrication as part of the national programmatic environmental impact statement on plutonium storage/disposition. FMEF is also under consideration for pit storage as part of a PANTEX EIS for increased pit storage capacity. In the past FMEF has also been evaluated for a hot lab, a pretreatment pilot plant and hot melter test facility among other uses. Recent public announcements have opened the possibility of "private" use for FMEF. Any other interested party considering use of the FMEF could declare their intent making the facility unavailable for use.

Although not very likely, especially while the programmatic EIS on plutonium storage and disposition is underway, there is a possibility that a portion of the special nuclear material could be categorized as waste. Categorization of the four metric tonnes of surplus plutonium as waste would only complicate matters. The waste categorization would add additional regulatory requirements to the storage function and the requirements for

storage of this material in the 200 Area of the Hanford site may allow for collocation of storage of portions of the material under the scope of this study. Particular materials which may be suited to collocated storage include cesium and strontium capsules and miscellaneous sources of material.

1.3.2.5 Vitrified Low Level Mixed Tank Waste.

The Defense Nuclear Facilities Safety Board recommended in Recommendation 94-2 to the Secretary of Energy that:

> More immediate steps be taken to complete the performance assessment process for all active low-level waste burial sites as required by DOE Order 5820.2A. In so doing clarifying instructions should be issued to insure that:
>
> a. Performance assessments are based upon the total inventories (past, present, and future) emplaced or planned for the burial site(s).
>
> b. Performance objectives (dose criteria) of DOE Order 5820.2A are achieved for the composite of all low-level waste disposal facilities on the site.

To this end performance assessments of the low level mixed tank waste disposal site should be integrated with the performance assessment of all other low level burial sites within and outside the scope of the M-33 engineering study.

1.3.2.6 Environmental Restoration Disposed Mixed Waste.

The Defense Nuclear Facilities Safety Board's Recommendation 94-2 to the Secretary of Energy (described above) would also apply to environmental restoration disposed mixed waste. To this end performance assessments of the environmental restoration disposed mixed should be integrated with the performance assessment of all other low level burial sites within and outside the scope of the M-33 engineering study.

decontamination, shipping, etc. of the potential TRU tank waste with the remote-handled TRU waste under investigation in this study. Examination of common needs should be investigated.

1.3.2.8 FFTF Contaminated Sodium.

As part of the decommissioning process for the Fast Flux Test Facility (FFTF) a new facility required to support the transition of FFTF, a sodium storage facility will be constructed. A sodium reaction facility will also be constructed to convert the sodium to an acceptable form for reuse or disposal. These new facilities will be constructed adjacent to the FFTF complex to support sodium drain operations and subsequent sodium conversion. Tri-Party Agreement milestones (milestone M-81) have been negotiated and agreed to within the last few months providing a plan to establish a safe and environmentally secure configuration for the FFTF. The stored sodium will be converted to an acceptable form and either used as a product by DOE's Tank Waste Remediation System (TWRS) tank waste pretreatment process, or properly disposed.

An area of potential interface exists regarding combination of storage and/or conversion of the FFTF sodium and the Hallam and SRE in the same location. The current planning does not call for integrating storage or processing of these materials but feasibility of doing so could be examined if the affected programs were interested in pursuing combining these functions.

1.4 DETERMINATION OF SCOPE OF FUNCTIONS

The functions included in this study are discussed below. The functions of interest are namely those referred to in the wording of the milestone, "...for storage, processing and/or disposal of solid waste and materials...". This study will not integrate those site wide functions that are identified under separate TPA milestones specific to those wastes (e.g., vitrification of low level tank waste under TPA Milestone M-60-00, vitrification of high level tank waste under TPA Milestone M-51-00, operation of the Environmental Restoration Disposal Facility under TPA Milestone M-70-00, disposition of spent nuclear fuel under M-34-00, etc.). Rather than integrate those functions identified under separate TPA milestones an attempt will be made to examine areas of potential interface for benefit.

alternatives. In determining the level of integration (or segregation) of the wastes and materials of interest there are two options for each stream of interest (integration or segregation). For example, if we assume that we have fourteen streams to deal with that would give us 2^{14} or 16,384 different combinations of integration/segregation of streams. Clearly some of these potential combinations do not make sense (integrate cesium capsules with unirradiated uranium or segregate cesium capsules and strontium capsules). Rather than try to examine the myriad of combinations available, engineering judgement was used to try to integrate streams where effective and reasonable to do so. Also, since this study is related to integration of the needs associated with the various streams, treating each stream in a completely segregated manner was not considered. Finally, the combination of alternatives available for the number of facilities could be based on how many facilities to consider (one, two, three, four, etc.). Rather a distinction was made whether a single facility (contiguous location) or multiple facilities (not necessarily contiguous) was made. The number of facilities that would be required in the modular approach is based on engineering judgement.

This leads to the set of four alternatives that are examined in this engineering study. Looking at the three variables of interest in the manner discussed above leads to eight alternatives. Two of these alternatives are not physically feasible (segregated processing in a single facility - either new or existing). Two additional alternatives were not considered to be of interest (segregated processing in modular facilities - either new or existing) since the study is interested in the potential for integration of streams. This leads to the four alternatives considered in this study: a single new facility (contiguous location) integrating all stream processing and storage; multiple new facilities integrating stream processing and storage (where effective); a single existing facility (contiguous location) integrating all stream processing and storage; and multiple existing facilities integrating stream processing and storage (where effective).

No consideration is made in the alternative set regarding source of funding for the new facility alternatives. It is assumed that these alternatives could either be pursued as capital projects or the defined scope of the alternatives could be privatized.

Transuranic Waste Low Level Mixed Waste Greater Than Category 3 Low Level Waste Low Level Waste		Contaminated processing equipment
Special Nuclear Material	Material	Special Nuclear Material
High Level Waste	Waste	Vitrified HLW waste canisters
Transuranic Waste Low Level Mixed Waste Greater Than Category 3 Low Level Waste Low Level Waste	Waste	Radioactive/hazardous solid wastes

Table 1.5-1. Basis for Alternative Set for this Engineering Study.

Alternative Feasibility	New/Existing Facility	Integrated/ Segregated Streams	Single/ Modular Facilities	Alternatives Considered
Yes	New	Integrated	Single	1
Yes	New	Integrated	Modular	2
No	New	Segregated	Single	Infeasible
Yes	New	Segregated	Modular	Not Included
Yes	Existing	Integrated	Single	4
Yes	Existing	Integrated	Modular	3
No	Existing	Segregated	Single	Infeasible
Yes	Existing	Segregated	Modular	Not Included
Yes	Programs Planning Bases			5

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2.0 UNCERTAINTIES

The uncertainties associated with the particular aspects (inventory, function, alternative analysis, etc.) of this study have been delineated in the various sections of the document where they pertain. It is not intended to consolidate all assumptions made throughout the report in this section. This section will list significant assumptions relative to the particular aspects of the study.

2.1 INVENTORY UNCERTAINTIES

Any uncertainties associated with the waste and materials inventory are identified in Section 4 of this document.

2.2 FUNCTIONS AND REQUIREMENTS UNCERTAINTIES

Any uncertainties associated with the functions and requirements are identified in Section 5 of this document.

2.3 MATERIAL PROCESS FLOWS UNCERTAINTIES

Uncertainties are identified in Section 6.3 of this document.

2.4 ALTERNATIVES UNCERTAINTIES

2.4.1 Alternative 1

Temperature requirements for safe storage of cesium and strontium capsules in air have not yet been determined. Temperature restraints could dramatically affect cost and the choice of the best/cost effective alternative. Depending on temperature requirements, design criteria for ventilation could require anything from a passive ventilation system to more expensive forced air ventilation and potential associated control systems which could be Safety Class I. Completion of associated Safety Analysis Reports and resultant operational costs could be much more expensive if Safety Class 1/OSRs are identified. Choice of a preferred alternative could be affected by the determination of these requirements.

Other uncertainties are identified in Section 6.4 of this document.

2.4.2 Alternative 2

Temperature requirements for safe storage of cesium and strontium capsules in air have not yet been determined. Temperature restraints could dramatically affect cost and the choice of the best/cost effective alternative. Depending on temperature requirements, design criteria for ventilation could require anything from a passive ventilation system to more expensive forced air ventilation and potential associated control systems which could be Safety Class I. Completion of associated Safety Analysis Reports and resultant operational costs could be much more expensive if Safety Class 1/Operating Safety Requirements are identified. Choice of a preferred alternative could be affected by the determination of these requirements.

Other uncertainties are identified in Section 6.5 of this document.

2.4.3 Alternative 3

Temperature requirements for safe storage of cesium and strontium capsules in air have not yet been determined. Temperature restraints could dramatically affect cost and the choice of the best/cost effective alternative. Depending on temperature requirements, design criteria for ventilation could require anything from a passive ventilation system to more expensive forced air ventilation and potential associated control systems which could be Safety Class I. Completion of associated Safety Analysis Reports and resultant operational costs could be much more expensive if Safety Class 1/OSRs are identified. Choice of a preferred alternative could be affected by the determination of these requirements.

Other uncertainties are identified in Section 6.6 of this document.

2.4.4 Alternative 4

Uncertainties are identified in Section 6.7 of this document.

2.4.5 Alternative 5

Uncertainties are identified in Section 6.8 of this document.

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3.0 ASSUMPTIONS

The assumptions associated with the particular aspects (inventory, function, alternative analysis, etc.) of this study have been delineated in the various sections of the document where they pertain. It is not intended to consolidate all assumptions made throughout the report in this section. This section will list significant assumptions relative to the particular aspects of the study.

3.1 INVENTORY ASSUMPTIONS

The forecasted inventory of solid waste is based on the information provided in the *Solid Waste 30-Year Volume Summary* (WHC-EP-0768). The forecast inventory information (volume, waste types, characteristics, etc.) presented in the reference document was used without modification. Any known changes from the forecast (e.g. cancellation of the HWVP project) were ignored assuming that a similar facility or function would exist that would also produce waste requiring management.

3.2 FUNCTIONS AND REQUIREMENTS ASSUMPTIONS

Functions for this study are based on the *Systems Engineering Functions and Requirements for the Hanford Cleanup Mission* (WHC-EP-0722). It is assumed that the defined functions completely define the functions necessary for the Hanford cleanup mission.

3.3 MATERIAL PROCESS FLOWS ASSUMPTIONS

No thermal treatment was pursued for the remote-handled low-level mixed waste. Of the 96,000 cubic meters of stored and projected remote-handled low-level mixed waste roughly 100 cubic meters would require incineration and about 3,000 cubic meters would benefit from incineration although incineration may not be required. Because of the very limited quantity of material requiring thermal treatment it was assumed that thermal treatment would not be provided. Rather waste would assumed to be stabilized.

Any material that is known to be, or suspected of being contaminated with transuranium radionuclides shall be evaluated as soon as possible and determined to either recoverable material, transuranic waste, low level waste, mixed waste, or non-radioactive trash in order to avoid commingling the various material streams. Low level waste shall be separated from uncontaminated waste to facilitate cost effective treatment and disposal. Mixed waste shall be separated from non-hazardous waste to facilitate cost effective treatment and disposal.

No processing or packaging for final disposal will be pursued for any greater than category 3 low level waste. This is based on no national policy having been established for management of this material.

The terms "overpack" and "cask" are used to describe external containers used to contain an internal container and/or large self-contained items. Internal containers used within the study include a number of different size drums, boxes canisters and miscellaneous other containers.

3.4 ALTERNATIVES ASSUMPTIONS

Assumptions specific to each of the alternatives are identified in Section 6 of this document. The following lists the alternatives by section:

Section	Alternative
6.4	Single New Facility Integrating Storage and Processing Needs
6.5	Multiple New Modular Facilities Integrating Storage and Processing Needs
6.6	Multiple Existing Facilities Integrating Storage and Processing Needs
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4.0 WASTE AND MATERIALS INVENTORY

This section provides information about the inventory of waste and materials that are included in the scope of this study. The inventory information is categorized by the classification of the material relative to applicable DOE Orders. Following are definitions of the various categories of waste and materials addressed in this study:

High-Level Waste--Highly radioactive waste material resulting from reprocessing spent nuclear fuel and including liquid and solid waste that contains a combination of transuranic waste and fission products in concentrations that require permanent isolation (DOE 1988).

Transuranic Waste--A type of waste regardless of source or form that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years, and concentrations greater than 100 nCi/g at the time of assay. Heads of field elements can determine that other alpha contaminated wastes, peculiar to a specific site, must be managed as transuranic waste (DOE 1988).

Low-Level Mixed Waste--(Mixed Waste is) Waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively. (Low-Level Waste is) Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, or 11e(2) byproduct material as defined by this Order. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic is less than 100 nCi/g (DOE 1988).

Greater Than Category 3 Low-Level Waste--Based on "table" definition as provided in Table 3-1 of Hanford Site Solid Waste Acceptance Criteria (Willis 1993).

Miscellaneous Materials

- Nuclear Material--A collective term for materials subject the provisions of DOE Order 5660.1B (DOE 1994). This refers to the unirradiated uranium inventory.
- Contaminated Sodium--No definition is provided for this category of material.

Cesium and Strontium Capsules--Double-encapsulated high-heat-generating isotopes ^{90}Sr and ^{137}Cs removed from the single-shell tank waste. These isotopes are contained in double-encapsulated metal capsules as SrF_2 and CsCl (DOE 1987).

Details regarding quantities (volumes), physical, chemical, and radiological characteristics of each of these wastes and materials can be found within this section. An inventory volume summary is shown in Table 4.0-1, and is pictorially represented in Figure 4.0-1. Volumes are represented with two significant figures, excluding those less than ten, where more may be allotted. Table 4.0-2 summarizes various characteristics of the wastes and materials. For a more detailed discussion refer to Appendix C.

4.1 HIGH-LEVEL WASTE (HLW)

4.1.1 HLW Canisters

The HLW immobilization glass product is a borosilicate glass (or equivalent) with a leach rate less than the environmental assessment (EA) benchmark glass using the product consistency test. The leach rate is acceptable where the concentration of lithium, sodium and boron in the leachate, after normalization for the concentration in glass, is less than that of the EA benchmark glass (DOE-OCRWM 1993).

Assuming a specific gravity of 2.66 and a level production rate during the 19 years of operation as stated in the Ecology et al. 1990 (TPA) the volume of HLW glass is approximately 8,600 m^3 (Orme 1994).

4.1.1.1 HLW Canister Description. When sufficiently cooled, the filled HLW canisters are sealed with an inner canister closure plug. Preliminary decontamination is performed by a low pressure water spray that removes loose contamination. Final decontamination is accomplished by a frit-blasting process. Canister decontamination is confirmed before onsite interim storage. A final canister seal is done with a welded closure before the canisters are transported to interim storage.

The HLW Vitrification Facility will be designed to produce HLW packages that are larger than the Defense Waste Processing Facility standard canister to reduce the amount of canister handling. The HLW package will meet the acceptance criteria of the Civilian Radioactive Waste Program (ORNL 1994). This HLW package is a 1.26 m^3 canister (3,330 kg of glass). The dimensions of the canister are 68 cm (27 in.) outer diameter x 4.6 m (15 ft) tall.

The transport of HLW casks to the geological repository is planned to begin some time after HLW vitrification is completed. Interim storage of vitrified HLW will be on the Hanford Site.

4.2 TRANSURANIC (TRU) WASTE

4.2.1 Remote-Handled Transuranic Waste (RH-TRU)

4.2.1.1 Stored Remote-Handled Waste. The stored RH-TRU inventory of retrievable stored solid TRU waste is approximately 380 m^3 (Anderson 1991).

4.2.1.1.1 200 Area Trenches. Transuranic waste (140 m^3) unsuitable for asphalt pad or caisson storage because of size, chemical composition, security requirements, or surface radiation has been packaged in reinforced plywood, concrete, or metal boxes, and stored in dry waste trenches.

4.2.1.1.2 200 Area Alpha Caissons. The alpha caissons are underground cylindrical vaults that are used to store small quantities of irradiated and experimental fuels generated during post irradiation exhaustion in the 300 Area in hot cells.

The Alpha Caissons contain a total of 5,534 containers of RH-TRU, with a total volume of 23 m^3, and miscellaneous debris (plastic sheeting, wrapping, etc.) estimated at an additional 5.7 m^3. Most of the waste is contained in 1 gal (4 L) paint cans (roughly 5,400 containers). There are over one hundred containers among other forms; metal scrap, 2 gal (8 L) cans, 4 in. (10 cm) tin cans, 5 gal (20 L) cans, machine trays and tray racks, fuel elements, and equipment. An unknown quantity of grinding/polishing lubricant (kerosene) is contained in the various cans. Small quantities of NaK may also be present.

The most common weight for containers is approximately 5 lb (2.27 kg). There are approximately 1,000 cans in Alpha Caisson's 3 and 4, weighing approximately 10 lb (4.5 kg) each.

All the containers contain some plutonium, and nearly all contain mixed fission products (MFP). The greatest curie content is in the form of MFP. The greatest amount of fissile material is in the form of enriched uranium, especially in Caisson 1.

Most of the radioactivity originates from the MFP category. Most cans contain sources of around 5 Ci, however, the number of cans that are "hotter" is significant with a maximum curie content of 8,000 Ci.

All of the cobalt is in Caisson 4 (290 cans). Most of the cans contain less than 5 Ci, however, a few (approximately ten) contain 50 to 55 Ci. There is a small amount (7 Ci in eight cans) of polonium in Alpha Caisson 4. Every can in every caisson has some plutonium in it. Most cans have less than 2.5 g, however, in Alpha Caisson 4, one-fourth of the cans have more than 2.5 g. The cans holding the greatest amount of plutonium are in Alpha Caisson 1, 32 of the cans have more than 20 g. About one-fourth of the cans in the caissons contain enriched uranium. The maximum load of enriched uranium for Caisson 1 is 1,361 gm/can (eight each), and the maximum load of enriched uranium for Caisson 4 is 671 gm/can (two each). In Alpha Caisson 1, cans typically contain less than 5 g of enriched uranium, however, in the Alpha Caisson 4 location, a significant number of cans contain more than 5 g of enriched uranium.

4.2.1.1.3 618-11 Burial Ground (Demiter 1995). The only Pre-1970 waste considered in this study scope is the transuranic waste from the 618-11 burial site containing drum storage units, and caissons (30 m^3). The vertical underground drum storage units were made by welding five 55-gal drum sections together. The drum storage units are 22 in. (56 cm) in diameter, and 15 ft (4.6 m) long, with the top and bottom of the drum open.

Trench wastes (180 m^3) include concrete and lead shielded 55-gal drums, non-shielded 55, 30, and 15-gal drums or cans, spent high-efficiency particulate air (HEPA) filters, wooden boxes, cardboard cartons, and failed equipment. Highly penetrating beta/gamma waste were buried in the shielded drums, including TRU radionuclides. Waste put into a cardboard carton were typically small items contaminated with MFP and TRU radionuclides; such as surgeon and other rubber gloves, cloth and paper wipes, plastic sheeting and liners, masking tape, and failed or used equipment. Steel drums or cans were often used for large, heavy, or sharp failed equipment, and contaminated lead bricks or shielding. Some wooden boxes were used to dispose of contaminated lead bricks and shielding pieces, broken non-irradiated fuel pieces, and other

metal waste. The HEPA filters, also referred to as control waste system filters, were typically wrapped or lined with plastic and placed in the original manufacturer cardboard container.

The radioactive and other hazardous materials known or suspected to have been buried at the site included solid metallic sodium, sodium-potassium metal liquid (NaK), beryllium residues, contaminated metallic lead shielding, technetium oxide, promethium oxide (very soft energy beta-hard to detect), zirconium cladding material, potentially ignitable metal turnings, thorium oxide, other thorium compounds, normal and depleted uranium compounds, and ITFP materials. Radionuclides known or suspected to be present include ^{14}C, ^{60}Co, ^{65}Zn, ^{90}Sr, ^{103}Ru, ^{131}I, ^{137}Cs, ^{144}Ce, ^{147}Pm, ^{226}Ra, ^{232}Th, ^{233}U, ^{235}U, ^{237}Np, ^{238}U, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Am, and ^{244}Cm. The ^{240}Pu content was typically 6% (weapons grade), but later PRTR test fuel was produced with up to 12% ^{240}Pu, and residues of that fuel are thought to be there. Numerous other fission products are present, as well as, salt residues from salt cycle work (KCl, NaCl, etc.). Fuel residues would be mostly oxides, but could include metals and metal alloys, carbides, nitrides, carbonitrides, and halides from the salt cycle work.

The 15-gal (57 L) container from the 325-A hot cells were put into drum storage units for disposal, while the 1-gal (4-L) and 5-gal (20-L) cans were put into both drum storage units and caissons for disposal.

4.2.1.2 Forecasted RH-TRU/Transuranic Mixed (TRUM) Waste. The forecast projection for the RH-TRU/TRUM waste category volume is 41,000 m^3. (Valero 1994a, 1994b; Templeton 1994).

4.2.1.2.1 Forecasted RH-TRU Waste Generators. Six generators consisting of Argonne National Laboratory-East, Hanford HLW Vitrification, Surplus Facilities (Decontamination and Decommission [D&D]), Battelle Columbus Laboratories, Pacific Northwest Laboratories, and K-Basin Operations are expected to generate RH-TRU waste during the next 30 years. Additional RH-TRU waste may be expected to be generated from facilities after they become surplus facilities. The total projected waste volume of forecasted RH-TRU is approximately 7,100 m^3.

Facilities not within the surplus facility program scope (covering the next 20 years), but are included in this study, and projected to produce D&D waste in this category, includes the 327 Building (TPNL_327), N-Reactor (TWHC_100N), PUREX and UO3-224U (TWHC_202A), PUREX 202A Tunnel Waste (TWHC_202A_TW), T-Plant Building (TWHC_211T), Plutonium Finishing Plant (PFP) (TWHC_2345Z), and Hanford Waste Vitrification Project (TWHC_HWVP).

4.2.1.2.2 Forecasted RH-TRUM Waste. There are five generators consisting of long-length equipment, T-Plant Building, Double-Shell Tank (DST) Neutralized Current Acid Waste (NCAW) Process Tests, Hanford HLW Vitrification, and Surplus Facilities, that are expected to generate RH-TRUM waste during the next 30 years. Additional RH-TRUM waste may be expected to be generated from facilities after they become surplus facilities. The total projected waste volume of forecasted RH-TRUM is approximately 34,000 m^3.

Facilities not within the surplus facility program scope (covering the next 20 years) but are included in this study, and projected to produce D&D

waste in this category include 327 Building (TPNL_327), PUREX and UO3-224U (TWHC_202A), T-Plant Building (TWHC_211T), Plutonium Finishing Plant (TWHC_2345Z), and the Liquid Waste Handling Facility (TWHC_340).

4.2.2 Contact-Handled (CH) Transuranic Large Containers

Since May, 1970, solid waste classed as, or suspected of being TRU waste has been packaged, labeled, and stored to be retrievable for at least 20 years. In 1973, the official level for segregation and storage became 10 nCi TRU/g of waste. Later, the basis for classification as TRU waste was established as 100 nCi TRU/g. Thus, some of the waste now stored with TRU waste may actually be classed as LLW. It is estimated that 15% of the TRU waste in boxes will be classified as LLW once assay analyses are completed.

4.2.2.1 Stored CH-TRU and TRUM Large Container Waste (Anderson 1991). Four main burial ground sites have been used for storage of CH-TRU wastes. These four underground trench storage areas consist of burial grounds 218-W-3A, 218-W-4B, 218-W-4C, and 218-E-12B. Also, used as CH-TRU storage sites, are buildings 212-N and 212-P in the 200 North Area and the Transuranic Waste Storage and Assay Facility (TRUSAF) 224-T. The CH-TRU waste stored in these trenches was contaminated with, or suspected of being contaminated with, TRU radionuclides. The stored CH-TRU and TRUM inventory of retrievable stored solid TRU waste is approximately 7,300 m^3.

4.2.2.1.1 Stored CH-TRU and TRUM Description. Most CH waste is in 55-gal (0.81 m^3) drums, but some is contained in large boxes constructed of steel, fiberglass-reinforced plywood, or concrete. The containers are covered with plywood, plastic-reinforced nylon sheeting, and a 1.3 m layer of uncontaminated soil to reduce surface radiation exposure rates.

Very few containers contain 100% of any one waste form. Combustible versus noncombustible segregation was required for the 1972 to 1978 period and, as such, represents the only segregation requirement imposed on waste generation. Approximately two-thirds of the waste in drums is combustible material (paper, plastic, rubber, etc.), and the remaining one-third is noncombustible (metal and glass). The waste in fiberglass reinforced plywood and metal boxes is predominantly noncombustible (75%). The CH-TRU waste has been packaged in a wide variety of containers. The largest being an 8 f x 16 ft x 17 ft (2.4 m x 4.8 m x 5.1 m) metal box. The total alpha content ranges from 141 Ci. to 8.35E-06 Ci.

4.2.2.2 Forecast CH-TRU and TRUM Large Container Waste. The total projected waste volume of forecasted CH-TRU is approximately 22,000 m^3 (Valero 1994a, 1994b; Templeton 1994).

4.2.2.2.1 Forecast CH-TRU Large Container Waste. Only three generators consisting of Pacific Northwest Laboratories, K Basin Operations, and the Hanford HLW Vitrification are expected to generate CH-TRU large container waste during the next 30 years. Additional CH-TRU large container waste may be expected to be generated from facilities after they become surplus facilities. The total projected waste volume of forecasted CH-TRU large container waste is approximately 9,100 m^3.

Facilities not within the surplus facility program scope (covering the next 20 years), but are included in this study and projected to produce D&D waste in this category include 327 Building (TPNL_327), PUREX and UO3-224U (TWHC_202A), 231Z Building (TPNL_231Z), and Plutonium Finishing Plant (TWHC_2345Z).

4.2.2.2.2 Forecast CH-TRUM Large Container Waste. The CH-TRUM large container waste may be expected to be generated from facilities after they become surplus facilities. These facilities are not within the surplus facility program scope (covering the next 20 years), but are included in this study and projected to produce D&D waste in this category include T-Plant Building (TWHC_221T), PUREX and UO3-224U (TWHC_202A), 231Z Building (TPNL_231Z), and Plutonium Finishing Plant (TWHC_2345Z). The total projected waste volume of forecasted CH-TRUM large container waste is approximately 13,000 m^3.

4.2.3 Special Contact-Handled Waste

This category includes waste items that will require unique and special considerations during processing activities (e.g., storage, processing, and treatment).

4.2.3.1 Special Stored CH Waste. The stored CH special case waste items that constitute this category are 1240 55-gal (0.81 m^3) drums of classified waste (Venetz 1993), 42 55-gal (0.81 m^3) drums containing more than 200 g of ^{238}Pu (Anderson 1991), 653 55-gal (0.81 m^3) drums of dirt form the Z-9 crib, 175 55 gal (0.81 m^3) drums weighing over 1,000 lbs (454 kg) (Weidert 1993), and plutonium nitrate shipping containers (83 L10s which are 2 55-gal [0.81 m^3] drums welded together, 78 PRs inside 55-gal [0.81 m^3] drums, and 10 3Ls which are a 30-gal [120 L] drum) or approximately 490 m^3 of special stored CH waste.

4.2.3.2 Special Forecast CH Waste. The forecast CH special case waste inventory would include the waste items rejected from the Waste Receiving and Packaging (WRAP) 1 facility. This includes: CH-TRUM with a hazard classification of "reactive" (RCRA code D003); and CH-TRU and CH-TRUM waste with a physical waste form consisting of soil or particulate. The total projected waste volume of special forecasted CH Waste is approximately 1,900 m^3 (Valero 1994a, 1994b; Templeton 1994).

Eight generators consisting of Argonne National Laboratory-East, Surplus Facilities (D&D), Past Practice Remediation Projects, Rockwell Canoga Park, Solid Waste Radioactive Mixed Waste Storage Facility, Solid Waste Retrieval Phases 1 and 2, and Environmental Projects, that are expected to generate special forecast CH waste during the next 30 years. Additional special forecast CH waste may be expected to be generated from facilities after they become surplus facilities.

Facilities not within the surplus facility program scope (covering the next 20 years), but are included in this study and projected to produce D&D waste in this category include the T-Plant Building (TWHC_221T).

4.3 LOW-LEVEL MIXED WASTE (LLMW)

4.3.1 RH-LLMW

4.3.1.1 Stored RH-LLMW. The waste category has been identified to include RH-LLMW taken from Solid Waste Information and Tracking System (SWITS) dated 1987-1995. Twelve items were identified in the 218E10 and 218W4C burial grounds. The total volume of RH-LLMW is estimated to be 280 m^3 (9,800 ft^3).

The physical contents of the waste consist of absorbent, concrete, metal/iron, filters, grout, rubber, cloth/rags, stainless steel, wood, cotton, glass, plastic, lead, and paper. Radioisotopes included in the RH-LLMW waste stream include ^{14}C, ^{60}Co, $^{137}Cs/^{137}Ba$, ^{129}I, Pu, Tc, U, and ^{90}Sr. The hazardous constituents in the waste include 1,1,1-trichloroethane, acetone, asbestos, chromium, methylene chloride, sodium hydroxide, di-octyl phthalate, lead, and lead shielding.

4.3.1.2 Forecasted RH-LLMW. The total projected waste volume of forecasted RH-LLMW is approximately 96,000 m^3. Seven generators consisting of W320 Tank 241-C Sluicing, 222-S Laboratory, Hanford Grout Facility, Surplus Facilities, T-Plant Building, PUREX Plant, and Long-Length Equipment are expected to generate RH-LLMW during the next 30 years. Additional RH-LLMW may be expected to be generated from facilities after they become surplus facilities. One unique waste item is a piece of long length equipment from tank farms, 241-SY, currently being stored in the Hanford Central Waste Complex (CWC) Building 2403WD (Valero 1994a, 1994b; Templeton 1994).

Facilities not within the surplus facility program scope (covering the next 20 years), but are included in this stud, and projected to produce D&D waste in this category include 324 Building (TPNL_324), 326 Building (TPNL_326), PUREX and UO3-224U (TWHC_202A), PUREX_202A Tunnel Waste (TWHC_202A_TW), T-Plant Building (TWHC_211T), and B-Plant and WESF (TWHC_225B).

4.3.2 Contact-Handled (CH) LLMW Large Containers

4.3.2.1 Stored CH LLMW Large Containers (Anderson 1991). The waste category has been identified to include CH-LLMW waste from SWITS information dated 1987-1995. Six items were identified in the 218E10 and 218W4C burial grounds. Items from Pacific Northwest Laboratory and Knolls Atomic Power Shipyards are being stored in the Hanford CWC Building 2403WD. The total volume of stored CH-LLMW is estimated to be 650 m^3.

The physical contents of the waste consist of absorbent, concrete, metal/iron, fiberglass, cloth/rags, stainless steel, plastic, lead, and paper. Radioisotopes included in the RH-LLMW waste stream include americium, carbon-14, cobalt-60, cesium-137/barium-137, iodine-129, plutonium, technetium, uranium, and strontium-90. The hazardous constituents in the waste include 1,1,1-trichloroethane, acetone, beryllium, chromium, methylene chloride, sodium hydroxide, lead shielding, and lead.

4.3.2.2 Forecasted CH-LLMW Large Containers. The total projected waste volume of forecasted CH-LLMW large containers is approximately 980 m^3. Only

four generators consisting of Bettis Atomic Power Laboratory, Knolls Atomic Power Shipyards, PUREX Plant, and Hanford Grout Facility are expected to generate CH-LLMW during the next 30 years. Additional CH-LLMW may be expected to be generated from facilities after they become surplus facilities. Unique waste items are pieces of long length equipment from the tank farms, Tank 241-SY, and two silver reactors from the PUREX tunnels (Valero 1994a, 1994b; Templeton 1994).

4.4 GREATER THAN CATEGORY 3 (GTC3) LLW AND LLMW

4.4.1 GTC3 Remote-Handled Low-Level and Mixed Waste

4.4.1.1 GTC3 Remote-Handled LLW. Two generators consisting of Pacific Northwest Laboratories and the Hanford Site Surplus Facilities Program are expected to generate GTC3 RH-LLW during the next 30 years. Additional GTC3 RH-LLW may be expected to be generated from facilities after they become surplus facilities. The total projected waste volume of GTC3 RH-LLW is approximately 41,000 m^3.

Facilities not within the surplus facility program scope (covering the next 20 years), but are included in this study, and projected to produce D&D waste in this category include 324 Building (TPNL_324), and PUREX and UO3-224U (TWHC_202A).

4.4.1.2 GTC3 Remote-Handled Low Level Mixed Waste. Two generators consisting of PNL and the Hanford Site Surplus Facilities Program are expected to generate GTC3 RH-LLMW during the next 30 years. Additional GTC3 RH-LLMW may be expected to be generated from facilities after they become surplus facilities. The total projected waste volume of GTC3 RH-LLMW is approximately 1,600 m^3.

Facilities not within the surplus facility program scope (covering the next 20 years) but are included in this study, and projected to produce D&D waste in this category include 222-S Laboratory (TWHC_222S), T-Plant Building (TWHC_211T), A Evaporator (TWHC_242A), S Evaporator (TWHC_242S), and T Evaporator (TWHC_242T).

4.4.2 GTC3 CH-LLMW

4.4.2.1 GTC3 CH-LLW. One generator, the Hanford Site Surplus Facilities Program, is expected to generate GTC3 CH-LLW during the next 30 years. Additional GTC3 CH-LLW may be expected to be generated from facilities after they become surplus facilities. The total projected waste volume of GTC3 CH-LLW is approximately 42,000 m^3.

Facilities not within the surplus facility program scope (covering the next 20 years) but are included in this study, and projected to produce D&D waste in this category includes the PUREX and UO3-224U (TWHC_202A).

4.4.2.2 GTC3 Contact-Handled Low Level Mixed Waste. Five generators consisting of Pacific Northwest Laboratories, Past Practice Remediation Projects, Portsmouth Gaseous Diffusion Plant, 222-S Analytical Laboratories,

and the Hanford Site Surplus Facilities Program are expected to generate GTC3 CH-LLMW during the next 30 years. Additional GTC3 CH-LLMW may be expected to be generated from facilities after they become surplus facilities. The total projected waste volume of GTC3 CH-LLMW is approximately 4,400 m^3.

Facilities not within the surplus facility program scope (covering the next 20 years), but are included in this study, and projected to produce D&D waste in this category include T-Plant Building (TWHC_211T), 222-S Laboratory (TWHC_222S), and T Evaporator (TWHC_242T).

4.5 MISCELLANEOUS MATERIALS

4.5.1 Contaminated Hallam and Sodium Reactor Experiment Sodium

The contaminated metallic sodium inventory consists of quantities from Hallam Nuclear Power Facility (HNPF) and Sodium Reactor Experiment (SRE) (Jacobsen 1993). The sodium was originally planned to be converted to another form (sodium hydroxide) for use in the PUREX Plant to neutralize acid waste. The PUREX is now undergoing deactivation and no subsequent plans have been made for use of this sodium. The sodium is currently being held in Sodium Storage Buildings 2727W and 2727WA. The HNPF and SRE material was placed into storage April 1977 and December 1967, respectively.

There are five 15,000 gal (57 m^3) tanks of metallic sodium from the HNPF. There are 158 55-gal (0.81 m^3) drums of metallic sodium from the SRE. These quantities of sodium are 140 m^3 HNPF and 33 m^3 SRE.

The contaminated metallic sodium has been classified as CH_LLW (<200 mrem/h). The sodium, an alkali metal, is considered a Resource Conservation and Recovery Act (RCRA) hazardous component that is ignitable. The lead shielding used for storage purposes is considered a mixed waste and may be contaminated.

4.5.2 Unirradiated Uranium (Lini 1994)

Portions of the unirradiated uranium inventory at the Hanford Site will continue to be stored as a resource, and offsite beneficial uses will be pursued to remove the material from Hanford as a non-waste product. In the event that beneficial uses for the material cannot be located for al, or part of the inventory prior to December 31, 2005, the material will be declared waste and repackaged for shipment and burial as a low level nuclear waste.

The estimated total volume of unirradiated uranium inventory is 140 m^3. The fuel assemblies, elements, and metal billets are stored in wooden boxes in the 300 Area. The DU trioxide is stored in 55-gal (0.21 m^3) drums in the 200 West Area. The enriched uranium trioxide is stored in T-Hoppers in the 200 West Area. The DU metal slabs are stored in metal or wood boxes in the 400 Area, and the uranium dioxide powder and pellets are stored in cans, pins, assemblies, and drums in the 300 Area.

4.5.3 Miscellaneous Sources

The miscellaneous materials information was compiled from waste management records, from principal line, or facility contacts from the PNL unique materials listing. The estimated total volume of miscellaneous sources is 15 m^3.

4.5.3.1 Borosilicate Glass Canisters. This waste stream consist of various wastes vitrified in borosilicate glasses. Pacific Northwest Laboratory received 12 waste canisters, two from the Nuclear Waste Vitrification Program (NWVP), two from West Valley (WV), four from Three Mile Island (TMI), one from the Waste Solidification Engineering Prototype Program (WSEP), and one from the Federal Republic of Germany (FRG). Thirty-five FRG heat and isotope sources were also received. All 47 canisters are stored in the 324 B-Cell (12 canisters), the 324 Building A-Cell (32 FRG canisters), and the 324 Building B-Cell (3 FRG canisters). Current plans are to over-pack these materials into canisters 2.9 to 4.7 m long and 14 in (36 cm) diameter.

The total canister volume is about 4.7 m^3 (those known include; NWVP - 0.3 m^3; West Valley - 0.8 m^3; TMI - 0.6 m^3; WSEP - 0.15 m^3; FRG - 2.7 m^3; and RLFCM - 0.14 m^3). NWVP Canisters are HLW with a dose rate of 4,000 R/h at 1 m, and 1,500 R/h at 2 m with a curie content of 4.6E5 Ci and a heat output of 350 W at the time of solidification. The West Valley canisters are GTC3-LLW with a curie content of 1.8E4 Ci and a heat output of 120 W at the time of solidification. The TMI canisters are GTC3-LLW with a curie content of 1.3E5 Ci and a heat output of 240 W. The WSEP canisters are either Class 3 or GTC3-LLW with a curie content of 1.4E3 Ci and a heat output of 10 W. The FRG canisters are TRU waste with a total curie content of 207K Ci ^{137}Cs and 130 KCi ^{90}Sr (surface dose rate 310K R/hr) and maximum heat generation of 1,860 W.

4.5.3.2 High Dose Rate LLW and RMW (solid material). Four different solid waste streams have been identified for this grouping called out as high dose rate LLW and RMW, made up of solid debris (7.3 m^3). The solid debris is represented as; dispersable fines (~10 55-gal drums (possibly TRU); dried feed in TK-131 (45 gal of dry residue from FRG melter runs); oil absorption materials; and liquid metal sealant. This material is currently being collected as part of the cleanup project in the 324 Building B-Cell. Specific radioactivity levels have not been determined for each waste stream, but it is currently estimated that the package for all of the wastes will be above 2,000 R/h, and some containers will be in the 100,000 R/h range.

4.5.3.3 Neptunium Oxide Powder. Approximately 48 g of neptunium oxide powder was secured for a program that did not materialize. It remains in its original form and is stored in the basement of the 324 Building. The material was packaged inside a 55-gal (0.81 m^3) drum and the total volume is approximately 0.2 m^3 including packaging.

4.5.3.4 Non-Fuel Bearing Reactor Components. Non-fuel bearing reactor components resulting from completed R&D efforts consist of three components (control rod, poison rod, and column blade). They are located in the 324 Building B and D cells.

Each of the three items were part of a fuel assembly that would be roughly 12 ft (3.6 m) long and 9 in. x 9 in. (23 cm x 23 cm). The total

material volume was based on the dimensions mentioned above. This volume is approximately 0.2 m^3. If the items were cut or compacted, the volume would be greatly reduced. This material is considered Class C waste. It has a curie content of 650 Ci which is made up of ^{55}Fe (333 Ci), ^{60}Co (253 Ci), ^{63}Ni (62.7 Ci), and small amounts of ^{14}C, ^{14}Mn, ^{59}Ni, and ^{94}Nb.

4.6 CESIUM AND STRONTIUM CAPSULES

In 1972, activities began in the waste fractionation facility (B-Plant) to remove and encapsulate the high-heat-generating isotopes (^{90}Sr and ^{137}Cs) from the single-shell tank waste, to permit solidification of waste in the single-shell tanks. These isotopes are currently contained in double-encapsulated stainless steel capsules as SrF_2 and CsCl. Presently, there are no plans to separate strontium or cesium from future PUREX Plant waste; cesium would however, be separated in the in-place stabilization and disposal alternative. Some capsules were removed from Hanford temporarily for beneficial uses (heat or radiation sources), but are being returned to Hanford for disposal (DOE 1987).

Most of the high-heat generating fission products, ^{90}Sr and ^{137}Cs, are contained in seal-welded, high-integrity double-shell stainless steel capsules (Figure 4.6-1) as strontium fluoride and cesium chloride, respectively. Weighing approximately 22 lb/capsule (10 kg/capsule), they are stored in shielded water basins for dissipation of decay heat and the reduction of exposure to operating personnel. Storage of the strontium and cesium capsules at WESF in existing water basins will be continued until a disposal or other long-term storage alternative is selected.

4.6.1 Cesium Capsules

There are 1577 cesium-137 capsules (or 2.38 m^3) that were fabricated at the WESF (Bender 1994a). Once all offsite capsules are returned in FY 1996, the inventory will be 1,295. Additionally, plans will be developed to receive approximately 37 capsules (includes 33 capsules and material to be encapsulated) from PNL. The remaining original capsules have been cut or destroyed, and are outside the scope of this study. The cesium capsule status (location and number of capsules stored at each location) as of January 15, 1995, is provided in Figure 4.6-2.

The dose rate for a cesium capsule is approximately 300,000 R/hr gamma emissions (Pereira 1992). The average curie content for the cesium capsules as of December 31, 1996, is 38.32 KCi (minimum is 25.06; maximum is 51.94). The total KCi are 51.0 MCi decayed to December 31, 1996.

4.6.2 Strontium Capsules

There are a total of 640 strontium capsules (or 1.12 m^3) that were fabricated at WESF (Bender 1994b). Currently, there are 601 strontium capsules (23.23 MCi decayed to October 15, 1994) stored in the WESF pool cells. There are four strontium capsules (0.32 MCi decayed to October 15, 1994) located offsite, five strontium capsules (0.17 MCi decayed to October 15, 1994) at PNL, and 30 strontium capsules (2.36 MCi decayed to October 15,

1994) that have been cut or destroyed. The cut strontium capsules could potentially be re-encapsulated and returned to WESF. The strontium capsule status (location and number of capsules stored at each location) is provided in Figure 4.6-3.

The dose rate for a strontium capsule is approximately 99.9% Beta emissions (Pereira 1992). The average curie content for the uncut strontium capsules as of December 31, 1996, is 36.97 KCi (minimum is 4.13; maximum is 88.92).

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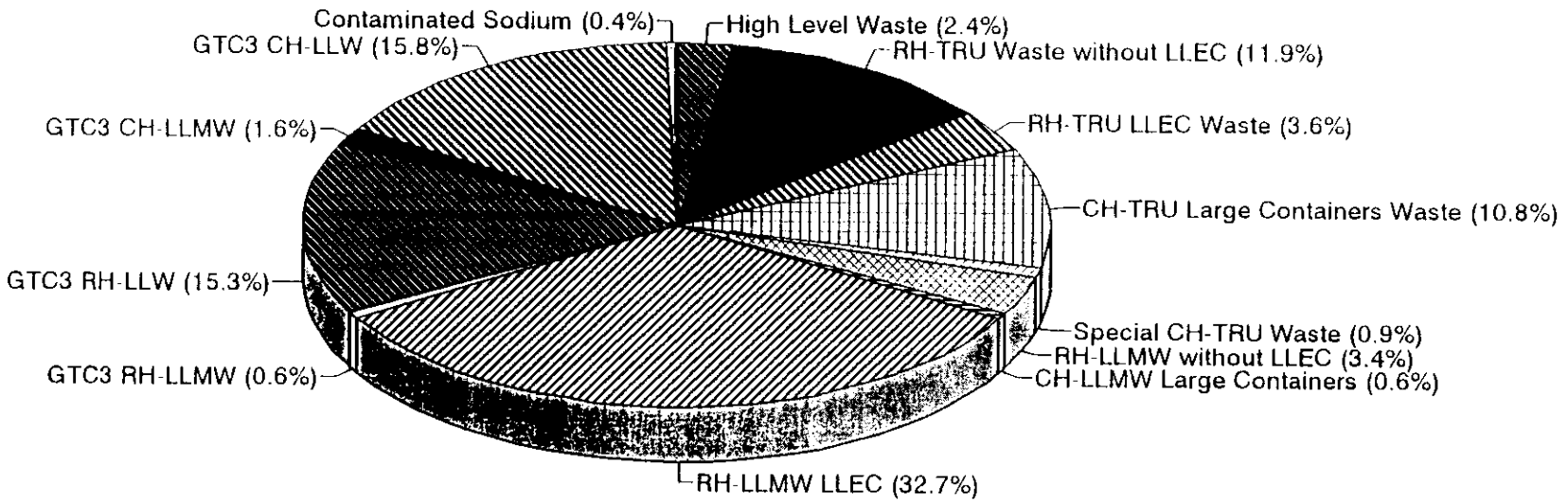
Figure 4.0-1. M-33 Waste and Materials Inventory.

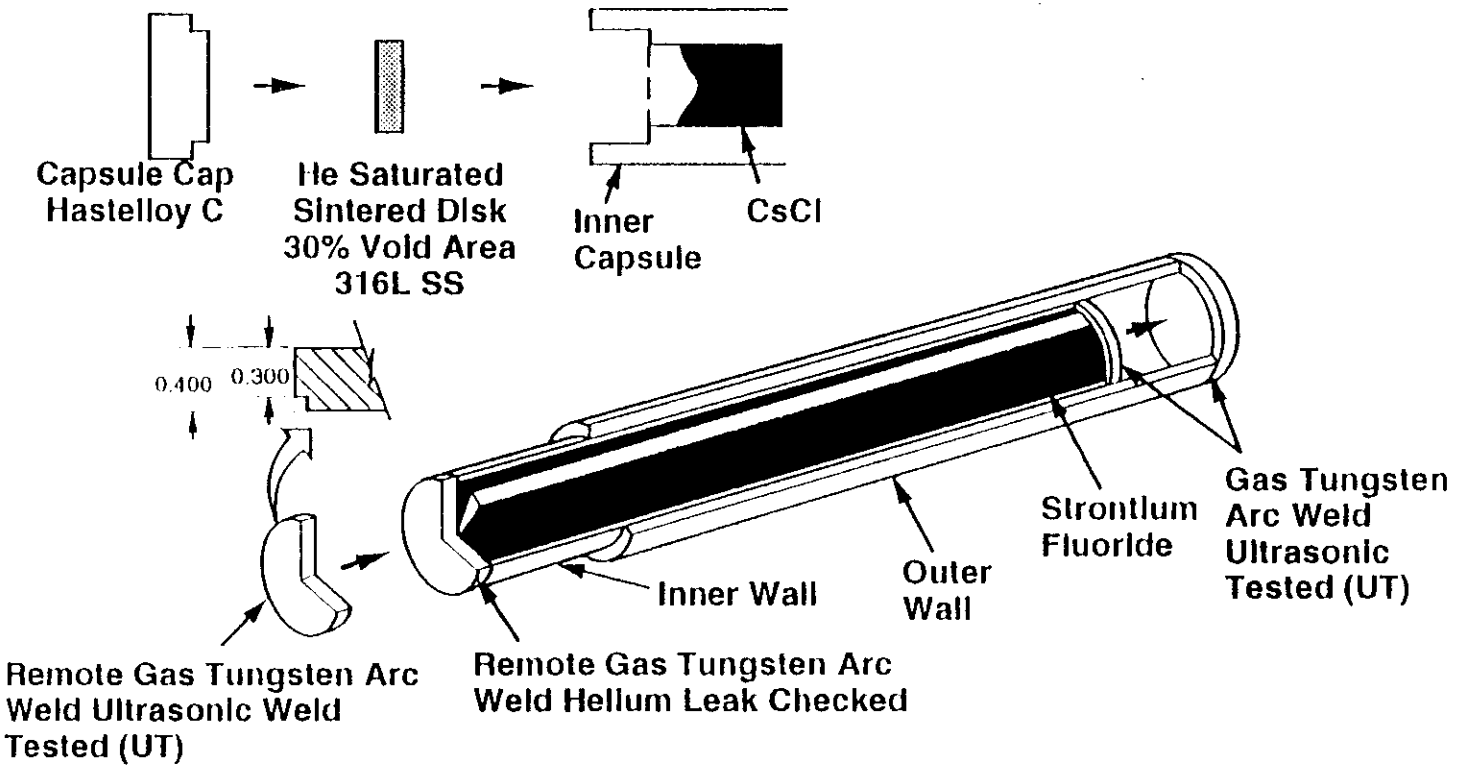
M-33 WASTE AND MATERIALS INVENTORY

The Total Volume of Waste and Materials is Approximately 270,000 Cubic Meters



Note: Unirradiated Uranium, PNL Miscellaneous Sources, & Cs/Sr Capsules constituting <0.1% are not displayed.

Figure 4.6-1. Strontium and Cesium Capsules. (DOE 1987) (Page 1 of 2)



Radio-active Material	Form	^{90}Sr Loading
Strontium Fluoride	Compact Powder	90 KCl

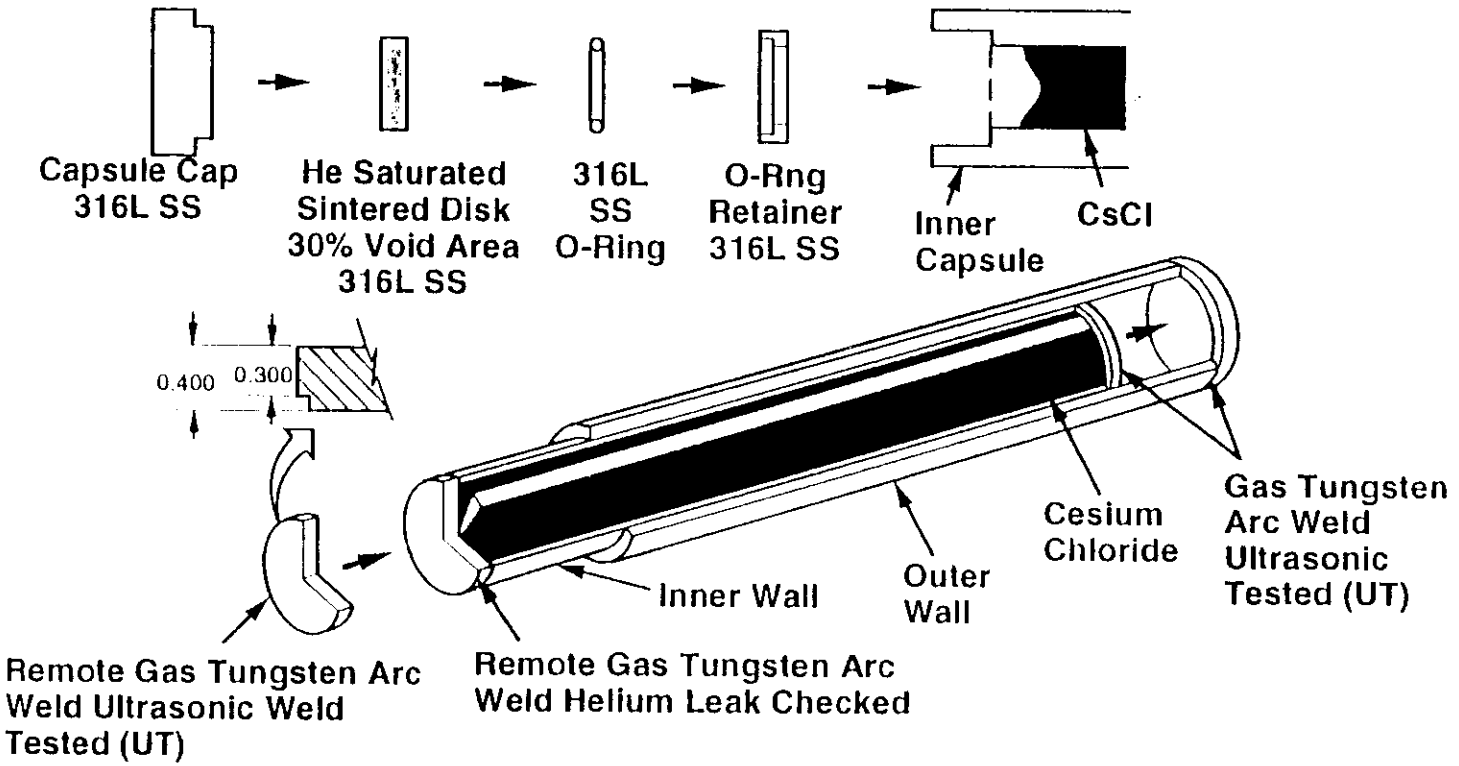
Radio-active Material	Capsule									
	Inner					Outer				
	Material	Wall Thickness	Outside Diameter	Total Length	Total Cap Thickness	Material	Wall Thickness	Outside Diameter	Total Length	Total Cap Thickness
Strontium Fluoride	Hastelloy C	0.095 (UT)	2.245	18.450	0.400	316L Stainless Steel (UT)	0.109 (UT)	2.620	20.100	0.400

Note: All dimensions are in inches

29410024.2

Detail of WESF Strontium-90 Source Capsule

Figure 4.6-1. Strontium and Cesium Capsules. (DOE 1987) (Page 2 of 2)



Radio-active Material	Form	^{137}Cs Loading	Percent of Theoretical Density Based on Total Void Space of Capsule	Temperature			
				Air		Water	
				Center Line	Surface	Center Line	Surface
Cesium Chloride	Melt-Cast	70 k Ci	65	450 °C	200 °C	327 °C	58 °C

Radio-active Material	Capsule									
	Inner					Outer				
	Material	Wall Thickness	Outside Diameter	Total Length	Total Cap Thickness	Material	Wall Thickness	Outside Diameter	Total Length	Total Cap Thickness
Cesium Chloride	316L Stainless Steel (UT)	0.095 (UT)	2.250	19.375	0.400	316L Stainless Steel (UT)	0.109 (UT)	2.625	20.425	0.400

Note: All dimensions are in inches

29102001.12

Figure 1. Detail of WESF Cesium-137 Source Capsule

Figure 4.6-2. Cesium Capsule Locations as of October 15, 1995. (Bender 1994a)

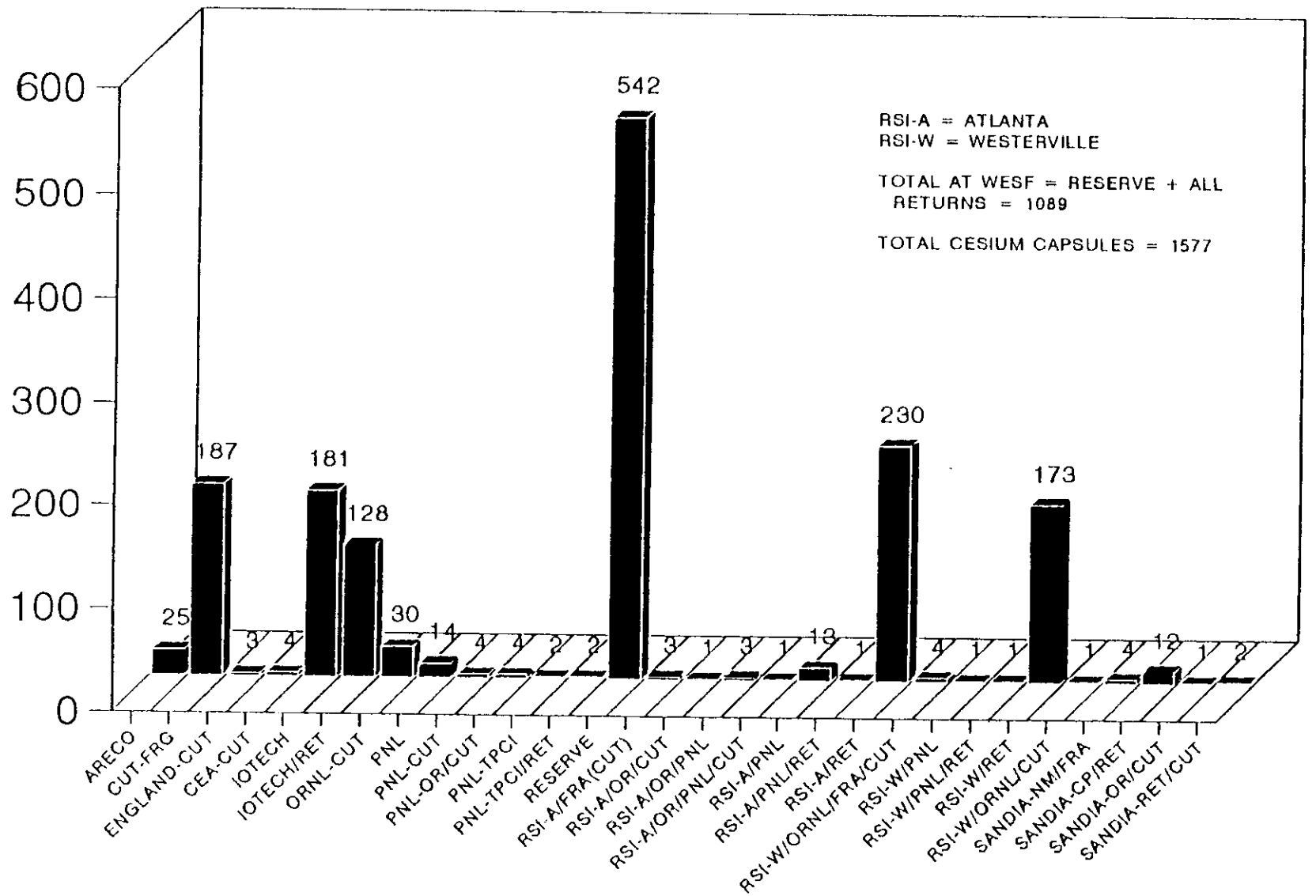


Figure 4.6-3. Strontium Capsule Locations as of April 1, 1995. (Bender 1994b)

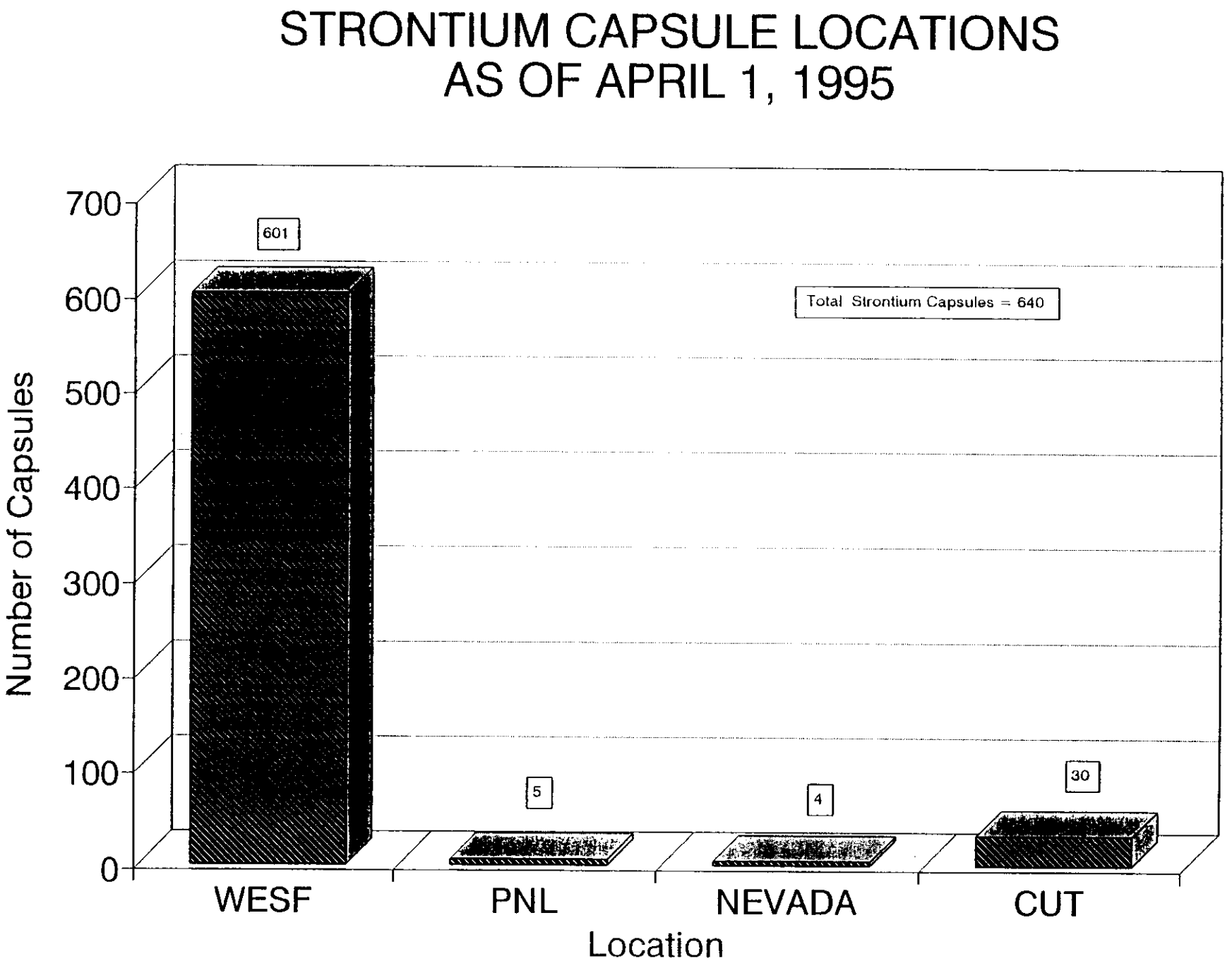


Table 4.0-1. Waste and Materials Inventory Volume Summary

Waste or Material type	Container	Volume (m^3)
HLW	Canister	8,600.00
TRU	Forecast RH	41,000.00
	Stored RH	380.00
	Forecast CH Large Containers	22,000.00
	Stored CH Large Containers	7,300.00
	Stored Special CH Waste	490.00
	Forecast Special CH Waste	1,900.00
LLMW	Forecast RH	96,000.00
	Stored RH	280.00
	Forecast CH Large Container	980.00
	Stored CH Large Container	650.00
GTC 3	Forecast RH LLW	41,000.00
	Forecast RH LLMW	1,600.00
	Forecast CH LLW	42,000.00
	Forecast CH LLMW	4,400.00
Misc. Materials	Contaminated Metallic Sodium	180.00
	Unirradiated Uranium	140.00
	Misc. Sources	15.00
Cs/Sr Capsules	Cesium Capsules	2.38
	Strontium Capsules	1.12

Table 4.0-2. Waste and Materials Characteristic Summary.

Waste or Material Category	Waste or Material Type	Container Type	Maximum Container Dimension	Maximum Container Weight	Maximum Radiation Field	Average Density (kg/l)	Notes
HLW	Vitrified Waste	Canister	27"OD x 15' (2.2m OD x 4.6m)	4 tons (3.6 MT)	Per Canister 359,000 Ci Cs-Ba 13,400 Ci Sr-Y	2.66	12K m^3 Canister 6800 Canisters
TRU Waste	Forecast RH	Ion Exchange Column	75 ft^3 (2.1 m^3) [nom. 4'OD x 6' or 1.2m OD x 1.8m]	2.5 tons (2.3 MT)	4,200 Ci/m^3 ^{137}Cs	0.34	1,000 Casks 18,000 m^3 Cask Exterior Volume
		Shipping Cask	9.5'OD x 9.1' (2.9m OD x 2.8m)	40 tons (36 MT)			
		Overpack	66"OD x 70' (1.7m OD x 21m)	15 tons (14 MT)	5,000 mrem/hr	0.34	22K m^3 Overpack
	Stored RH	Waste Overpack	26"OD x 10.1' (0.7m OD x 3.1m)	4 tons (3.6 MT)	7,000 Ci/m^3 Mixed Fission Products	0.34	35 Casks
		Cask	6.3'OD x 15.7' (1.9m OD x 4.8m)	25 tons (23 MT)			
		Box	4' x 4' x 4' (1.2m x 1.2m x 1.2m)	2 tons (1.8 MT)	1,300 mrem/hr (contact)	0.34	
	Forecast CH Large Container	Box	4' x 4' x 4' (1.2m x 1.2m x 1.2m)	Unknown	200 mrem/hr	0.40	
	Stored CH Large Container	Box	8' x 17' x 16' (2.4m x 5.2m x 4.9m)	30 tons (27 MT)	200 mrem/hr	0.40	
	Forecast Special CH Waste	Drum	2'OD x 3' (0.6m OD x 0.9m)	Unknown	200 mrem/hr	0.40	
	Stored Special CH Waste	Drum	2'OD x 3' (0.6m OD x 0.9m)	1,000 lb (454 kg)	200 mrem/hr	0.40	

Table 4.0-2. Waste and Materials Characteristic Summary.

Waste or Material Category	Waste or Material Type	Container Type	Maximum Container Dimension	Maximum Container Weight	Maximum Radiation Field	Average Density (kg/L)	Notes
LLMW	Forecast RH	Cask	4' x 4' x 4' (1.2m x 1.2m x 1.2m)	Unknown	Unknown	0.16	2,000 Casks
		Overpack	66"OD x 70' (1.7m OD x 21m)	15 tons (14 MT)	5,000 R/hr	0.16	93K m^3 Overpack
	Stored RH	Drum Box	2' OD x 3' (0.6m OD x 0.9m)	100 kg	500 mrem/hr	0.16	
	Forecast CH Large Container	Overpack	66"OD x 70' (1.7m OD x 21m)	15 tons (14 MT)	100 mrem/hr	0.40	
	Stored CH Large Container	Box Self-Contained	8.6' OD x 12.8' (2.6m OD x 3.9m)	78 MT	200 mrem/hr	0.40	
GTC3	Forecast RH LLW & LLMW	Box Drum	4' x 4' x 8' (1.2m x 1.2m x 2.4m) 2'OD x 3' (0.6m OD x 0.9m)	Unknown	Unknown	0.40	
	Forecast CH LLW & LLMW	Box Drum	4' x 4' x 8' (1.2m x 1.2m x 2.4m) 2'OD x 3' (0.6m OD x 0.9m)	Unknown	200 mrem/hr	0.40	
Misc. Materials	Contaminated Metallic Sodium	Tank Drum	15,000 gallon (57 m^3) 2'OD x 3' (0.6m OD x 0.9m)	47 MT	200 mrem/hr	1.00	
	Unirradiated Uranium	Box Drum	4' x 4' x 8' (1.2m x 1.2m x 2.4m) 2'OD x 3' (0.6m OD x 0.9m)	6 tons (5.4 MT)	10 mrem/hr	8.10	
	Misc. Sources	Canister Box Drum	0.32 m OD x 2.59 m 4.5 m x 22 cm^2 2'OD x 3' (0.6m OD x 0.9m)	Unknown	310,000 R/hr	0.40	
Cs/Sr	Cs/Sr Capsules	Capsule	2.6"OD x 20.8" (6.6cm x 5.3dm)	22 lb (10 kg)	300,000 R/hr 51.9K Ci/CsCapsule 88.9K Ci/Sr Capsule	4.30	1,577 Cs Capsules 601 Sr Capsules
		Cask	54"OD x 49" (1.4m OD x 1.2m)	16.5 tons (15 MT)			

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5.0 FUNCTIONAL ANALYSIS

The functions identified within the scope of the TPA milestone M-33-00 are identified below. The functions are tied to the scope of this engineering study. A discussion of the tie between the site wide systems engineering functional analysis and this engineering study is provided.

5.1 TIE BETWEEN SITE WIDE SYSTEMS ENGINEERING ANALYSIS AND THIS ENGINEERING STUDY

This engineering study is being conducted to support the integration of programs at the Hanford site. Program integration is being accomplished through the site wide systems engineering effort. The tie between this engineering study and site wide systems engineering is described below.

5.1.1 Site Wide Systems Engineering Analysis

The Systems Engineering (SE) approach to defining work content and organization is being introduced to the Hanford Site cleanup effort as an initiative to substantially improve mission performance. Systems Engineering methodology evolved mostly from the U.S. Department of Defense (DOD) where its application to weapons system development, procurement, and verification is well known. This approach also has been used for planning and conducting the National Aeronautics and Space Administration activities which stretched the envelope of human experience to the moon and beyond. During the last few years, SE has been extended to applications beyond its original base such as improvements to business systems; the design and production of complex computer equipment; and advances in the nuclear industry, at the Yucca Mountain repository, and in the Nuclear Regulatory Commission regulatory process.

The formalized methodology of Systems Engineering is being applied to the Hanford Cleanup effort. Systems Engineering is a prescriptive process consisting of steps that span the entirety of the cleanup effort including program strategy development, system design, acquisition and verification, and deployment of the system to achieve the desired mission objectives. The initial steps in application of Systems Engineering to the cleanup effort include top-level mission analysis, functional breakdown, requirements analysis, and measures of effectiveness development for the selection of specific designs or functional architectures. This has been documented (WHC-EP-0722) for top-level SE mission analysis, functions analysis, and requirements analysis for the Hanford Site cleanup mission. Because SE is an iterative process, results are continuously updated as the mission evolves.

The mission statement for the Hanford cleanup work is:

"The waste management and environmental restoration mission is to clean up the Hanford Site, protect the health and safety of the public and our workers, protect the environment, and provide beneficial use of land and other resources while serving as the DOE model for environmental restoration. Site cleanup will be in accordance with the Hanford Federal Facility Agreement and Consent

Order (also known as the Tri-Party Agreement), other agreements, and will be in compliance with all applicable federal, state, and local laws. The stakeholders will be active participants in the decision processes including establishing priorities, determining end states, and developing a consistent set of rules, regulations, and laws. The work will be leveraged with providing positive, lasting economic impact in the region. Effectiveness, efficiency, and discipline in all mission activities will enable us to achieve our vision and mission in a continuous and substantive manner."

The mission includes the following: (1) management and transition of all materials and facilities from the Hanford Site's former mission; (2) treatment and preparation of waste and other materials for disposal on site or shipment off site; (3) assimilation and disposition of nuclear materials; (4) disassembly and disposal of existing facilities; (5) development and deployment of the infrastructure necessary to support the cleanup mission, (6) closure of waste sites; and (7) postclosure monitoring in accordance with regulatory requirements.

Figure 5.1-1 shows the top level functional analysis developed under the Hanford Site Systems Engineering Functions and Requirements. It shows the five functions identified to meet the mission of cleaning up Hanford. One of the five functions identified for the Hanford clean up mission is to Remedy Unsafe and Unacceptable Conditions [Function 4.0]. This function provides the physical changes needed to complete the function and provides the safe and efficient operation of all facilities. Included within this function are environmental restoration of building, facilities, groundwater, and soils, treatment of waste materials, interim storage of various materials, disposition of low-level waste, packaging and shipment of hazardous, transuranic, mixed, and high-level waste, retrieval of wastes for disposition, regulatory compliance actions, and disposition of new imported wastes and materials. The Remedy Unsafe and Unacceptable Conditions (Function 4.0) function contains seven sub functions.

The Deactivate Facilities (4.1) function ensures safe operation of those facilities that have been declared excess (facilities that no longer have a mission). This set of functions can also be used to transition a facility to a new mission. The primary output is eventual facility conversion to a state where transfer to function 4.4, Remedy/Restore Sites, Facilities, and Ground Water, can take place.

The Remedy Tank Waste (4.2) function is to store, treat, and immobilize highly radioactive Hanford Site waste (including current and future tank waste and cesium/strontium capsule disposition) in an environmentally sound, safe, secure, and cost-effective manner.

The Remedy Solid Waste (4.3) function is charged with disposition of buried wastes and solid waste materials generated during past missions as well as solid wastes generated during the cleanup mission.

The Remedy/Restore Sites, Facilities, and Ground Water (4.4) function restores sites, deactivated facilities, ground water, and related items to an acceptable state. This function includes restoration of chemically

contaminated lands, and removal or disposition of buildings, fission reactors, chemical processing plants, infrastructure, etc. This function includes new as well as legacy items.

The Manage Aqueous Wastes (4.5) function disposes of hazardous aqueous liquids, low level aqueous wastes, and liquid effluents being generated as a result of continued plant operations and ongoing cleanup activities.

The Correct Unsafe Infrastructure Conditions (4.6) function has a dual purpose, namely to correct all unsafe or non-compliant conditions as well as operation of all the services and facilities not identified with the programs or integrated cleanup activities. Infrastructure includes such items as roads, utilities, transportation, office buildings.

The Store, Treat, and Disposition of Special Nuclear Material/Nuclear Material/Nuclear Fuel (4.7) function converts currently non-compliant and physically degrading SNM/nuclear material (NM)/nuclear fuel (NF) materials storage facilities into a robust, safe and compliant condition.

Each of the functions described above is either responsible for managing radioactive waste and/or materials or the activities done under these functions will generate radioactive wastes requiring future management.

5.1.2 Site Wide Functions within the Scope of this Engineering Study

The functions identified as providing the means of accomplishing the mission within the context of the TPA M-33-00 milestone are discussed below. The functions of interest are namely those referred to in the wording of the milestone, "...for storage, processing and/or disposal of solid waste and materials...". This study will not integrate those site wide functions that are identified under separate TPA milestones specific to those wastes (e.g., vitrification of low level tank waste under TPA Milestone M-60-00, vitrification of high level tank waste under TPA Milestone M-51-00, operation of the Environmental Restoration Disposal Facility under TPA Milestone M-70-00, disposition of spent nuclear fuel under M-34-00, etc.). Rather than integrate those functions identified under separate TPA milestones an attempt will be made to examine areas of potential interface for benefit.

The site wide functions identified within the scope of TPA Milestone M-33-00 are:

- [4.2.2.6] Prepare Cs/Sr Capsules for Disposal

  Receive Cs/Sr Capsules from storage, prepare capsules for interim storage at Hanford and disposal offsite at HLW geologic repository. This function also includes treatment/preparation of liquid, gaseous, and solid wastes generatedc during preparation of capsules for disposal and interim storage of the prepared capsules.

  [4.2.2.6.1] Receive Cs/Sr Capsules
  Receive Cs/Sr capsules from the site function 4.7, Store, Treat & Disposition SNM/NM/NF, and unload capsules from the transfer mechanism for inspection and overpacking by companion functions.

[4.2.2.6.2] Overpack Cs/Sr Capsules
Install the successfully inspected Cs/Sr capsules into overpack containers, close and seal the containers, and certify that the product meets geologic repository acceptance criteria.

[4.2.2.6.3] Prepare for Transfer to Interim Storage
Perform necessary tasks to remove overpacked capsules from overpacking area, load overpacks into shipping containers for transport to the interim storage site and load shipping containers onto transport mechanism, and inspect prior for transport.

[4.2.2.6.4] Support Overpacking Process
Provide support services for the overpack Cs/Sr capsules function. Services include the building structure to perform the process, HVAC, electrical power distribution, instrument and service air, service water, maintenance services, health physics/operations support, contamination repair shop, and treatment, preparation, packaging, discharge, etc. of system generated solid, liquid and gaseous effluents.

- [4.2.2.7] Interim Store Immobilized Wastes

Transport sealed canisters of IHLW and ITRU from the HLW/TRU Immobilization facility location and overpacked containers of Cs/Sr from the overpacking facility, emplace the canisters/containers in their designated storage locations, monitor canisters/containers for storage containment integrity, and eventually retrieve from storage, prepare, and load the canisters/containers on other transport conveyances for offsite shipment.

[4.2.2.7.1] Transport Immobilized Waste Containers to Interim Storage
Move onsite transfer containers loaded with overpacked Cs/Sr capsules from the overpacking process and/or IHLW/ITRU containers from the immobilization process to an onsite interim storage facility, unload the overpack/canisters from the transfer containers at the interim storage facility, and return the transfer containers to the overpacking or immobilization process to repeat the transport process.

[4.2.2.7.2] Isolate Containers
Emplace overpacked Cs/Sr capsules and/or IHLW/ITRU containers in interim storage locations isolated from the environment and monitor these locations to assure safe and compliant storage.

[4.2.2.7.3] Retrieve Containers from Storage
Containers of IHLW and/or overpacked Cs/Sr capsules are removed from their location and transported to the offsite transport cask loading location.

[4.2.2.7.4] Load Container Transport Casks
Perform re-certification of IHLW/ITRU containers and/or Cs/Sr overpack containers for disposal site acceptability, condition overpack containers as necessary, load containers into offsite

transport casks, and load casks onto transport vehicle for delivery to the offsite disposal facility.

[4.2.2.7.5] Support Storage of Immobilized Wastes
Provide support services for the interim storage of IHLW/ITRU containers and overpacked Cs/Sr capsules. Services include the building structure to perform the process, HVAC, electrical power distribution, instrument and service air, service water, maintenance services, health physics/operations support, contamination repair shop, and treatment, preparation, packaging, discharge, etc. of system generated solid, liquid and gaseous effluents.

- [4.3.2] Receive Solid Waste

  Retrieve legacy solid waste and receive solid waste generated during cleanup operations and solid waste from other missions.

  [4.3.2.2] Receive New Solid Waste
  Receives solid waste generated during Hanford Cleanup mission operations and from other missions; includes solid waste receipt planning, characterization information verification for acceptance, establishes receipt capability requirements, and forecasts future receipt operations.

- [4.3.5.1] Treat Solid Waste

  Provide treatment of solid waste to neutralize, immobilize, and stabilize it for storage and final disposition.

  [4.3.5.1.1] Decontaminate Waste
  Decontaminate solid waste for storage and final disposition.

  [4.3.5.1.2] Treat CHTRU Waste
  Provide treatment of CH TRU solid waste for storage and final disposition.

  [4.3.5.1.5] Treat RH Waste
  Provide treatment of RH solid waste for storage and final disposition.

- [4.3.5.2] Package Solid Waste

  Containerize the treated solid waste in a container suitable for the waste type. Provide solid waste packaging documentation including packaging certifications and solid waste feedstock traceability. Provide appropriate labeling and inspection of the containers of solid waste.

  [4.3.5.2.1] Package Decontaminated Waste
  Containerize the decontaminated solid waste in a container suitable for the waste type. Provide solid waste packaging documentation including packaging certifications and solid waste feedstock traceability. Provide appropriate labeling and inspection of the containers of solid waste.

[4.3.5.2.2] Package CHTRU Waste
Containerize the treated CH TRU waste in a container suitable for the waste type. Provide solid waste packaging documentation including packaging certifications and solid waste feedstock traceability. Provide appropriate labeling and inspection of the containers of solid waste.

[4.3.5.2.5] Package RH Waste
Containerize the treated RH waste in a container suitable for the waste type. Provide solid waste packaging documentation including packaging certifications and solid waste feedstock traceability. Provide appropriate labeling and inspection of the containers of solid waste.

- [4.3.5.3] Certify Solid Waste

Certify that the solid waste was treated according to the disposition requirements and that the documentation is in order to allow release of the solid waste package for storage and disposition.

[4.3.5.3.1] Certify Decontaminated Waste
Certify that the decontaminated waste was treated according to the disposition requirements and that the documentation is in order to allow release of the solid waste package for storage and disposition.

[4.3.5.3.2] Certify CH TRU Waste
Certify that the CH TRU waste was treated according to the disposition requirements and that the documentation is in order to allow release of the solid waste package for storage and disposition.

[4.3.5.3.5] Certify RH Waste
Certify that the RH waste was treated according to the disposition requirements and that the documentation is in order to allow release of the solid waste package for storage and disposition.

- [4.3.5.4] Store Solid Waste

Store the solid waste before shipment to the disposal site.

[4.3.5.4.1] Store Radioactive and Mixed Waste

- [4.3.5.5] Ship Solid Waste

Receive the certified solid waste package and prepare the necessary shipment requests and documentation. Coordinate the solid waste package shipment with shippers and receivers to verify that the final waste disposition was accomplished. Document the final solid waste disposition status.

[4.3.5.5.1] Ship TRU Waste Off-Site
Receive the certified TRU waste package and prepare the necessary shipment requests and documentation. Coordinate the TRU waste

package shipment with shippers and receivers to verify that the final waste disposition was accomplished. Document the final TRU waste disposition status.

[4.3.5.5.2] Ship LLW/LLMW to On-Site Disposal
Receive the certified LLW/LLMW waste package and prepare the necessary shipment requests and documentation for on-site disposal. Coordinate the LLW/LLMW waste package shipment with shippers and receivers to verify that the final waste disposition was accomplished. Document the LLW/LLMW waste disposition status.

- [4.3.5.6] Dispose Solid Waste

  Schedule the solid waste package disposal and prepare the waste transport package and disposal documentation. Provide final inspection of the solid waste package load and place in disposal site. Close the disposal site in regulatory compliance and provide institutional controls and closure security to maintain the disposal site security and integrity.

  [4.3.5.6.1] Dispose LLW Waste
  Schedule the LLW waste package disposal and prepare the waste transport package and disposal documentation. Provide final inspection of the LLW waste package load and place in disposal site. Close the disposal site in regulatory compliance and provide institutional controls and closure security to maintain the disposal site security and integrity.

  [4.3.5.6.2] Dispose LLMW Waste
  Schedule the LLMW waste package disposal and prepare the waste transport package and disposal documentation. Provide final inspection of the LLMW waste package load and place in disposal site. Close the disposal site in regulatory compliance and provide institutional controls and closure security to maintain the disposal site security and integrity.

- [4.7.3.4] Store Materials (Cs/Sr)

  Inventory and monitor Cs137 & Sr90. Prepare material (Cs and Sr) for stablization and store CS and Sr. Perform periodic inventory and monitor condition of stored material. Assure capability to identify, isolate, recover, and rework failed material. Dispose of generated wasters. Prepares and stabilizes the materials for storage and stores these materials until they are transferred to disposition. It is responsible for disposal of wastes generated during the material storage process.

  [4.7.3.4.1] Stabilize for Storage (Cs/Sr)
  Treats the Cs137 & Sr90 material to permit safe storage. Includes rework due to failure during storage. Perform the operations to comply with long-term storage requirements. This includes all inspections and acceptance testing of final storage form.

[4.7.3.4.2] Store Stable Materials (Cs/Sr)
Place stabliized Cs137 and/or Sr90 into pool cells. Provides all periodic inspections and tests to ensure the safety and security of the materials placed in storage. Verify capsule identification numbers and location by pool cell, rack number, and specific location in rack.

[4.7.3.4.3] Dispose of Incidental Waste (Storage) (Cs/Sr)
Arranges for the disposal of solid, liquid, and effluent wastes generated during the treatment of material prior to storage and during the actual storage of the material.

- [4.7.3.5] Transfer Outgoing Materials for Disposition (Cs/Sr)

  Acquire material transfer capability, prepare material for transfer, load, and transfer. Perform notifications and maintain chain of custody documentation. Dispose of generated waste. Prepares material and documentation, and transfers materials for disposition. It arranges for disposal of incidental wastes generated during the disposition process.

  [4.7.3.5.1] Prepare for Final Disposition (Cs/Sr)
  Characterizes material for disposition treatment, treats the material and packages it for disposition.

  [4.7.3.5.2] Transfer Dispositioned Materials (Cs/Sr)
  Loads containers into transfer device. It prepares the necessary shipping documentation, makes the necessary notifications, and ships the material.

- [4.7.4.4] Store Misc Materials

  Prepares and stabilizes the materials for storage and stores these materials until they are transferred to disposition. It is responsible for disposal of wastes generated during the material storage process.

  [4.7.4.4.1] Stabilize Misc for Storage
  Treats the Misc material to permit safe storage.

  [4.7.4.4.2] Store Stable Misc Materials
  Provides all periodic inspections and tests to ensure the safety and security of the materials placed in storage.

- [4.7.4.5] Transfer Outgoing Misc Materials for Disposition

  Prepares, stabilizes, and transfers materials for disposition. The disposition of materials is one of two processes: The transfer of useable material or the transfer of materials for disposal. It arranges for disposal of incidental wastes generated during the disposition process.

  [4.7.4.5.1] Prepare for Final Misc Disposition
  Characterizes material for disposition treatment, treats the material and packages it for disposition.

[4.7.4.5.2] Transfer Dispositioned Misc Materials
Obtains and loads the shipping containers and transporter. It prepares the necessary shipping documentation, makes the necessary notifications, and ships the material.

- [4.7.5.4] Store Du/Nu/LeU Materials

  Prepares and stabilizes the materials for storage and stores these materials until they are transferred to disposition. It is responsible for disposal of wastes generated during the material storage process.

  [4.7.5.4.1] Stabilize Du/Nu/LeU for Storage
  Treats the Du/Nu/LeU material to permit safe storage.

  [4.7.5.4.2] Store Stable Du/Nu/LeU Materials
  Provides all periodic inspections and tests to ensure the safety and security of the materials placed in storage.

5.1.3 Site Wide Functions Applied to the Scope of this Engineering Study

Each of the bulleted functions described in section 5.1.2 above has been categorized according to a general functional sequence for materials based on the approach taken in the *Hanford Strategic Analysis Study* (WHC-EP-0549, Volume 1, p. 2-9 through 13). The *Hanford Strategic Analysis Study* applied the following functions: inventory management (existing storage and characterization), generation (pretreatment and retrieval), storage prior to treatment, treatment, storage prior to disposal, and disposal. The modified set of the general functional sequences for this study is: characterization, retrieval, storage prior to processing, treat, package, storage prior to disposal, disposal. As in the *Hanford Strategic Analysis Study* application of each functional step in the sequence is not required for each material. This general functional sequence is not intended to indicate the many interactions between processing systems that are identified in the various alternatives in section 6.0.

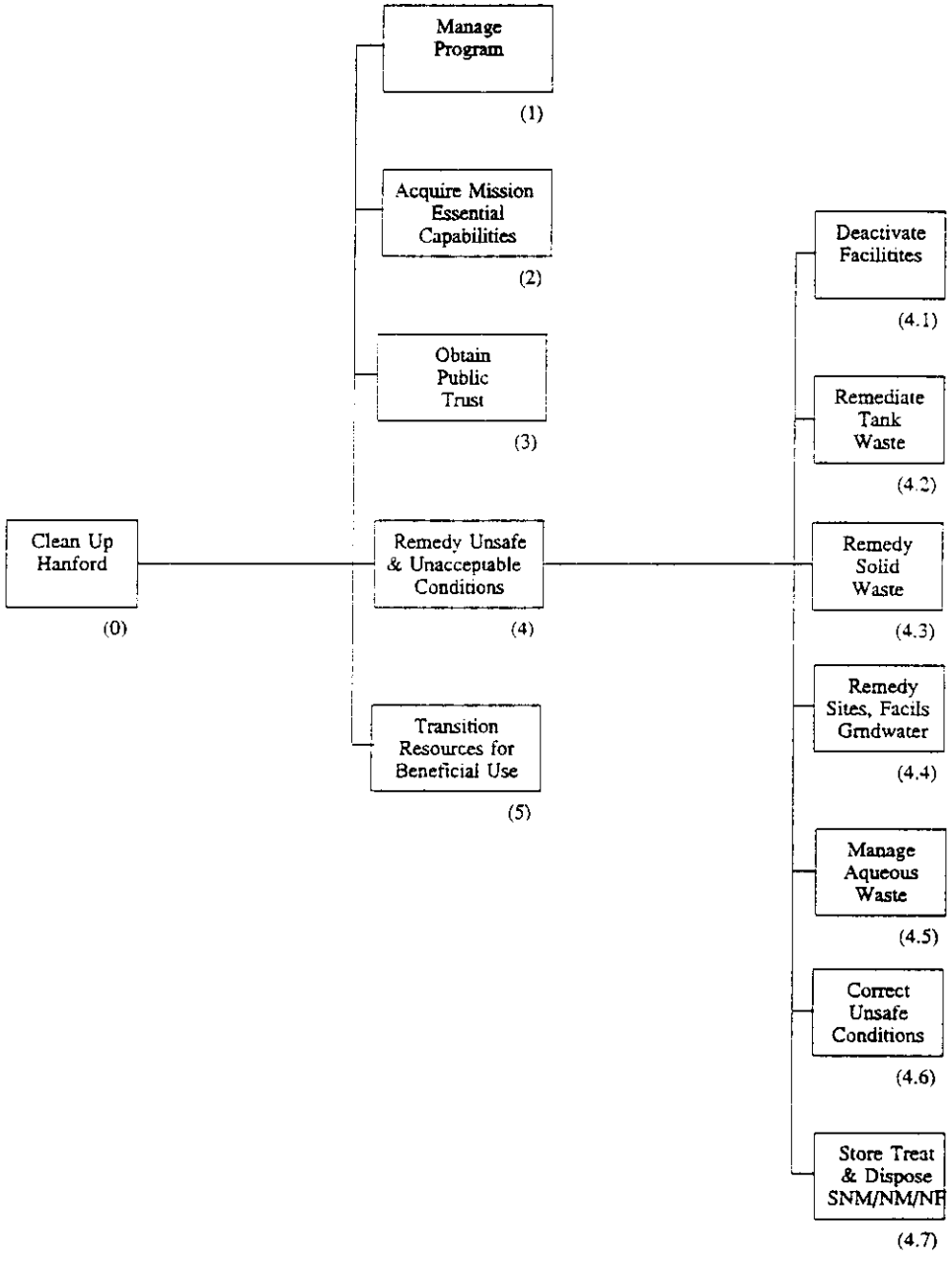
The site wide functions identified within the scope of TPA milestone M-33-00 have been identified in terms of a matrix. The matrix consists of the inventory of materials within the scope of the milestone as one axis and the general functional sequence as the other matrix. The scope of the study in terms of materials and functions is presented in Figure 5.1-2.

Each site-wide function that is within the scope of the M-33 milestone is identified by the function number in Figure 5.1-2. The grey shaded boxes in Figure 5.1-2 represent those functions within the general functional sequence for materials which are not within the scope of the M-33 milestone. Since the milestone has been identified for storage, processing and/or disposal of solid waste and materials the functions associated with characterization and retrieval have been eliminated from consideration of the milestone. Those functions provided under other TPA milestones also are not included within the scope of this effort. Namely, the storage prior to processing, treatment and packaging of high level waste are covered under TPA milestone M-51-00 and are not addressed here. Functions other than storage prior to processing are not addressed for Greater Than Category 3 low level and low level mixed waste. This is based on no national policy for the ultimate disposal of this category

of waste. Until a national policy is developed it is assumed the waste will be stored awaiting treatment and packaging to proper waste acceptance criteria. No treatment is anticipated for either unirradiated uranium or miscellaneous sources of materials within the scope of this study. The current technical strategy for cesium and strontium capsules calls for emplacement of the intact capsules within a canister for disposal in the geologic repository and no treatment only packaging will be required for this material.

Figure 5.1-3 represents additional materials for which potential interface with materials within the scope of milestone M-33-00 may exist. These potential interfaces have not been examined as part of this study. Potential interfaces exist with the following: pre-1970 TRU contaminated buried wastes, TRU contaminated soil sites, spent nuclear fuel, vitrified low level mixed waste, low level mixed waste disposed in the Environmental Restoration Disposal Facility. TRU contaminated waste buried prior to 1970 (when segregation of TRU waste was initiated) exist but no decision has been made regarding the ultimate disposition of these wastes. Because of the uncertainty surrounding whether these materials will be retrieved for processing and disposition they were not included within the scope of the study. Similar to TRU contaminated waste buried prior to 1970, no decision has been made regarding the ultimate disposition of TRU contaminated soil sites. Other areas of potential interfaces exists with the management of spent nuclear fuels and disposal of the low level mixed waste within the scope of this study and vitrified low level mixed waste from tank waste and low level mixed waste disposed in the Environmental Restoration Disposal Facility from environmental restoration.

Figure 5.1-1. Site Wide Systems Engineering Functional Analysis.



[WHC-EP-0722, Systems Engineering Functions and Requirements for the Hanford Cleanup Mission]

Figure 5.1-2. Site-Wide Functions Within the Scope of the M-33 Milestone.

Material	Activity						
	Character-ization	Retrieval	Storage Prior to Processing	Treat	Package	Storage Prior to Disposition	Dispos-ition
High Level Waste							
Canisters						4.2.2.7	
TRU Waste							
Remote-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Contact-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Low Level Mixed Waste							
Remote-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	4.3.5.6
Contact-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	4.3.5.6
Greater Than Category 3 LLW							
Remote-Handled			4.3.2				
Contact-Handled			4.3.2				
Miscellaneous Materials							
Sodium (Hallam & SRE)						4.3.5.4&5	
Unirradiated Uranium			4.7.5.4		4.7.5.4	4.7.5.4	
Miscellaneous Sources			4.3.2 & 4.7.4.4		4.3.5.2&3 & 4.7.4.4	4.3.5.4&5 & 4.7.4.4	
Cesium & Strontium Capsules							
Cesium Capsules			4.7.3.4&5		4.2.2.6.2	4.2.2.5.3	
Strontium Capsules			4.7.3.4&5		4.2.2.6.2	4.2.2.5.3	

X.Y.Z =In Scope =Not In Scope

Figure 5.1-3. Addition of Potential Interfaces to the Site-Wide Functions Within the Scope of the M-33 Milestone.

Material	Activity						
	Character-ization	Retrieval	Storage Prior to Processing	Treat	Package	Storage Prior to Disposition	Disposition
High Level Waste							
Canisters						4.2.2.7	
TRU Waste							
Remote-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Contact-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Buried Pre-70 Waste			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Contaminated Soil			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	
Low Level Mixed Waste							
Remote-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	4.3.5.6
Contact-Handled			4.3.2	4.3.5.1	4.3.5.2&3	4.3.5.4&5	4.3.5.6
Vitrified Low Level Waste				4.2.2.4	4.2.2.4	4.2.2.4	4.2.2.4
ERDF Low Level Waste				4.4.2.9 & 4.4.3.3	4.4.2.5 & 4.4.3.6	4.4.4.11	4.4.4.4
Greater Than Category 3 LLW							
Remote-Handled			4.3.2				
Contact-Handled			4.3.2				
Spent Fuel							
N Reactor Fuel			4.7.2	4.7.2	4.7.2	4.7.2	
FFTF Fuel			4.7.2	4.7.2	4.7.2	4.7.2	
Shippingport Fuel			4.7.2	4.7.2	4.7.2	4.7.2	
Single Pass Reactor Fuel			4.7.2	4.7.2	4.7.2	4.7.2	
Miscellaneous Buried Fuel			4.7.2	4.7.2	4.7.2	4.7.2	
Miscellaneous Stored Fuel			4.7.2	4.7.2	4.7.2	4.7.2	
Miscellaneous Materials							
Sodium (Hallam & SRE)						4.3.5.4&5	
Sodium (FFTF)			4.1.1.4.3.3	4.1.1.4.3.3	4.1.1.4.3.3	4.1.1.4.3.3	
Unirradiated Uranium			4.7.5.4		4.7.5.4	4.7.5.4	
Miscellaneous Sources			4.3.2 & 4.7.4.4		4.3.5.2&3 & 4.7.4.4	4.3.5.4&5 & 4.7.4.4	
Cesium & Strontium Capsules							
Cesium Capsules			4.7.3.4 & 4.7.3.5		4.2.2.6.2	4.2.2.7	
Strontium Capsules			4.7.3.4 & 4.7.3.5		4.2.2.6.2	4.2.2.7	

X Y Z = Included; = Not Included; X Y Z = Interface Only

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6.0 INTEGRATED SYSTEM ALTERNATIVES

6.1 DETERMINATION OF ALTERNATIVES TO BE EXAMINED

Table 6.1-1 below is the starting point from which the alternative set for this study was derived. The variables considered in coming up with the alternative set were: use of new or existing facilities; integration of storage and/or processing of streams; single or multiple facilities. In determining whether to use new or existing facilities there are only two alternatives. In determining the level of integration (or segregation) of the wastes and materials of interest there are two options for each stream of interest (integration or segregation). For example, if we assume that we have fourteen streams to deal with that would give us 2^{14} or 16,384 different combinations of integration/segregation of streams. Clearly some of these potential combinations do not make sense (integrate cesium capsules with unirradiated uranium or segregate cesium capsules and strontium capsules). Rather than try to examine the myriad of combinations available, engineering judgement was used to try to integrate streams where effective and reasonable to do so. Also, since this study is related to integration of the needs associated with the various streams, treating each stream in a completely segregated manner was not considered. Finally, the combination of alternatives available for the number of facilities could be based on how many facilities to consider (one, two, three, four, etc.). Rather a distinction was made whether a single facility (contiguous location) or multiple facilities (not necessarily contiguous) was made. The number of facilities that would be required in the modular approach is based on engineering judgement.

This leads to the set of four alternatives that are examined in this engineering study. Looking at the three variables of interest in the manner discussed above leads to eight alternatives. Two of these alternatives are not physically feasible (segregated processing in a single facility - either new or existing). Two additional alternatives were not considered to be of interest (segregated processing in modular facilities - either new or existing) since the study is interested in the potential for integration of streams. This leads to the four alternatives considered in this study: a single new facility (contiguous location) integrating all stream processing and storage; multiple new facilities integrating stream processing and storage (where effective); a single existing facility (contiguous location) integrating all stream processing and storage; and multiple existing facilities integrating stream processing and storage (where effective).

No consideration is made in the alternative set regarding source of funding for the new facility alternatives. It is assumed that these alternatives could either be pursued as capital projects or the defined scope of the alternatives could be privatized.

6.2 SCOPE OF INVENTORY INCLUDED IN ALTERNATIVES

The inventory included in the scope of the alternatives is categorized according to the classification of the material relative to DOE Orders wherever applicable. Below are definitions of the various categories of waste and materials addressed in this study:

High Level Waste. The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation. [DOE 5820.2A]

Transuranic Waste. Without regard to source or form, waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay. Heads of Field Elements can determine that other alpha contaminated wastes, peculiar to a specific site, must be managed as transuranic waste. [DOE 5820.2A]

Low-Level Mixed Waste. (Mixed Waste is) Waste containing both radioactive and hazardous components as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively. (Low-Level Waste is) Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel or 11e(2) byproduct material as defined by this Order. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic is less than 100 nCi/g. [DOE 5820.2A]

Greater Than Category 3 Low-Level Waste. Based on "table" definition as provided in Table 3-1 of Hanford Site Solid Waste Acceptance Criteria. [WHC-EP-0063-4]

Miscellaneous Materials:

Nuclear Material. A collective term for materials subject to the provisions of DOE Order 5660.1B [DOE 5660.1B]. This refers to the unirradiated uranium inventory.

Contaminated Sodium. No definition is provided for this category of material.

Cesium & Strontium Capsules. Doubly encapsulated high-heat-generating isotopes ^{90}Sr and ^{137}Cs removed from the single shell tank waste. These isotopes are contained in doubly encapsulated metal capsules as SrF_2 and CsCl. [HDW-EIS, DOE/EIS-0113 p. 3.3]

Details regarding quantities (volumes), timing of generation, physical, chemical, and radiological characteristics of each of these wastes and materials can be found in section 4 of this document.

6.3 SCOPE OF FUNCTIONS INCLUDED IN ALTERNATIVES

This section outlines the processing and storage functions associated with the waste and material streams included in this study. Functional block diagrams for each stream as well as a brief description of the functions are provided.

6.3.1 Functional Block Diagram for High Level Waste

Figure 6.3-1 is a functional block diagram depicting the function associated with high level waste that is within the scope of this study. Specific details associated with the function are based on previous work that has been accomplished in the area of high level waste canister storage.

Store Prior to Disposal. Interim storage will be provided for the high-level waste canisters resulting from high-level waste vitrification. Storage will occur until a geological repository becomes available for final high-level waste disposition. (WHC-EP-0616, Rev. 0)

6.3.2 Functional Block Diagram for Transuranic Waste

6.3.2.1 Remote-Handled Waste. Figure 6.3-2 is a functional block diagram depicting the process steps for remote-handled transuranic waste. Process steps are shown functionally and detail has not been developed for the processes, equipment, and design features. Specific details will be selected and evaluated in later stages of project documentation.

Where feasible, reuse of overpacks and shielding is shown. In other cases, containers and shielding are considered sacrificial and processed as low-level waste and low-level mixed waste respectively.

The functional block diagram for remote-handled transuranic waste shown in Figure 6.3-2 is described below.

Storage Prior to Processing. Newly generated remote-handled transuranic waste will be maintained in a dry storage configuration until processing capabilities become available. This dry mode of storage is consistent with that of the "monitored retrievable storage (MRS)" concept defined in the Nuclear Regulatory Commission Code of Federal Regulations, namely NRC 10 CFR 72. Remote-handled waste currently located in caissons and retrievable storage trenches will continue to reside in these locations until processing capability exists.

Receipt for Processing. Receipt of feed material is expected to be by truck or rail. Truck or rail receipt is used for all remote-handled TRU waste whether it is waste directly from retrieval that bypasses storage or in shielded transport casks from storage.

The receiving function will have crane capability to remove the waste container and overpack from the transport vehicle. Provision for shielding and remote operation of the crane will be required. This will accommodate equipment and boxes that cannot be shielded down to CH levels.

Cask Load In. The cask load in function will be a sequence of specialized processes that allow separation of the waste item from the shipping cask to minimize contamination of the cask. This will allow more expeditious decontamination and release of the cask for reuse.

Waste Removal from Overpack. Separation from the overpack includes removal of the waste container from the reusable overpack and removal of any reusable shielding materials. Specialized processes to perform this function should be developed that allow separation of the container from the overpack to minimize contamination of the overpack. This will allow more expeditious decontamination and release of the overpack for reuse.

Waste Removal from Container. The waste removal from container function includes separation of the waste contents from the package (box, drum) and from the overpack (where the overpack is not reusable). Specialized processes to perform this function should be developed that allow separation of these items while minimizing contamination of the package and overpack. This would allow their disposal as LLW.

Waste Assay. The assay function will determine the radioactive material content of waste. Transuranic, fissile, and beta-gamma emitting fission and activation products will all be accounted for by the assay. The assay will provide the necessary information for certification of the waste as either TRU or LLW/LLMW.

Waste Sorting. Waste sorting is performed to remove non-compliant items and those requiring further characterization from the primary feedstream. Sorting may also be required to reduce Pu loading of some items to meet transportation limits.

Waste Size Reduction. Size reduction is performed to make large items more manageable and able to fit into approved TRU disposal containers (RH canisters).

Restricted Waste Management. Restricted waste management may include the following: depressurizing and draining of aerosol cans, neutralization of corrosive materials, liquid absorption/solidification, particulate immobilization, sample management, and a declassification of classified waste.

Waste Packaging. RH-TRU waste is packaged into canisters that meet the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria. This function includes placing the waste into the canister, and loading and closing the canister.

Cask Load Out. After the packaging and assay functions are completed, the RH canister will be placed in a transfer cask and transported to the shipping station. The flow diagram shows load out occurring after packaging because the use of bagless transfer systems are envisioned. These steps could be reversed if conventional bag out techniques are used.

Lead Removal from Containers. Waste containers that have a removable lead shielding liner will undergo a lead extraction process. Processing steps should be developed to ensure complete lead removal from the container in order for the container to be characterized as LLW.

Lead Packaging. Lead extracted from the waste containers will be repackaged into a container suitable for interim storage prior to final stabilization and disposition. This waste will be reclassified as CH-LLMW and will follow the functional flow path depicted by Figure 6.3-7.

Container Shredding. The empty waste containers are reduced in size using a shredder. The shredder will significantly reduce the volume of LLW requiring disposal.

Container Packaging. The shredded LLW containers are packaged into a drum or box that meets low-level waste land disposal requirements.

Container Assay. The assay function determines the radioactive material content of waste. Because the containers were originally contaminated with TRU waste, the assay verifies that the container no longer meets the TRU definition and can be reclassified as LLW.

Overpack Decontamination. Overpacks released for reuse will first be surveyed for contamination and undergo decontamination processes as necessary.

Waste and Overpack Shipping. Exit functions include shipping of RH canisters to storage prior to transport to WIPP, shipping LLW containers to onsite burial, transferring packaged lead to storage prior to stabilization, and release of overpacks and casks for reuse.

Store Prior to Disposal. Processed remote-handled transuranic waste will be maintained in a dry storage configuration until the waste can be transferred to WIPP for final disposition. This dry mode of storage is consistent with that of the "monitored retrievable storage (MRS)" concept defined in the Nuclear Regulatory Commission Code of Federal Regulations, namely NRC 10 CFR 72.

Shipping of TRU Waste to WIPP. Waste that meets the WIPP WAC will be placed inside a shipping cask and transported by truck to the repository. This is based on the assumption that WIPP will be available for waste receipt.

6.3.2.2 Contact-Handled Waste in Large Containers and Drums Requiring Specialized Treatment. Figure 6.3-3 is a functional block diagram depicting the process steps for contact-handled transuranic waste. Process steps are shown functionally and detail has not been developed for the processes, equipment, and design features. Specific details will be selected and evaluated in later stages of project documentation.

Where feasible, reuse of overpacks is shown. In other cases, containers are considered sacrificial and processed as low-level waste.

The functional block diagram for contact-handled transuranic waste shown in Figure 6.3-3 is described below.

Storage Prior to Processing. Newly generated contact-handled transuranic waste will be maintained in a dry storage configuration until processing capabilities become available. Contact-handled waste currently located in retrievable storage trenches will continue to reside in these locations until processing capability exists.

Receipt for Processing. Receipt of retrievably stored or newly generated waste is expected to be by truck or rail. Truck or rail receipt is used for all contact-handled TRU waste in large boxes from retrieval that bypass storage. CH TRU in drums and moderate sized boxes will be transferred from storage using either a truck, automated guided vehicle or forklift. The receiving function will have crane capability to remove extremely large waste containers and overpacks from the transport vehicle.

Waste Assay. The assay function will determine the radioactive material content of waste. Transuranic, fissile, and beta-gamma emitting fission and activation products will all be accounted for by the assay. The assay will provide the necessary information for certification of the waste as either TRU or LLW/LLMW.

Waste Removal from Overpack. Separation from the overpack includes removal of the waste container from the reusable overpack. Specialized processes to perform this function should be developed that allow separation of the container from the overpack to minimize contamination of the overpack. This will allow more expeditious decontamination and release of the overpack for reuse.

Waste Removal from Container. The waste removal from container function includes separation of the waste contents from the package (box, drum) and from the overpack (where the overpack is not reusable). Specialized processes to perform this function should be developed that allow separation of these items while minimizing contamination of the package and overpack. This would allow their disposal as LLW.

Waste Sorting. Waste sorting is performed to remove non-compliant items and those requiring further characterization from the primary feedstream. Sorting may also be required to reduce Pu loading of some items to meet transportation limits.

Waste Size Reduction. Size reduction is performed to make large items more manageable and able to fit into approved TRU disposal containers (drums or standard waste boxes).

Restricted Waste Management. Restricted waste management may include the following: depressurizing and draining of aerosol cans, neutralization of corrosive materials, liquid absorption/solidification, particulate immobilization, sample management, and declassification of classified waste.

CH Waste Packaging. CH-TRU waste is packaged into drums and standard waste boxes that meet the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria. The packaging function will not provide proper certification of the waste, therefore the waste will require a final assay in WRAP 1.

Container Shredding. The empty waste containers are reduced in size using a shredder. The shredder will significantly decrease the volume of LLW requiring disposal.

Container Packaging. The shredded LLW containers are packaged into a drum or box that meets low-level waste land disposal requirements.

Container Assay. The assay function determines the radioactive material content of waste. Because the containers were originally contaminated with TRU waste, the assay verifies that the container no longer meets the TRU definition and can be reclassified as LLW.

Overpack Decontamination. Overpacks released for reuse will first be surveyed for contamination and undergo decontamination processes as necessary.

Package LLMW. A portion of the TRU waste will be characterized as LLMW after assay. This waste will be packaged into containers suitable for storage until final stabilization and disposition can be completed.

Waste and Overpack Shipping. Exit functions include shipping of CH waste to storage prior to transport to WRAP 1 for final certification, shipping LLW containers to onsite burial, and release of overpacks for reuse.

Waste Receipt at WRAP 1. Waste will be transferred from storage using an AGV or forklift to WRAP 1 for final certification.

WRAP 1 Assay. WRAP 1 will perform a final assay to determine the radioactive material content of the waste. Transuranic, fissile, and beta-gamma emitting fission and activation products will all be accounted for by the assay. The assay function will provide the necessary information for certification of the CH TRU SWBs and drums in accordance with the WIPP WAC.

Storage Prior to Disposal. Processed remote-handled transuranic waste will be maintained in a dry storage configuration until the waste can be transferred to WIPP for final disposition.

Ship to WIPP. Waste that meets the WIPP WAC will be placed in a TRUPACT shipping container and transported by truck to the repository.

6.3.3 Functional Block Diagram for Low-Level Mixed Waste

6.3.3.1 Remote-Handled Waste. Figure 6.3-4 is a functional block diagram depicting the process steps for remote-handled low-level mixed waste. Process steps are shown functionally and detail has not been developed for the processes, equipment, and design features. Specific details will be selected and evaluated in later stages of project documentation.

The functional block diagram for remote-handled low-level mixed waste shown in Figure 6.3-4 is described below.

Storage Prior to Processing. Remote-handled low-level mixed waste will be maintained in a dry storage configuration until processing capabilities become available. This dry mode of storage is consistent with that of the "monitored retrievable storage (MRS)" concept defined in the Nuclear Regulatory Commission Code of Federal Regulations, namely NRC 10 CFR 72.

Receipt for Processing. Receipt of feed material is expected to be by truck or rail. Truck or rail receipt is used for all remote-handled LLMW waste whether it is waste directly from retrieval that bypasses storage or in shielded transport casks from storage.

The receiving function will have crane capability to remove the waste container and overpack from the transport vehicle. Provision for shielding and remote operation of the crane will be required. This will accommodate equipment and boxes that cannot be shielded down to CH levels.

Cask Load In. The cask load in function will be a sequence of specialized processes that allow separation of the waste item from the shipping cask to minimize contamination of the cask. This will allow more expeditious decontamination and release of the cask for reuse.

Waste Removal from Container. The waste removal from container function includes separation of the waste contents from the package (box, drum) and from the overpack (where the overpack is not reusable). Specialized processes to perform this function should be developed that allow separation of these items while minimizing contamination of the package and overpack. This would allow their disposal as LLW.

Waste Sorting. Waste sorting is performed to batch the waste according to processing requirements. Items requiring thermal treatment will be segregated from those requiring non-thermal stabilization.

Waste Size Reduction. Size reduction is performed to make large items more manageable and able to fit into smaller containers (drums and boxes less than 5'x5'x9').

Waste Stabilization. Stabilization consists of adding a reagent to the waste to immobilize any hazardous constituents present. The contaminants are not removed or destroyed, but the concentration of the contamination and/or the mobility of the contaminants are decreased by adding a stabilizing agent (WHC-EP-0802).

RH Waste Packaging. RH-LLMW waste is packaged into drums or boxes up to 5'x5'x9' in size. The final package must be suitable for direct disposal in the mixed waste disposal trench.

Cask Load Out. After the waste has been packaged into a container meeting land disposal requirements, the package will be placed in a transfer cask and transported to the shipping station.

Lead Removal from Containers. Waste containers that have a removable lead shielding liner will undergo a lead removal process. Processing steps should be developed to ensure complete lead removal from the container in order for the container to be characterized as LLW.

Lead Packaging. Lead removed from the waste containers will be repackaged into a container suitable for interim storage prior to final stabilization and disposition. This waste will be reclassified as CH-LLMW and will follow the functional flow path depicted in Figure 6.3-5.

Container Shredding. The empty waste containers are reduced in size using a shredder. The shredder will significantly reduce the volume of LLW requiring disposal. Any reusable shielding will be salvaged.

Container Packaging. The shredded LLW containers are packaged into a drum or box that meets low-level waste land disposal requirements.

Waste Shipping. Exit functions include shipping of RH waste to the mixed waste disposal trench, shipping LLW containers to onsite burial, and transferring packaged lead to storage prior to stabilization.

6.3.3.2 Contact-Handled Low-Level Mixed Waste in Large Containers. Figure 6.3-5 is a functional block diagram depicting the process steps for contact-handled low-level mixed waste. Process steps are shown functionally and detail has not been developed for the processes, equipment, and design features. Specific details will be selected and evaluated in later stages of project documentation.

The functional block diagram for contact-handled low-level mixed waste shown in Figure 6.3-5 is described below.

Storage Prior to Processing. Contact-handled low-level mixed waste will be maintained in a dry storage configuration until processing capabilities become available.

Receipt for Processing. Receipt of feed material is expected to be by truck or rail. CH LLMW in moderate sized boxes will be transferred from storage using a truck, AGV or forklift. Truck or rail will be used for large boxes from retrieval. The receiving function will have crane capability to remove extremely large waste containers and overpacks from the transport vehicle.

Waste Removal from Overpack. Separation from the overpack includes removal of the waste container from the reusable overpack. Specialized processes to perform this function should be developed that allow separation of the container from the overpack to minimize contamination of the overpack. This will allow more expeditious decontamination and release of the overpack for reuse.

Waste Removal from Container. The waste removal from container function includes separation of the waste contents from the package (box, drum) and from the overpack (where the overpack is not reusable). Specialized processes to perform this function should be developed that allow separation of these items while minimizing contamination of the package and overpack. This would allow their disposal as LLW.

Waste Sorting. Waste sorting is performed to batch the waste according to processing requirements. Items requiring thermal treatment will be segregated from waste requiring non-thermal stabilization.

Waste Size Reduction. Size reduction is performed to make large items more manageable and able to fit into smaller containers (drums and boxes less than 5'x5'x9).

Waste Packaging. CH-LLMW waste is packaged into drums or boxes up to 5'x5'x9' in size. These packages will be suitable for shipment to WRAP 2A or the commercial thermal treatment facility (CTTF) for final stabilization prior to onsite burial.

Overpack Decontamination. Overpacks released for reuse will first be surveyed for contamination and undergo decontamination processes as necessary.

Container Shredding. The empty waste containers are reduced in size using a shredder. The shredder will significantly reduce the volume of LLW requiring disposal.

Container Packaging. The shredded LLW containers are packaged into a drum or box that meets low-level waste land disposal requirements.

Waste Shipping. Exit functions include shipping of drums and 5'x5'x9' boxes to storage prior to stabilization in WRAP 2A or the CTTF, shipping LLW containers to onsite burial, and releasing overpack containers for reuse.

Waste Receipt at WRAP 2A. Waste will be transferred from storage using an AGV, forklift, or truck to WRAP 2A for final stabilization.

WRAP 2A Stabilization. Stabilization consists of adding a reagent to the waste to immobilize any hazardous constituents present. The contaminants are not removed or destroyed, but the concentration of the contamination and/or the mobility of the contaminants are decreased by adding a stabilizing agent.

Waste Receipt at the Thermal Treatment Facility. Waste will be transferred from storage by AGV, forklift, or truck to the commercial thermal treatment facility for final stabilization.

Waste Thermal Treatment. This treatment consists of thermal destruction of the hazardous waste in the presence of oxygen for combustion. The basic process typically consists of oxidation of the organic constituents of the waste to form carbon dioxide, water vapor, sulfur oxides, phosphorous oxides, and hydrogen halides (WHC-EP-0802).

Waste Shipping to Disposal. After waste has been properly stabilized for burial it will be transferred by truck to the onsite mixed waste disposal trench.

6.3.4 Functional Block Diagram for Greater Than Category 3 Low-Level Waste

No national policy has been established for the disposal of greater than category 3 waste and until then no processing or packaging for final disposal will be pursued (WHC-SD-W272-FDC-001, Rev 1). Most likely the waste will require disposal in a deep geologic repository.

6.3.4.1 Remote-Handled Greater Than Category 3 Waste. Figure 6.3-6 is a functional block diagram depicting the process steps for remote handled greater than category 3 low-level and low-level mixed waste. Segregated storage will be provided for *hazardous* and *nonhazardous* remote-handled high activity waste.

Store Prior to Processing. Remote-handled greater than category 3 low-level waste will be stored utilizing a dry mode of storage reflecting that of the "monitored retrievable storage (MRS)" concept defined in the Nuclear Regulatory Commission Code of Federal Regulations, namely NRC 10 CFR 72.

Remote-handled greater than category 3 low-level mixed waste will be stored in a manner similar to the nonhazardous remote-handled greater than category 3 low-level waste. This waste storage will incorporate the requirements related to the hazardous constituents of the waste inventories regulated as hazardous waste under the Federal *"Resource Conservation and Recovery Act of 1980,"* or Washington Administrative Code (WAC) 173-303.

6.3.4.2 Contact-Handled Greater Than Category 3 Waste. Figure 6.3-7 is a functional block diagram depicting the process steps for contact handled greater than category 3 low-level and low-level mixed waste.

Store Prior to Processing. Contact-handled greater than category 3 low-level waste will be stored indoors in radioactive and/or mixed waste storage buildings utilizing a dry mode of storage reflecting that of the "monitored retrievable storage (MRS)" concept defined in the Nuclear Regulatory Commission Code of Federal Regulations, namely NRC 10 CFR 72.

Contact-handled greater than category 3 low-level mixed waste will be stored indoor in mixed waste storage buildings using the dry mode storage concept.

6.3.5 Functional Block Diagram for Miscellaneous Materials

6.3.5.1 Contaminated Metallic Sodium. Figure 6.3-8 is a functional block diagram depicting the process steps for contaminated metallic sodium. Process steps are shown functionally and detail has not been developed for the processes, equipment, and design features. Specific details will be selected and evaluated in later stages of project documentation.

Store Prior to Processing. Contaminated sodium will be stored prior to processing. Final disposition has not yet been determined.

6.3.5.2 Unirradiated Uranium. Figure 6.3-9 is a functional block diagram depicting the process steps for unirradiated uranium. Process steps are shown functionally and detail has not been developed for the design features. Specific details will be selected and evaluated in later stages of project documentation.

The functional block diagram for unirradiated uranium shown in Figure 6.3-9 is described below.

Store Prior to Packaging. Unirradiated uranium will be maintained in its current storage and packaging configuration until new storage and/or packaging capabilities are required.

Receipt for Packaging. Receipt of feed material is expected to be by truck.

Waste Packaging. The unirradiated uranium will be packaged to meet shipping requirements for material being shipped as product. If any of the unirradiated uranium is ever declared waste it will be packaged to meet low-level waste land disposal requirements.

Waste Shipping. The packaged uranium will be shipped to storage to await final disposition.

Store Prior to Disposal. The final disposition of unirradiated uranium has not been determined. The material will remain in storage, as described by the **Store Prior to Processing** function, until a decision has been reached on long-term uses and/or final disposition.

6.3.5.3 Miscellaneous Sources. Figure 6.3-10 is a functional block diagram depicting the process steps for miscellaneous source material. Process steps are shown functionally and detail has not been developed for the processes, equipment, and design features. Specific details will be selected and evaluated in later stages of project documentation.

The functional block diagram for miscellaneous sources shown in Figure 6.3-10 is described below.

Store Prior to Processing. Interim storage will be provided for miscellaneous source material existing at the Hanford Site. The material will be maintained in a dry storage configuration until processing capabilities become available. This dry mode of storage is consistent with that of the "monitored retrievable storage (MRS)" concept defined in the Nuclear Regulatory Commission Code of Federal Regulations, namely NRC 10 CFR 72.

Receipt for Processing. Receipt of feed material is expected to be by truck or rail. Truck or rail receipt is used for all material requiring remote-handling. The receiving function will have crane capability to remove the cask from the transport vehicle and the waste container from the cask. Provision for shielding and remote operation of the crane will be required. This will accommodate equipment and boxes that cannot be shielded down to CH levels.

Cask Load In. The cask load in function will be a sequence of specialized processes that allow separation of the waste item from the shipping cask to minimize contamination of the cask. This will allow more expeditious decontamination and release of the cask for reuse.

Waste Packaging. The source material will be packaged into containers conducive to long-term storage. Remote handling capability will be used to transfer the waste into the packaging material.

Cask Load Out. After the miscellaneous sources have been packaged, the material will be placed in a transfer cask and transported to the shipping station. The flow diagram shows load out occurring after packaging because the use of bagless transfer systems is envisioned. These steps could be reversed if conventional bag out techniques are used.

Waste Shipping. The RH canisters will be shipped to storage to await final disposition.

Store Prior to Disposal. The final disposition of the miscellaneous sources has not been determined. The material will remain in dry storage, as described by the **Store Prior to Processing** function, until a decision has been reached on long-term uses and/or final disposition.

6.3.6 Functional Block Diagram for Cesium/Strontium Capsules

Figure 6.3-11 is a functional block diagram depicting the process steps for Cesium/Strontium Capsules. Process steps are shown functionally and detail has not been developed for the processes, equipment, and design features. Specific details will be selected and evaluated in later stages of project documentation.

The functional block diagram for cesium and strontium capsules shown in Figure 6.3-11 is described below.

Receipt for Packaging. Receipt of feed material is expected to be by truck or rail. The receiving function will have crane capability to remove the waste container and overpack from the transport vehicle. Provision for shielding and remote operation of the crane will be required. This will accommodate equipment and boxes that cannot be shielded down to CH levels.

Cask Load In. The cask load in function will be a sequence of specialized processes that allow separation of the waste item from the shipping cask to minimize contamination of the cask. This will allow more expeditious decontamination and release of the cask for reuse.

Waste Packaging. The cesium/strontium capsules will be packaged into steel canisters. These canisters will serve as long-term storage vessels for the capsules until transport to the geological repository.

Cask Load Out. This function will consist of steps necessary to transport the steel canisters from packaging to the shipping station for transfer to long-term storage.

Waste Shipping. Exit functions include shipping of steel canisters to storage prior to final disposition.

Figure 6.3-1. High Level Waste Functional Block Diagram.

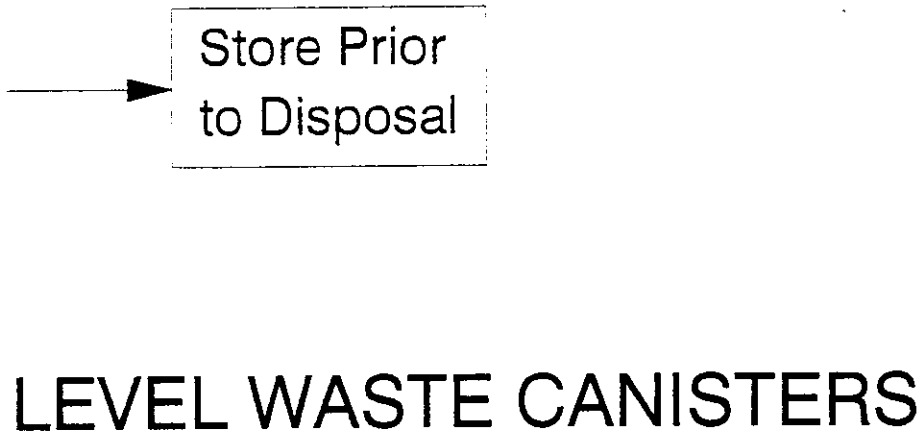
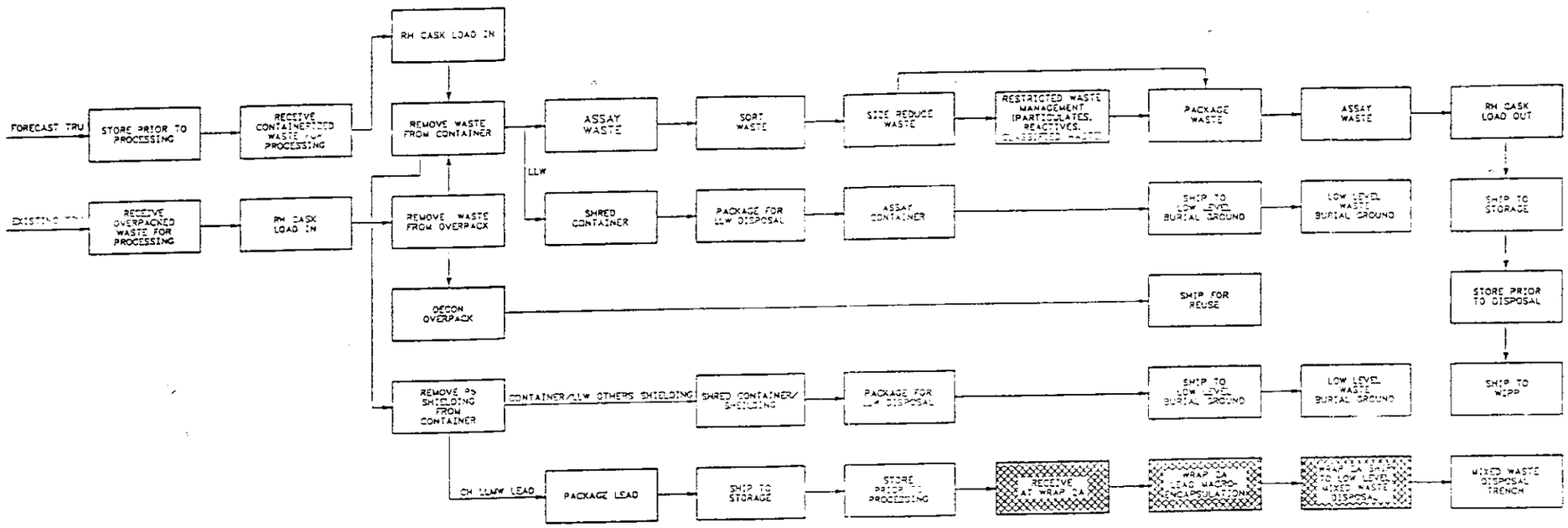


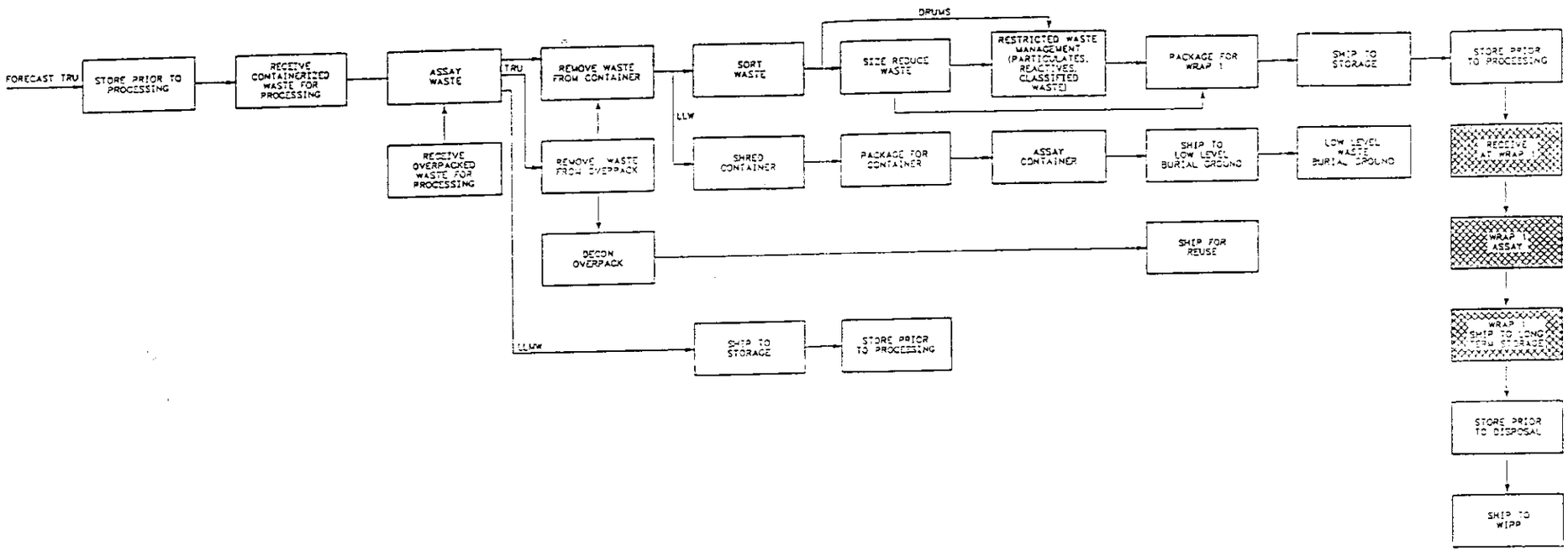
Figure 6.3-2. Remote-Handled Transuranic Waste Functional Block Diagram.



REMOTE-HANDLED TRANSURANIC WASTE

TRU WASTE

Figure 6.0.0. Contact-Handled Transuranic Waste in Large Containers and Drums Requiring Specialized Treatment Functional Block Diagram.



CONTACT-HANDLED TRANSURANIC WASTE IN LARGE CONTAINERS & SPECIAL TREATMENT STREAM

TRU WASTE

Figure 6.3-4. Remote-Handled Low-Level Mixed Waste Functional Block Diagram.

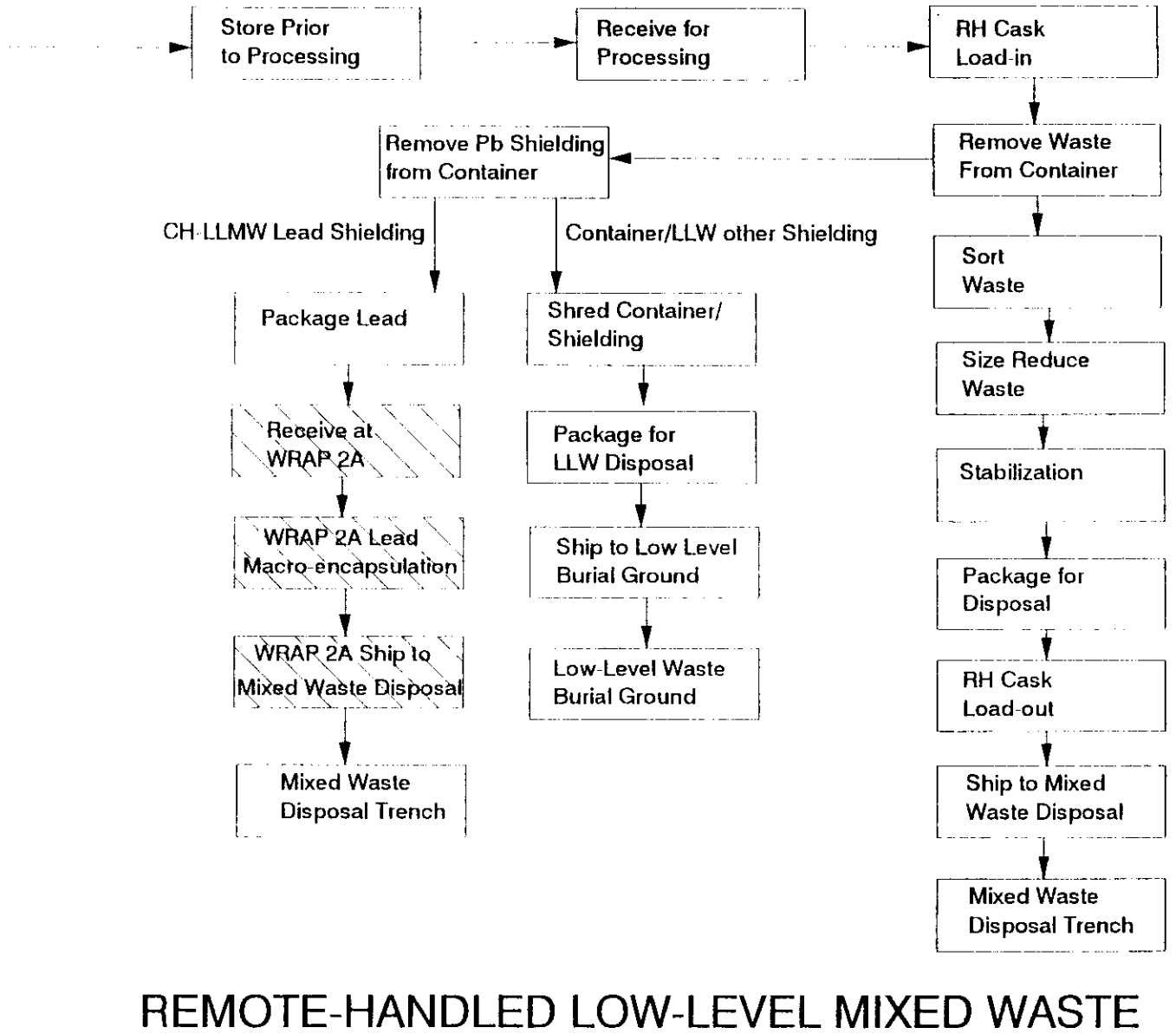


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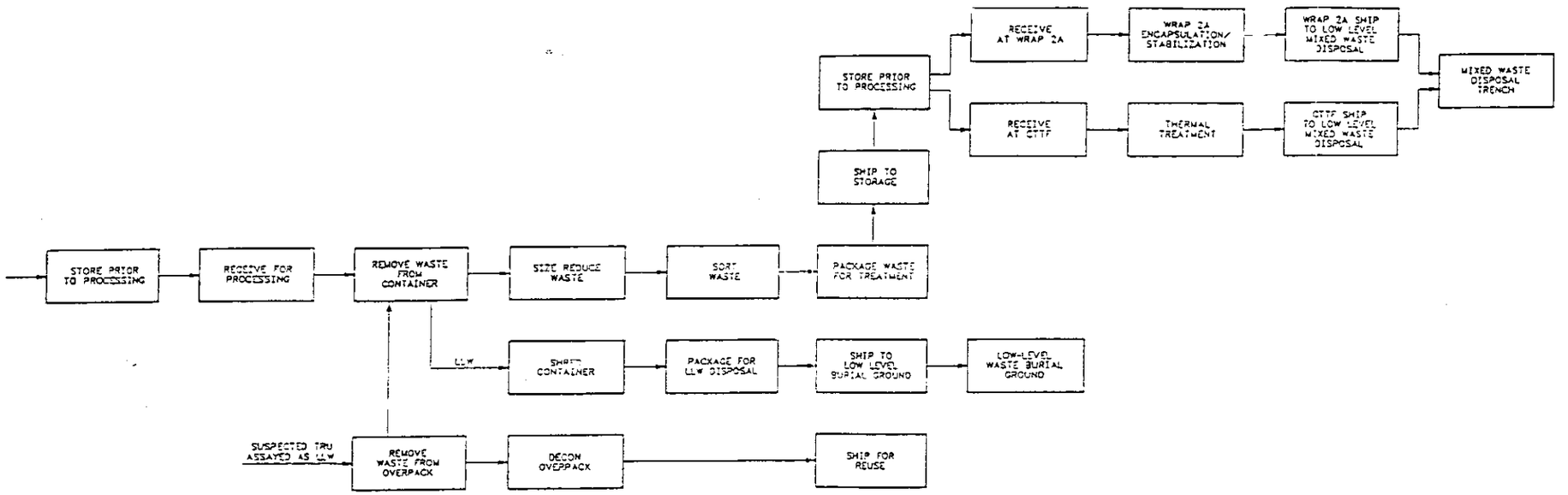
Figure 6.3-5. Contact-Handled Low-Level Mixed Waste in Large Containers Functional Block Diagram.



CONTACT-HANDLED LOW LEVEL MIXED WASTE
IN LARGE CONTAINERS

LOW LEVEL MIXED WASTE

Figure 6.3-6. Remote-Handled Greater Than Category 3 Waste Functional Block Diagram.

REMOTE HANDLED GREATER THAN
CATEGORY 3 LLW/LLMW

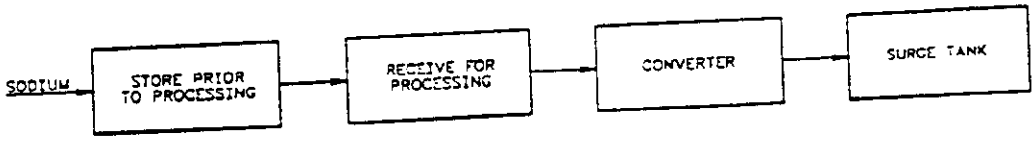
GREATER THAN CATEGORY 3 LLW/LLMW

Figure 6.3-7. Contact-Handled Greater Than Category 3 Waste Functional Block Diagram.

CONTACT HANDLED GREATER THAN
CATEGORY 3 LLW/LLMW

GREATER THAN CATEGORY 3 LLW/LLMW

Figure 6.3-8. Contaminated Metallic Sodium Functional Block Diagram.



CONTAMINATED METALLIC SODIUM

MISCELLANEOUS MATERIALS

Figure 6.3-9. Unirradiated Uranium Functional Block Diagram.

UNIRRADIATED URANIUM

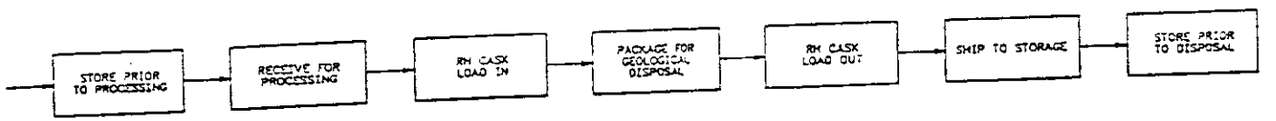
MISCELLANEOUS MATERIALS

Figure 6.3-10. Miscellaneous Sources Functional Block Diagram.

MISCELLANEOUS SOURCES

MISCELLANEOUS MATERIALS

Figure 6.3-11. Cesium and Strontium Functional Block Diagram



CESIUM AND STRONTIUM CAPSULES

CESIUM AND STRONTIUM CAPSULES

6-29/6-30

FILE: ES-W33-WSM
DATE: 3/13/95

Table 6.1-1. Basis for Alternative Set for this Engineering Study.

Alternative Feasibility	New/Existing Facility	Integrated/ Segregated Streams	Single/ Modular Facilities	Alternatives Considered
Yes	New	Integrated	Single	1
Yes	New	Integrated	Modular	2
No	New	Segregated	Single	Infeasible
Yes	New	Segregated	Modular	Not Included
Yes	Existing	Integrated	Single	4
Yes	Existing	Integrated	Modular	3
No	Existing	Segregated	Single	Infeasible
Yes	Existing	Segregated	Modular	Not Included
Yes	Programs Planning Bases			5

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6.4 ALTERNATIVE 1: SINGLE NEW FACILITY INTEGRATING STORAGE AND PROCESSING NEEDS FOR ALL WASTE AND MATERIAL STREAMS

6.4.1 Process Description

Alternative 1 is an integrated processing approach for all waste and materials included in the scope of this study. Multiple treatment lines and processing stations for the various waste forms will be contained in a single new facility. The facility will come on-line in 2006 and continue to process waste through 2023. Processing capability that will be available by the planned solid waste treatment facilities, such as WRAP 1, WRAP 2A, and the CTTF, will not be replicated in the new treatment module. Instead, waste will be sent to these planned facilities as applicable.

Figure 6.4-1 illustrates the Alternative 1 process flow sheet. The waste streams requiring storage and processing are displayed on the left hand side of the figure. The processing facilities and storage facilities are shown in the center, with the onsite and offsite disposal sites and the planned solid waste treatment facilities shown to the right. The numbered lines indicate the stream number for flow of materials from waste generation to processing, storage, and disposal. The annual and total waste and material volume flow corresponding to each of these lines are also provided in Figure 6.4-1.

The high-level planing assumptions for Alternative 1 are outlined in Table 6.4-1. The operation schedule for the storage facilities is typically 30 to 35 years. The treatment start-up date for the new single facility is 2006 with operations completed by 2023. The table also indicates the capacity requirements for all storage and treatment facilities, the waste streams and materials managed by each facility, and the percent of the treatment facility capacity utilized for each waste stream.

Descriptions of the processing facility, the processing stations contained within the facility, and the functions completed at each station are described below.

6.4.1.1 Processing Facility. The processing facility will provide necessary treatment, size reduction, and repackaging for the waste and materials included in this study. The stations included in this multi-processing facility include a receiving area; a heavily shielded hot cell; assay stations for TRU waste; size reduction and packaging stations for TRU waste, LLW, and LLMW; a glove box for CH TRU processing; and a shipping area. Descriptions of the facility stations are provided below and the corresponding functions and waste streams managed at each station are shown in Table 6.4-2.

6.4.1.1.1 Receive for Processing. A single receiving station will accept all waste packages by rail, truck or AGV. Rail and truck receipt is available for RH waste, massive equipment, and large boxes from retrieval. Receipt of material from storage using automated guided vehicle (AGV) or forklift via the transport corridor will also occur. The receiving area will be shielded and a remotely operated crane will be used to remove the waste from the transport vehicles.

6.4.1.1.2 **Heavily Shielded Hot Cell.** A heavily shielded hot cell for high-dose-rate waste processing will be used during all processing operations of remote handled waste. The equipment areas that will be included in this containment include the following:

RH Cask Load In/Load Out. Casks will be transferred from the receiving station to containment through an airlock area. In the airlock the overpack will be removed from the waste package and transferred to the shipping station.

Package Examination/Verification. This processing area will have assay/examination equipment for verifying the contents of the RH TRU waste and repackaging capability for all RH waste and materials.

LLMW Processing. This station will provide the processing capability required for all RH LLMW to meet land disposal requirements and packaging requirements for CH LLMW.

TRU Processing. The TRU station will provide size reduction, repackaging, and processing for TRU waste in accordance with the WIPP WAC.

6.4.1.1.3 **Contact-Handled TRU Waste Assay Area.** All CH TRU waste will be sent to an assay station upon receipt. An assay is performed to separate the TRU waste from the LLW.

6.4.1.1.4 **TRU Waste Size Reduction and Packaging.** Many of the objects that enter this facility will be too large for certification in WRAP 1 and for acceptance by WIPP. Size reduction equipment will be used to cut large objects into smaller pieces that will then be repackaged into drums and SWBs.

6.4.1.1.5 **TRU Waste Glovebox Processing Area.** A moderately shielded glovebox will be used to provide any processing necessary to meet the WIPP WAC. Waste that requires absorption, immobilization, neutralization, and declassification will be processed within the glovebox.

6.4.1.1.6 **CH Low Level Waste Size Reduction and Packaging.** Containers and non-lead shielding used for shipping CH and RH waste to the processing facility will be decontaminated to contact handled low-level waste and routed to a size reduction/repackaging station. The waste will be shredded, packaged into drums and moderate sized burial boxes, and transferred to the shipping station for transport to disposal. Assay equipment will also be used to validate that all containers do not exceed the limits of low level waste.

6.4.1.1.7 **Ship to Storage or Disposal.** All waste and materials are transferred from the processing station to storage or directly to disposal. RH TRU waste is sent to storage to await shipment to WIPP, Cs/Sr and Miscellaneous Sources are sent to long-term storage, CH TRU is sent to storage to await certification in WRAP 1, CH LLMW is sent to storage prior to additional stabilization in WRAP 2A or the CTTF, and RH LLMW and CH LLW are sent directly to onsite burial.

6.4.1.2 Storage Facilities. The waste and materials will be stored in new modular storage buildings as shown in Figure 6.4-1. Storage of waste and materials may be in separate buildings or within designated areas of one facility. Table 6.4-1 denotes the waste streams that will be stored within each facility, and Figures 6.4-2 and 6.4-3 illustrate the annual storage requirements for the RH and CH storage areas, respectively.

6.4.1.3 Planned Solid Waste Facilities, Disposal Sites, and Overpacks. The far right column of Figure 6.4-1 shows three disposal sites, three planned solid waste processing facilities, and the recycling of overpacks. Specific information and the functions performed by these facilities are provided in Table 6.4-3.

6.4.2 Facility Description

6.4.2.1 Criteria. In general, the transfer and storage facilities will limit radiation levels to meet As Low As Readily Achievable (ALARA) guidelines. The design of the facilities will use the latest revisions of the applicable DOE, federal, national, and Westinghouse Hanford Company regulations, codes and standards in effect at the time of the facility designs. In addition, all applicable national consensus codes and standards such as the American Concrete Institute, American National Standards Institute, and American Society of Mechanical Engineers, etc. will be employed.

Safety Classes of the facilities were chosen based on the processes or functions performed and the applicable waste type. Safety Classes are summarized in Table 6.4-4.

6.4.2.2 Approach. To meet Tri-Party commitments relative to the issuance of this document, an expedited approach was taken to determine facility attributes. This approach consisted of obtaining and reviewing over 40 existing solid waste documents (see section 6.4.6) to obtain a basis for determining new facility sizes and characteristics. The references utilized for this task (Feizollahi and Shropshire 1993 & 1994) were the best suited regarding typical facilities and equipment, or portions of facilities (modules), for processing and storing radioactive waste at government owned, contractor operated sites. Modules were selected that most accurately represented the required process or storage functions. Modifications to some of the modules will be required to compensate for differences between the waste characteristics (size, form, etc.) of the references and those required by M-33. Engineering studies to select exact equipment, size facilities, and apply accurate integration meeting the exact process requirements described in Section 6.4.1, were not performed. Although the processing and storage modules that were selected were typical and were not uniquely designed for the exact processes at hand, they are sufficiently accurate, and representative, to obtain comparison cost estimates. For a summary of the modules selected, see Figure 6.4-4.

To obtain facility size, a method of scaling the data found within the existing references was employed. The references contained facility or module size with its associated through-put or storage capacity. Through-put or storage capacity of the M-33 facilities were then scaled with this information to obtain the new facility size (See Appendix tbd). This data establishes the basis for the cost estimates.

Total through-put and storage capacities used as a basis for M-33 are described in Section 6.4.1. For comparison of M-33 processing through-put data with the reference documents, the M-33 capacities were changed to a rate by dividing the volumes by the amount of time the processing facilities were required to operate. Mass flow rates were obtained using an average density when required (Appendix tbd). For storage capacity comparison, less alterations were required. Storage capacities within the references were depicted as simple volumes. To size the M-33 facilities, maximum (peak year) capacities were used as the scaler.

6.4.2.3 General Plant Description. The objective of Alternative 1 was to evaluate a single facility for the purpose of providing all storage, processing and disposal requirements for all waste and materials defined in the scope of TPA milestone M-33-00. Following evaluation and selection of the applicable modules, and consideration of the design and function differences between storage and processing facilities, the complex will comprise one processing facility, one remote-handled storage facility and one contact-handled storage facility. Each storage facility may be sub-divided to separate storage "prior to processing" and "storage prior to disposal" areas. See Table 6.4-5 for a summary of facility size. It should be noted that the remote-handled storage facility required a larger floor plan than the contact-handled storage facility even though the volume of stored waste is less for remote-handled. This is due to the fact that a contact-handled storage facility can store considerably more waste by volume per unit floor area than a remote-handled storage facility due to allocations for shielding walls, vaults, cranes, and other remote handling attributes.

6.4.2.3.1 Processing Facility.

Open, Dump, and Sort Module (OSORT). This module is intended to support the "Receive For Processing" function as shown on the process flowsheet. The OSORT module shown in Figure 6.4-5 is designed to be contiguous with the treatment modules and is ideal for use with an integrated waste management facility that handles multiple waste streams. This module handles smaller waste forms such as boxes, drums, or metal bins that are assumed to be properly characterized before they are opened. The module opens and dumps the incoming waste containers and segregates the waste so it can be fed to a combination of treatment processes. This module is applicable to both contact-handled and remote-handled waste.

The module also has the capability to reduce the size of empty nonmetal containers. Metal containers must be transported to other modules for handling, such as a decontamination module for wash down and reuse or a metal melting module for processing.

Functional Operation: At the OSORT module the waste containers are decapped, and the waste is dumped onto sorting devices or into transport bins that carry it to the treatment operations.

In the remote decap operation, containers of waste are opened by remote means, then dumped and sorted remotely by manipulators and robots housed in a cell. The cell has a controlled environment and multiple barriers. Adequate hoods and supporting ventilation are provided to minimize the spread of dust and contamination. Containers enter the cell through airlock doors. Equipment maintenance is accomplished in a controlled

environment manually by personnel equipped with protective clothing. In addition, the equipment can be retrieved and decontaminated before maintenance is performed.

After the waste containers enter the controlled cubicle environment through airlock doors, they are grouped into two categories: homogeneous waste and heterogeneous waste. Containers of homogeneous waste are opened, dumped, placed in transport bins, and transported to treatment modules. Containers of heterogeneous waste are opened, dumped, robot sorted, placed in transport bins, and then transported to treatment modules. Waste meeting disposal requirements without any further treatment are packaged in this module.

Containerized waste that is designated for segregation is dumped onto a sorting station, which removes bulk metal, noncombustibles, partial combustibles, combustibles, special waste, and gas cylinders. Various sorting technologies, such as robotic assisted sort tables, vibratory screens, and air classifiers, may be used in the sorting station. Any spilled liquid is collected and transported to other unit operations for treatment. The sorted waste material is then placed in transfer bins and moved to the treatment modules. Nonmetallic containers are cut into smaller pieces as required for processing.

Waste packages designated for direct disposal are distributed in multiple containers in such a way that eliminates criticality risks and does not exceed thermal heat generation criteria for individual containers.

Treatment Receiving, Preparation, and Shipping Module (BB). This module is intended to support the "Receive For Processing" and "CH TRU Waste Assay Area" functions as shown on the process flowsheet. The BB module shown in Figure 6.4-6 is one of the first parts of an overall complex needed for treatment, storage, and disposal of waste. It provides initial receiving operations and shipping preparation operations such that the waste can be shipped to the waste treatment modules. It will be designed to handle the larger waste forms such as the cesium and strontium transportation casks, PUREX tunnel equipment and long length transfer pumps. It may also handle large boxes which cannot be handled by the OSORT module.

The module is designed to remotely unload, store, inspect, open, and sort the incoming (untreated) waste and feed it to the treatment modules. It also receives, stores, inspects, certifies and ships the outgoing (treated) waste. When the incoming waste is not compatible with the treatment capabilities of a given treatment module, the BB module provides a special waste packaging operation to assure receipt at the treatment module is possible. These operations will include the necessary shielding and oversize cell operations necessary for the processing of large contaminated equipment or high radiation waste forms. The module also has the capability to size reduce, package and return the empty waste containers for treatment, or disposal.

The functions of the BB module are accomplished by 13 major unit operations including: load/unload, stage and store, inspect and assay, decap containers, sort, package discarded containers, and special waste packaging.

Functional Operation: Transportation vehicles are used to ship waste containers from the generators to the BB module. A loading and unloading unit operation equipped with a high capacity bridge crane with an auxiliary hoist receives, loads, and unloads containers such as cesium and strontium transportation casks, PUREX tunnel equipment, long length transfer pumps and large boxes, drums, etc which can not be handled by the OSORT module. Containers brought in large overpacks can also be unloaded. The loading and unloading unit operation removes high level containers from their shipping casks and places them in a staging and storage area suited to their radiation levels.

The staging and storage unit operation stores the containers and moves them within the unloading, staging, and surge storage areas. In addition, the unit operation transfers containers to and from the various interfacing unit operations. The surge and storage area is large enough to allow maneuvering of the containers during the staging operations and provide sufficient surge storage capacity to meet the desired operational reliability.

An assay and inspect unit operation determines radioactivity, physical properties, and other parameters that are necessary to categorize the containerized waste in accordance with the criteria established for the processing unit operations. In addition, the unit operation can sample the waste in the containers as required for characterization of the waste according to the Resources Conservation and Recovery Act (RCRA) requirements. Samples can then be sent to a laboratory for analysis. Assay functions can be accomplished by various devices, such as passive/active neutron (PAN) counting and Segmented Gamma Scan (SGS) instruments.

After the containers are assayed, they are weighed and measured to determine waste density. Contents (such as metals, paper, glass, sludge, gas cylinders, and liquids) are determined by nondestructive examination. As a minimum, each container is examined using nondestructive assay equipment such as real-time radiography (RTR) or ultrasonic devices. After examination, each container is labeled, and the properties of its contents are logged and entered into a computer database.

Containers holding waste which meet treatment criteria are sent to a decap unit operation similar to that in the OSORT module. Waste forms not meeting criteria are sent to a special waste packaging unit operation where special processing techniques are employed. This will be the case for the large contaminated equipment.

The module also includes a discarded container packaging unit operation. In this unit operation both metallic and nonmetallic containers are cut into smaller pieces and are either placed in drums and sent for offsite disposal, or placed in bins and sent for treatment by one of the treatment modules (e.g., solidification, metal melting, or shredding and

compaction). As an alterative, the unit operation can wash and decontaminate the containers and return them for reuse.

The major secondary waste from this facility is contaminated air generated during the handling operations. This air is collected by the ventilation system, filtered by high efficiency particulate air (HEPA) filters, monitored, and discharged to the atmosphere.

Shredding and Compaction Module (CMPCT). This module is intended to support each of the "LLMW Size Reduction And Packaging", "TRU Size Reduction And Packaging" and "LLW Size Reduction And Packaging" functions as shown on the process flowsheet. The CMPCT module shown in Figure 6.4-7 is used in conjunction with the OSORT and BB modules. It is applicable to both contact-handle and remote-handled waste. The shredding and compaction module functions either as an initial process unit for feeding size-reduced waste to a given process train or as a self contained process unit where solids are size-reduced, compacted in drums, and transported to the certification and shipping module. An example of this operation is size reduction of the long length transfer pumps.

Functional Operation: The module is designed to shred incoming solid waste and package it in .20 m^3 (55 gal) drums, compact the drums and repackage them in .32 m^3 (85 gal) overpacks. This module is capable of shredding, compaction, and repackaging. A dust collection and filtration unit is provided to treat air containing fugitive dust from the shredding operations.

After shredding, drums containing shredded waste are transported to the supercompactor unit operation where a lift device places the filled drums onto press conveyors. The operator selects a drum from one of the conveyors and feeds it to the press through an airlock. A device pierces the drum to release gasses that may be trapped. A high pressure compactor (supercompactor) compresses the drum and transfers it from the press to a staging conveyor (or turntable). A lift device picks up the compressed drum and places it into one of several overpacks located on an adjacent conveyor. After each overpack is filled, the operator feeds it to a grout unit operation where grout is added to fill void spaces in the overpack. The overpack is then transported to the sorting machine where it is capped and scaled. The operator moves the sealed overpack to a drum washing unit where a high-pressure water spray jet is used to remove any loose contamination on the outside surface of the overpacks. The overpacks are then inspected prior to being released from the treatment module.

Any liquid discharged during press operation is directed to a sump which pumps it to the aqueous waste unit operation.

Packaging Module (PACKG). This module is intended to support both the "TRU Processing" and "LLMW Processing" functions as shown on the process flowsheet within the heavily shielded hot cell. The PACKG module shown in Figure 6.4-8 consists of ten unit operations that incorporate all buildings, systems, processes, equipment, controls, and accessories required to repackage incoming drummed solid waste in overpacks. This module also provides size reduction and packaging of large equipment.

such as the PUREX tunnel equipment, and other metal waste of various shapes and forms. It is applicable to both contact-handled and remote-handled waste.

Functional Operation: The packaging module is designed to receive drummed waste and package it in .32 m^3 (85 gal) overpack containers. In the drum inspection unit operation, drummed waste is inspected for physical integrity. Following inspection, drums that meet the packaging module's acceptance criteria are transported to the overpack, grout, and cap unit operation; drums that fail are returned to the incoming drum storage area for return to their original location.

In the overpack, grout, and cap unit operation, a lift device picks drums and places them inside .32 m^3 overpacks. The overpacked drums are then transported to the grouting unit where the void spaces are filled with grout. The overpacks are then capped and transported to the drum washing unit operation, where they are washed and dried before leaving the module.

Liquid waste generated during the operation is collected in a dump and directed to the aqueous waste treatment module.

Certification and Shipping Module (CSHIP). This module is intended to support the "Packaging Examination/Verification" function within the heavily shielded hot cell and the "Ship To Storage Or Disposal" function as shown on the process flowsheet. The CSHIP module shown in Figure 6.4-9 will be utilized as a final and official examination and verification module at the "Ship To Storage Or Disposal" location. It will be used as an interim examination and verification module within the shielded hot cell, similar to the verification operations performed within the receiving and treatment modules. It will be designed to suit the large and unique waste forms such as the PUREX tunnel equipment and cesium/strontium capsules, as required.

The CSHIP module consists of three unit operations: incoming material storage, assay and certification, and truck loading where applicable. This module receives packaged waste containers from all treatment modules and provides temporary storage, radiological and physical characterization of the waste, and shipment of the containers. The module is applicable to both contact-handled and remote-handled waste.

The CSHIP module is used in conjunction with all of the receiving and treatment modules. The module includes all equipment needed for certification of the waste in compliance with the transportation, storage, and disposal regulations and requirements.

Functional Operation: Packaged waste containers arrive from the treatment modules on conveyors, carts, or other transport devices. Containers are removed from the transport devices and placed in a staging area. The containers are then visually examined, tagged, logged, recorded, and transported to an assay-and-certification unit

operation. In this unit operation, the containers are examined by radioassay devices to allow both alpha and gamma radioactivity classification in accordance with transportation, storage, and disposal criteria. Various devices, such as PAN counting and SGS instruments, may be used.

Next the containers are weighed and measured to determine waste density. The presence of material restricted by transportation, storage, and disposal criteria is determined by nondestructive examination using ultrasonic instruments or an RTR device. After examination, each container is labeled and its properties are logged and recorded into a computerized database. After inspection, the container is moved to a temporary storage area until readied for shipment to an interim storage or disposal facility. Containers that do not meet the transportation dose criteria are shipped in a truck equipped with shield overpacks.

The CSHIP module is equipped with a bridge crane and a forklift. Containers can be loaded onto flat-bed trailers or van trucks. Containers can also be loaded into large transportation overpacks. This module is designed to be installed contiguous to a treatment module.

Neutralization Module (NEUTR). This module is intended to support the "TRU Waste Glove Box Processing Area" function as shown on the process flowsheet. The NEUTR module shown in Figure 6.4-10 must be used in conjunction with the GROUT module subsequently described. The NEUTR module as specified within the reference is based on a liquid feed, not a solid waste feed, as intended for M-33. This module is assumed to represent, for cost comparison purposes, a module specifically designed for the treatment of special solid wastes such as contaminated soil, etc., as found in this process function. For the intent of M-33, it has been assumed that the solid waste will initially undergo a dissolution step, producing an aqueous phase, which will be treated as described below.

The neutralization module collects and treats input aqueous waste that is corrosive (pH below 2.0 or above 10.0) or contains inorganic compounds requiring destruction. The corrosive aqueous waste is received at the module in cans, drums, or special transport containers having several different capacities. In addition to treating input aqueous waste, this module treats the secondary aqueous waste (floor drains, equipment drains, and chemical wastes) from the waste treatment facility. The module has a number of unit operations that accomplish the required functions. It is applicable to both contact-handled and remote-handled waste.

Functional Operation: The NEUTR module has all the unit operations needed for treating solid and liquid incoming waste having a range of RCRA-controlled toxic, heavy metal and inorganic contaminants. Toxic metal contaminants can include mercury, cadmium, chromium, and lead. The unit operations also have the capability to treat secondary liquid waste generated by the waste treatment facility, such as distillate from air pollution control, rinse water container wash down operations, and liquids collected from the module equipment and floor drains.

The incoming liquid waste is precharacterized before it is brought to the treatment modules. For bulk operations, the incoming waste is segregated into different groups: liquids with a low pH, liquids with a high pH, and liquids that require destruction of various inorganic compounds.

The neutralization unit operations have maximum flexibility and can be used in series, in parallel, or as stand-alone units. Flexible piping connectors are provided at the inlet and outlet of each treatment device. The waste is transferred from the transport container to appropriate batch tanks or directly to a desired treatment unit operation.

Typical steps for treating bulk quantities of the three waste categories are as follows:

Low-pH waste: Waste having a low pH and requiring no treatment other than neutralization is treated with a basic neutralizer compound and transported to the stabilization module. No further processing is performed in order to minimize concentration and potentially increase the criticality of the treated stream.

High-pH Waste: Waste high in PH is processed through the neutralization module by the addition of acidic neutralizer compounds. The final treatment pH selected is dependent on the quantity of suspended solids that the stream would produce. This amount is minimized in order to reduce the criticality of the stream. Any sludge generated from the neutralization process is removed and transported to stabilization. Supernate from the neutralization is also transported to stabilization.

Inorganic waste: Waste containing only inorganic compounds that require destruction are treated by reacting these compounds with various compounds that will convert the toxic compounds into non- or lesser-toxic compounds. The resulting treated stream is transported to the GROUT stabilization module.

Grout Stabilization Module (GROUT). This module is also intended to support the "TRU Glove Box Processing Area" function as shown on the process flowsheet. The GROUT module shown in Figure 6.4-11 provides secondary waste treatment capability and is used at the end of the treatment modules. It is utilized to process the special case TRU waste. The module output is transported to the CSHIP module. The primary function of this module is to solidify solid and liquid waste that arrive from treatment modules or storage facilities. The module is applicable to both contact-handled and remote-handled waste.

The module consists of five main process unit operations that incorporate all buildings, systems, processes, equipment, devices, controls, and accessories required to prepare the incoming waste and stabilize it either by macro- or microencapsulation techniques.

Functional Operation: The module receives concentrated liquid waste, solids, or sludge via a pipeline or by special containers. A chemical addition unit is used to adjust the chemistry of the feed before it is

fed to the solidification unit operation. A preparation and feed unit crushes and shreds incoming solid waste. The shredded waste is then collected in a storage hopper.

The microencapsulation unit operation solidifies concentrated liquid waste, sludge, or a combination of the two. The unit has a remotely operated in-drum solidification assembly equipped with intake tanks and hoppers for sludge, liquid waste, and grout. To accomplish the solidification process, a drum is placed onto a transfer cart. The cart moves the drum to various fill stations where feeders place sludge and liquid waste and binder in the drum. Next, the cart moves the filled drum to a mixing station where the drum is capped and tumbled to achieve the required mixture. The cart moves the drum for a repeat of the filling and mixing steps to maximize the fill efficiency.

The macroencapsulation unit operation solidifies bulkier solids such as spent filters, shredded solids, soils and pelletized debris. Macroencapsulation is accomplished by placing the solids in a drum, adding grout, and mixing the two components. In large-generator modules, a pugmill accomplishes this function.

After encapsulation, the operator remotely moves the filled container to a capping and washing unit. This unit operation provides for sample collection, capping of the container, and removal of loose contamination from the container surface by high-pressure spray water jets. The containerized waste is ready for processing through radioassay and final certification, which are included within the CSHIP module.

Maintenance Module (MAINT). This module does not directly support a function shown on the process flowsheet but is required to sustain normal plant operations. The MAINT module is equipped with an area for receiving and repairing failed equipment and is used in conjunction with the treatment modules. The maintenance shop will repair components contaminated with low-level radioactivity but not alpha emitters. Components contaminated with alpha particles must be decontaminated in the alpha maintenance galleries before they are brought into the maintenance shop.

Functional Operation: Contaminated failed equipment and parts arrive at the shop in transfer carts. Parts are removed from the transport carts and are placed in a decontamination area where high-pressure spraying or other techniques are used to remove any loose contamination. After cleaning and decontamination, components are moved to maintenance tables. Maintenance machinery and tools are used as needed. The shop includes an overhead crane and a jib crane for material handling, and a paint booth.

Treatment Front-End Support Module (TADMN). This module also does not directly support a function shown on the process flowsheet. It too is intended to support normal plant operations. The TADMN module includes all administrative and laboratory buildings required for waste management support functions. The treatment front-end support module is essentially the same for all treatment facilities regardless of their capacity.

Functional Operation: The treatment front-end support module incorporates all technical and administrative support functions needed to manage the operation of a waste management facility. These functions include security, access control including personnel decontamination (radioactive and hazardous), maintenance of uncontaminated areas and equipment, health physics and radiation badges, facility access control, sanitary facilities, work control and personnel support, internal and external (public relations) communications, spill or emergency response provisions (hazardous and radioactive), analytical laboratory, environmental field sampling, environmental regulatory reporting, and records management.

6.4.2.3.2 Remote Handled Storage Facility.

Enclosed Vault Storage Module (Z). This module is intended to support the "Storage Prior To Processing" and "Storage Prior To Disposal" functions for remote-handled waste as shown on the process flowsheet. Two module sizes were utilized to handle the "prior to processing" and "prior to disposal" functions. The enclosed vault storage facilities shown in Figures 6.4-12 and 6.4-13 are used in conjunction with the treatment and shipping modules. Each module receives waste drums or overpacks and holds them in shielded vaults for long-term storage. The facility is suitable for storage of waste having high gamma radiation and requiring remote handling.

Functional Operation: Treated waste in metal drums, overpacks or canisters are brought to the Z module in a shielded transportation cask mounted on an approved vehicle. The unload and stage unit operation receives and inspects the vehicle and shield cask, and removes the cask cover. Using remote handling techniques, the unit operation removes the contents from the cask and places it in a shielded assay inspection cubicle. When the removal operation is completed, the empty cask and trailer is inspected, the cask lid is attached, and the trailer is sent either to the parking area or back to the CSHIP module. Decontamination of the transport vehicle and empty cask will be accomplished at the storage facility track bay or the BB module.

At the assay/inspection cubicle, the containers are first remotely examined, labeled, logged, and recorded. An assay/inspect unit operation is used to determine radioactivity, physical properties, and other parameters that are needed to classify the waste for disposal. Various devices such as SGS and PAN assay instruments may be used. After radiological examination, the containers are weighed and measured to determine waste density.

The vault safely stores the waste for the desired period. A monitoring unit operation continuously monitors the storage confinement system and will be able to determine when corrective action needs to be taken to maintain safe storage conditions. Monitoring includes any potential leakage of drums.

All operations involving storage of waste are accomplished remotely. Shielding is provided to reduce the worker's exposure to radiation.

Operation steps for shipment of waste out of the storage facility is the reverse of the incoming drum operation steps discussed above. The storage facility does not generate secondary waste.

6.4.2.3.3 Contact Handled Storage Facility.

Contact-Handled Storage Module (STORE). This module is intended to support the "Storage Prior To Processing" and "Storage Prior To Disposal" functions for contact-handled waste as shown on the process flowsheet. The STORE module shown in Figure 6.4-14 consists of three unit operations. All incoming waste is stored at a specified location depending on waste form. The module is equipped with a cleanup unit operation for responding to potential spills. The module also has permanent monitoring capabilities to ensure the integrity of the stored waste containers. The module should be used in conjunction with the SADMN module described below.

Functional Operation: The storage areas include features, such as spill collection and a combination of sloping floors and sumps, that achieve compliance with the storage requirement of RCRA. Designated storage areas are separated by 15 cm (6 in) high (minimum) concrete berms or full height partitions that extend the length of the storage bays. In bays located along the outside walls, floors slope to the rear of the module. Floors in the remainder of the bays are sloped to the center. Area monitors are included for both gamma and alpha radiation control.

Storage Front-End Support Module (SADMN). This module does not directly support a function shown on the process flowsheet but is required to support storage facility operations. The SADMN module includes all administrative and laboratory buildings required for waste management support functions.

Functional Operation: The SADMN module incorporates all technical and administrative support functions needed to manage the operation of a waste management facility. These functions include security, access control including personnel decontamination (radioactive and hazardous), maintenance of uncontaminated areas and equipment, radiological control and radiation badges, ability access control, sanitary facilities, work control and personnel support, internal and external (public relations) communications, spill or emergency response provisions (hazardous and radioactive), analytical laboratory, environmental field sampling, environmental regulatory reporting, and records management.

Storage Receiving and Shipping Module (SRCSH). This module also does not support a function shown on the process flowsheet but is also required to support storage plant operations. The SRCSH module is used in conjunction with the STORE module and supplies all the necessary accommodations for receiving truck shipments, unloading containers, transporting containers to the storage, and the reverse operations, as needed, for shipping containers out of the storage facility.

Functional Operation: Containers arrive on a transport vehicle and are unloaded using a forklift or overhead bridge crane, and placed in a staging area. The containers are visually examined, labeled, logged, recorded, and transported for inspection and assay. At the inspection

and assay operation, the category of the received waste is verified against the results obtained from previous modules. After inspection, the containers are moved to a storage area. The module is also used for shipping and loading containers that are ready for transport to disposal modules. The loading and shipping operations are the reverse of receiving and unloading steps.

The technical bases and requirements for the SRCSH module is the same as those outlined in the BB and CSHIP modules, except that the assay, inspection, and certification functions are for verification purposes only. In addition, the SRCSH module is equipped with a computer inventory system that tracks the incoming and outgoing waste, as well as types of sampling and analysis that may be performed at the staging area (nondestructive).

6.4.2.4 **Assumptions and Uncertainties.** The assumptions and uncertainties used to form the basis for Alternative 1 are listed below.

1. It was assumed that the engineering and design cycle will follow the requirements of a standard DOE Line Item Project and will have a duration of four years. Facility construction was assumed to be three years.

2. The average hourly waste flow rate was based on a facility operation of 250 days/year, 8 hours/day, at a 70% availability. This is equivalent to 175 days/year or 1400 hours/year of operation.

3. It was assumed that dry storage of cesium and strontium was acceptable and that the vault design depicted in Module Z will accommodate the cesium and strontium overpacks. This was assumed acceptable for cost estimating purposes.

4. Sodium storage following processing and "prior to disposal" was not incorporated within the alternative. All sodium was assumed to be converted to sodium hydroxide and utilized by the TWRS organization.

5. The availability of power and water utilities were not investigated for this alternative. It was assumed that sufficient utilities are available.

6. Although briefly mentioned in the description of some modules, the handling and disposition of all liquid and gaseous effluents were not investigated for this alternative. It is assumed that existing or planned facilities will be capable of handling the generated effluents of the new facilities.

7. Location of the new processing and storage facilities was assumed to be in the 200 Area plateau and that sufficient room is available to locate the facilities adjacent to each other or within close proximity of each other.

6.4.4 Cost

A breakdown of the life cycle cost for Alternative 1 is provided in Table 6.4-6. Presented is the total estimated cost, total project cost, operations and maintenance cost, and decontamination and decomissioning cost. The total life cycle cost for Alternative 1 including escalation and contingency is $6,205,547,270. This is summarized below:

Total Estimated Cost	$2,055,725,480
Other Project Cost	$ 727,705,501
Operations and Maintenance	$2,783,430,981
Decontamination and Decommissioning	$1,382,243,100
Total Life Cycle Cost	$6,205,547,270

The details of the capital cost estimate are provided in Appendix B. The personnel requirements and direct (no escalation, no contingency) operating and maintenance costs are presented in Appendix D.

6.4.5 Schedule

For an inclusive schedule of Alternative 1 depicting engineering, design, construction, operation and decommissioning, see Figure 6.4-15. The facility operation dates shown were established to support existing and projected waste volume inventory requirements. Design duration was based on a standard four year DOE Line Item Project and facility construction was assumed to be three years. Closure of processing facilities occurs the year following the final year in which waste is forecasted (fiscal year 2023).

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Figure 6.4-1. Alternative 1: One New Processing Facility. 1 of 2.

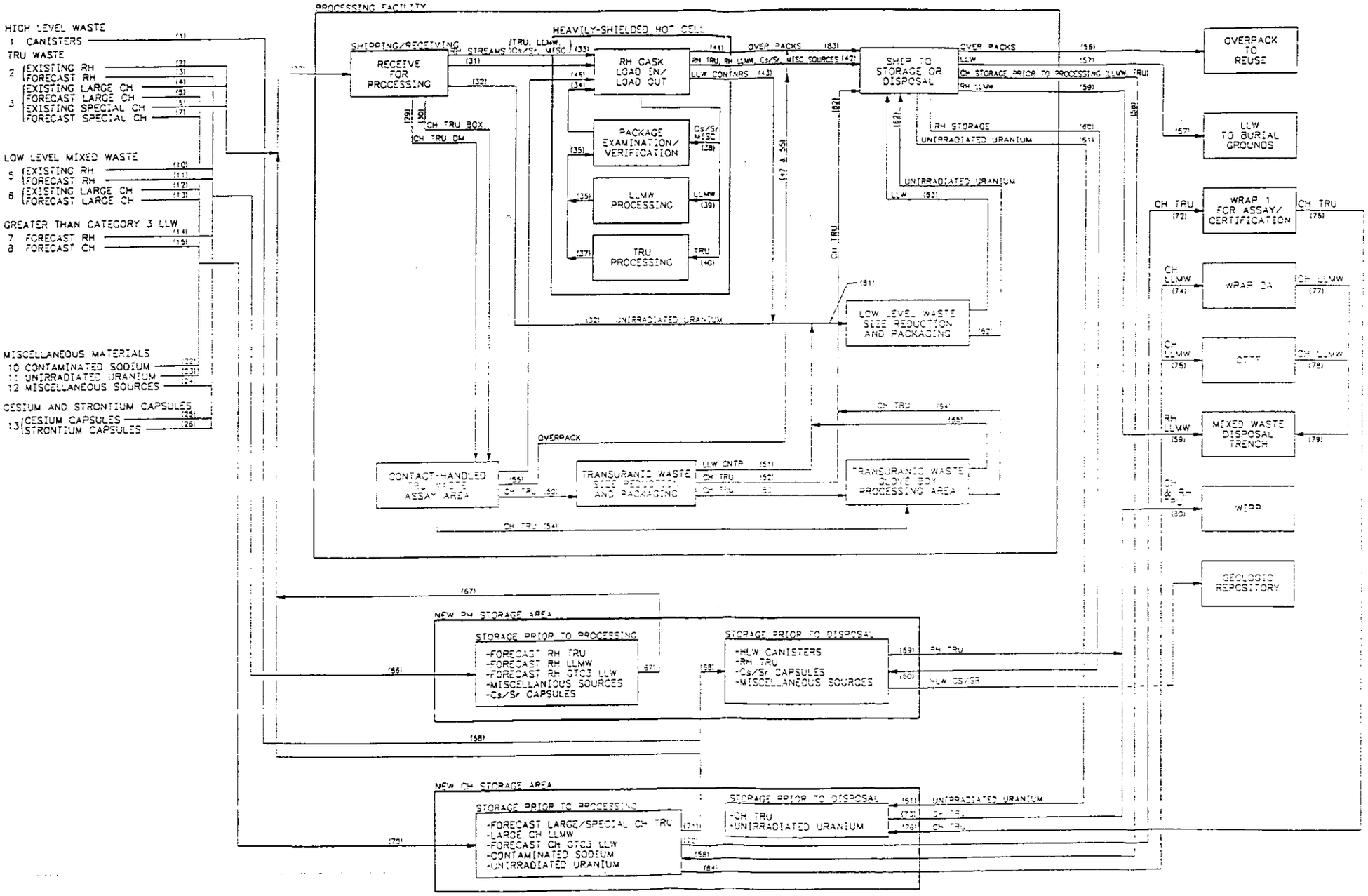

Figure 6.4-1. Alternative 1: One New Processing Facility.
2 of 2.

No.	Name	Total	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
1	HLW Canisters	8,569																	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451
2	Existing RH TRU	380													10	40	81	25	10	25	66	25	25				10		10		25	25					
3	Forecast RH TRU	41,316	1,533	228	153	169	176	183	192	180	203	208	4,069	7,738	7,707	368	326	348	493	579	685	1,523	1,585	1,900	1,925	1,945	1,505	1,437	1,192	1,162	1,194	399					
4	Existing CH TRU	7,299													581	567	757	560	750	688	703	532	480	120	97	43	165	270	225	217	195	150					
5	Forecast Large CH TRU	21,832	177	71	63	2,141	2,141	2,153	2,153	2,155	2,153	2,153	2,153	2,153	2,153	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
6	Existing CH TRU	491													36	21	20	53	38	91	33	33	48				30	15	5	491		15					
7	Forecast Special CH TRU	1,892	2	69	49	13	13	37	220	7	44	56	39	38	45	45	51	51	36	36	30	115	110	110	104	104	98	93	92	92	92	0					
10	Existing RH LLMW	27	27																																		
11	Forecast RH LLMW	96,483	1,143	1,327	1,314	1,792	1,466	1,529	1,554	1,773	1,977	2,018	2,797	2,631	2,459	2,703	2,637	3,029	3,555	4,268	5,232	5,707	6,560	7,167	7,430	7,574	3,149	2,736	2,419	2,589	3,018	2,827					
12	Existing CH LLMW	650	550																																		
13	Forecast CH LLMW	980	75	22	22	22	22	22	22	22	22	22	22	22	47	22	22	22	48	22	22	22	48	22	22	22	118	93	22	22	48	22					
14	Forecast RH GTCII	42,589	39	0	0	0	0	0	0	312	879	1,445	2,535	3,485	5,524	7,507	7,224	5,558	2,323	1,445	723	879	168	168	168	168	168	168	168	168	168	0					
15	Forecast CHGTCII	46,703	50	2	2	33	33	94	48	329	988	1,585	2,729	3,548	5,587	7,570	7,303	5,738	2,402	1,520	736	1,198	487	487	472	472	456	456	441	441	441	2					
22	SODIUM	1,159															1,159																				
23	UNIRRAD UR	144													48		24	24						12			24				12						
24	MISC SOURCES	15	15																																		
25	CS CAPSULES	2	2																																		
26	SR CAPSULES	1	1																																		
27	Receive for Processing	189,251													10,893	10,703	10,598	10,699	10,599	10,690	10,717	10,701	10,697	10,704	10,678	10,708	10,684	10,722	10,700	10,708	10,700	7,352					
29	CH TRU Waste Assay Area (incoming drums)	3,367													223	225	335	246	191	281	222	198	177	151	110	119	271	177	152	102	152	36					
30	CH TRU Waste Assay Area (incoming boxes)	43,729													1,805	2,105	2,115	2,435	2,342	2,292	1,674	2,538	2,962	2,162	1,903	1,865	2,518	2,963	3,287	3,364	3,098	962					
31	Receive for Processing (exting CH LLMW)	2,787													170	212	213	216	216	186	161	98	114	58	45	44	206	233	146	165	207	84					
32	LLW Size Reduction and Packaging (incoming UR)	144													48		24	24						12			24				12						
33	RH Cask Load In	142,021													9,617	8,370	8,224	7,994	5,166	8,117	8,621	6,564	7,555	8,379	8,665	8,704	7,771	7,882	7,251	7,222	7,438	6,355					
34	Package Examination/Verification (exting)	46,419													2,452	2,685	2,813	2,551	2,453	2,420	2,298	2,152	2,385	2,519	2,621	2,763	3,146	2,771	2,804	2,668	2,811	1,907					
35	Package Examination/Verification (incoming LLMW, TRU)	46,400													2,452	2,685	2,813	2,636	2,453	2,420	2,298	2,152	2,385	2,518	2,621	2,763	3,146	2,771	2,804	2,668	2,809	1,907					
36	LLMW Processing (out)	35,624													1,913	2,220	2,299	2,268	2,028	2,120	1,994	1,601	1,850	1,957	1,960	2,057	2,224	1,851	1,905	1,850	1,992	1,535					
37	TRU Processing (out)	10,776													539	465	514	368	425	300	304	551	536	560	560	706	922	920	898	819	817	371					
38	Package Examination/Verification (incoming CS/SR, Misc)	19																15						1							3						
39	LLMW Processing (in)	18,788													1,016	1,184	1,224	1,210	1,090	1,125	1,054	835	965	1,003	996	1,044	1,184	1,008	1,004	983	1,068	797					
40	TRU Processing (in)	10,512													530	465	505	368	420	299	302	546	523	548	557	693	904	905	874	805	804	362					
41	Ship to Storage or Disposal (Entering Overpacks)	100,610													4,442	4,174	4,629	4,955	5,477	5,247	6,908	5,681	6,201	7,144	7,014	7,355	4,782	5,301	4,702	5,242	5,169	5,185					
42	RH Cask Load Out (Exting RH TRU, CH&RH LLMW, etc)	46,419													2,452	2,685	2,813	2,551	2,453	2,420	2,298	2,152	2,385	2,519	2,621	2,763	3,146	2,771	2,804	2,668	2,811	1,907					
43	RH Cask Load Out (exting LLW Contrs)	43,753													4,351	4,419	3,829	2,274	2,934	2,112	1,914	1,472	1,506	1,275	1,568	1,369	3,039	2,335	2,641	2,037	2,041	1,225					
46	CH TRU Waste Assay Area (exting LLMW)	3,506													278	329	348	374	364	362	300	281	220	61	23	27	74	81	122	83	108	69					
50	TRU Waste Glovebox Processing (Entering Drums)	27,974													550	601	611	737	677	559	537	2,252	2,009	1,870	1,791	1,756	2,559	2,607	2,737	2,996	2,580	638					
51	CH TRU Waste Assay Area (Exting TRU to Size Reduction)	27,974													550	601	611	737	677	559	537	2,252	2,009	1,870	1,791	1,756	2,559	2,607	2,737	2,996	2,580	638					
52	CH TRU exting TRU (total)	16,732													312	351	367	433	406	386	322	1,357	1,205	1,122	1,075	1,053	1,405	1,564	1,542	1,791	1,548	383					
53	TRU Waste Glovebox Processing (Entering Boxes)	52													19			9		9							9			9							
54	TRU Waste Glovebox Processing (Entering Drums)	2,306													147	148	157	149	108	178	119	127	74	151	110	119	174	145	119	90	152	30					
55	TRU Waste Glovebox Processing (Exting LLW)	13,310													1,054	1,251	1,323	1,421	1,384	1,374	1,141	1,067	836	231	88	103	282	308	461	317	410	261					
56	Overpacks to Reuse	113,919													5,496	5,425	5,952	6,376	6,861	7,622	8,049	5,748	7,037	7,375	7,102	7,457	5,064	5,609	5,163	5,559	5,579	5,446					
57	LLW to Burial Grounds	14,807													1,012	1,034	921	832	744	590	514	772	718	559	714	649	1,114	1,017	1,099	1,024	1,014	379					
58	Ship to Storage or Disposal (Exting CH)	21,556													644	687	716	781	587	748	579	1,578	1,373	1,351	1,238	1,227	1,777	1,904	1,867	2,029	1,875	478					
59	Mixed Waste Disposal Trench (RH)	33,672													1,793	2,071	2,150	2,117	1,877	1,990	1,882	1,533	1,770	1,910	1,929	2,025	2,080	1,685	1,803	1,733	1,847	1,477					
60	RH Storage (from shipping)	10,794													539	465	514	383	425	300	304	551	535	561	560	706	922	920	898	819	819	371					
61	Ship to Storage or Disposal (Exting UR)	144													48		24	24						12			24				12						
62	LLW Size Reduction and Packaging (Exting UR)	144													48		24	24						12			24				12						
63	LLW Size Reduction and Packaging (Exting LLW)	14,807													1,012	1,034	921	832	744	590	514	772	718	559	714	649	1,114	1,017	1,099	1,024	1,014	379					
64	TRU Waste Glovebox Processing (Exting CH TRU)	2,971													213	178	200	197	130	232	143	153	88	181	132	142	225	174	143	121	182	35					
65	TRU Waste Glovebox Processing (Exting LLW)	2,306													147	148	157	149	108	178	119	127	74	151	110	119	174	145	119	90	152	30					
66	RH Storage Prior to Processing (in)	180,683	3,009	1,555	1,478	1,962	1,643	1,713	1,747	2,256	3,058	3,670	9,501	13,854	15,690	10,579	10,188	10,035	8,371	6,292	5,642	3,109	3,013	9,235	9,523	9,687	4,821	4,321	3,779	4,019	4,280	3,227					
67	RH Storage to Receive for Processing	138,094													8,415	8,040	7,928	7,657	7,829	7,793	8,353	5,790	7,368	8,311	8,530	8,660	7,534	7,345	7,116	7,055	7,232	6,235					
68	RH Storage Prior to Disposal (in)	8,569																	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451
69	RH Storage Prior to Disposal (exting RH TRU)	10,776													539	465	514	368	425	300	304	542	545	560	560	706	870	870	861	819	812	522					
70	CH Storage Prior to Processing	72,379	967	175	148	80	80	165	302	370	1,066	1,675	2,802	3,620	5,680	7,637	7,552	6,809	2,485	1,581	838	3,476	2,785	2,772	2,750	2,753	2,825	2,800	2,707	2,707	2,703	391					
71	CH Storage to Receive for Processing	26,656													396	346	364	425	319	346	255	1,561	1,784	1,988	1,903	1,868	2,624	2,837	2,774	3,096	2,748	624					
72	WRAP1 (in)	19,604													525	539	567	530	536	618	465	1,510	1,294	1,282	1,227	1,178	1,571	1,588	1,581	1,578	1,575	1,340					
73	CH Storage Prior to Disposal (exting CH TRU)	19,604													525	531	575	530	521	625	472	1,501	1,303	1,275	1,225	1,160	1,476	1,480	1,488	1,540	1,538	1,731					
74	WRAP 2A (entering)	1,950													117	120	119	127	129	130	124	126	101	58	28	39	128	117	127	109	128	123					
75	CTTF (incoming)	2													0				0				0				0				0						
76	WRAP1 Shipping to Storage	19,504													525	531	575	530	521	625	472	1,501	1,303	1,275	1,225	1,169	1,573	1,586	1,581	1,578	1,577	1,348					
77	WRAP 2A Ship to Disposal	3,900													212	241	256	247	262	242	265	253	203	98	74	79	238	251	255	219	249	256					
78	CTTF (exting)	0													0				0				0				0				0						
79	Mixed Waste Disposal Trench (CH)	3,900													212	241	256	247	262	242	255	253	203	98	74	79	238	251	255	219	249	256					
80	WRP	30,379													1,064	995	1,089	997	946	926	776	2,045	1,847	1,925	1,995	1,866	2,046	2,250	2,248	2,352	2,350	2,253					
81	CH Storage Prior to Processing (exting to W2A & TTF)	1,952													117	120	119	127	128	130	124	126	102	58	28	39	129	117	127	109	128	123					
82	Ship to Storage or Disposal (Entering Overpacks)	113,919													5,496	5,425	5,952	6,376	6,861	7,622	8,049	5,748	7,037	7,375	7,102	7,457	5,064	5,609	5,163	5,559	5,579	5,446					

Figure 6.4-2. Alternative 1 Annual RH Storage Requirements (Cubic Meters).

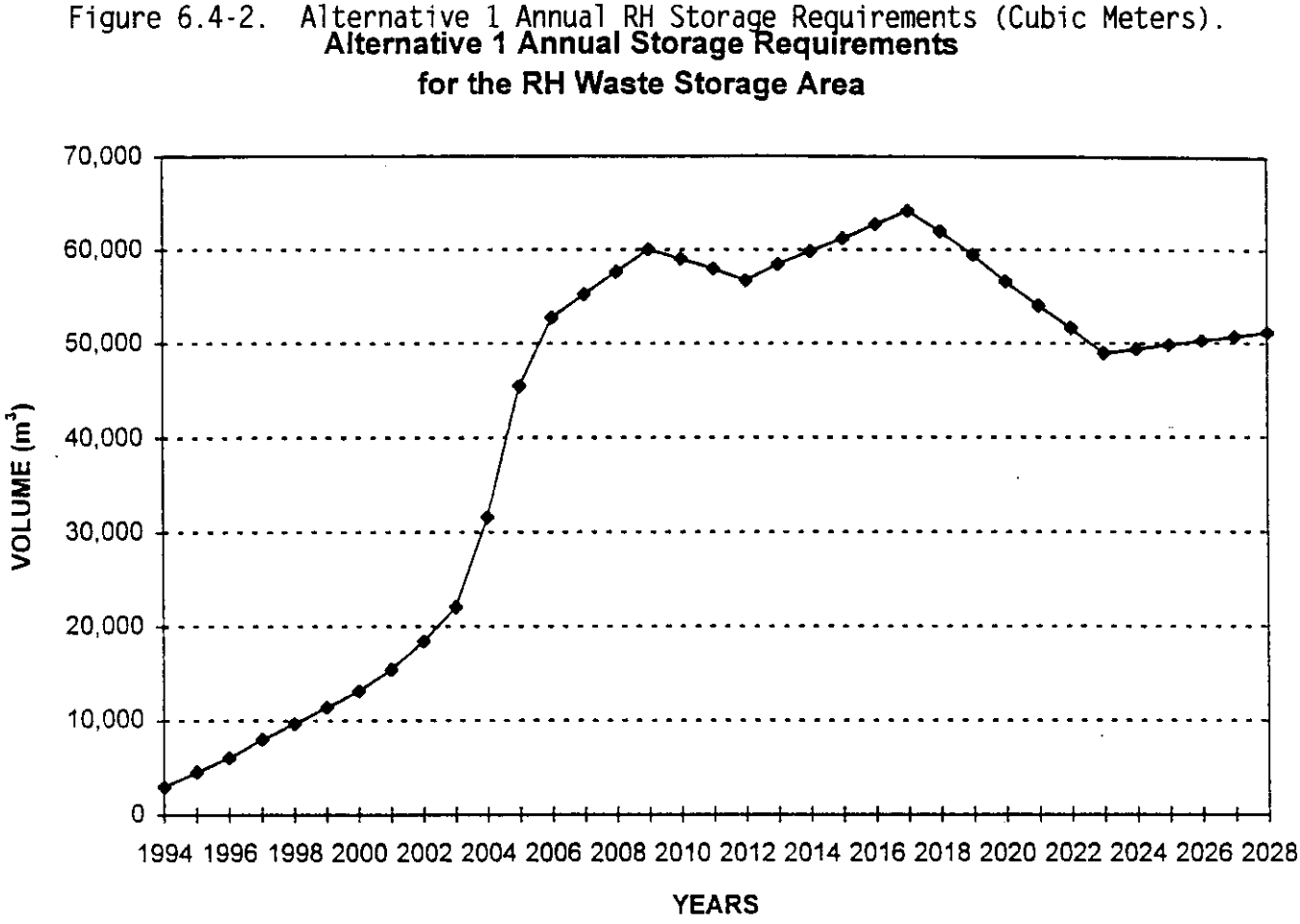

Figure 6.4-3. Alternative 1 Annual CH Storage Requirements (Cubic Meters).

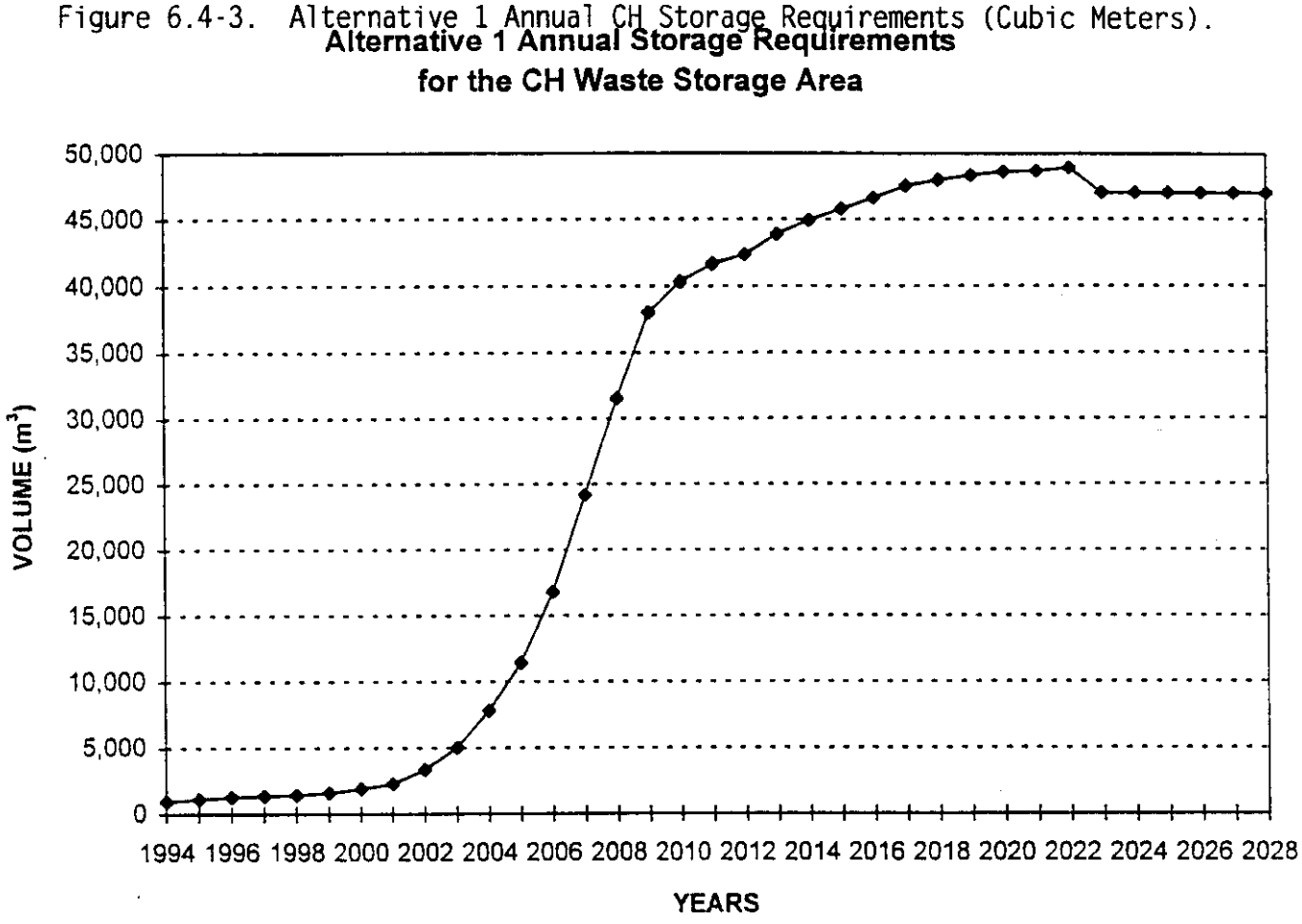

FIGURE 6.4-4 ALTERNATIVE 1 MODULE SELECTION SUMMARY

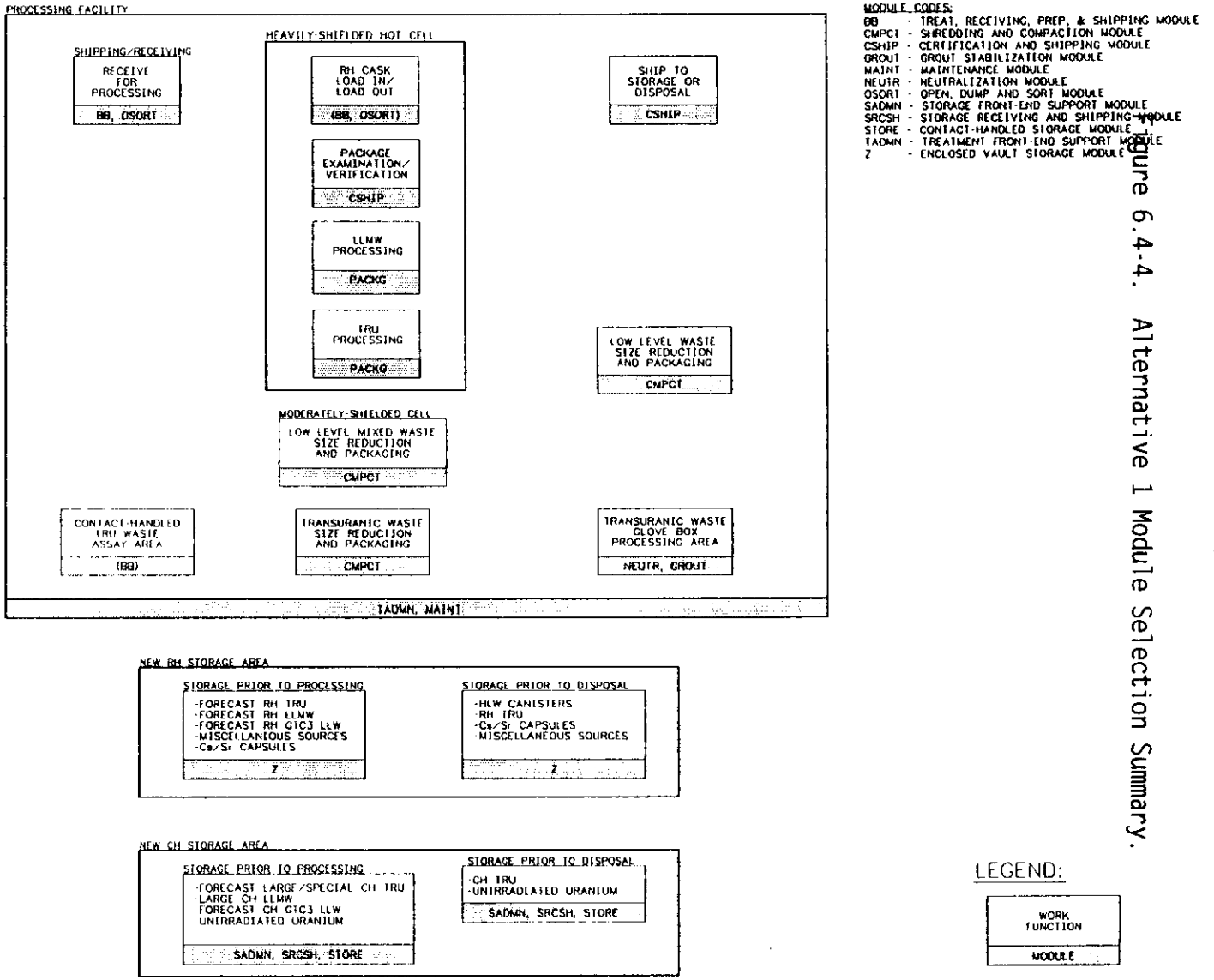

Figure 6.4-4. Alternative 1 Module Selection Summary.

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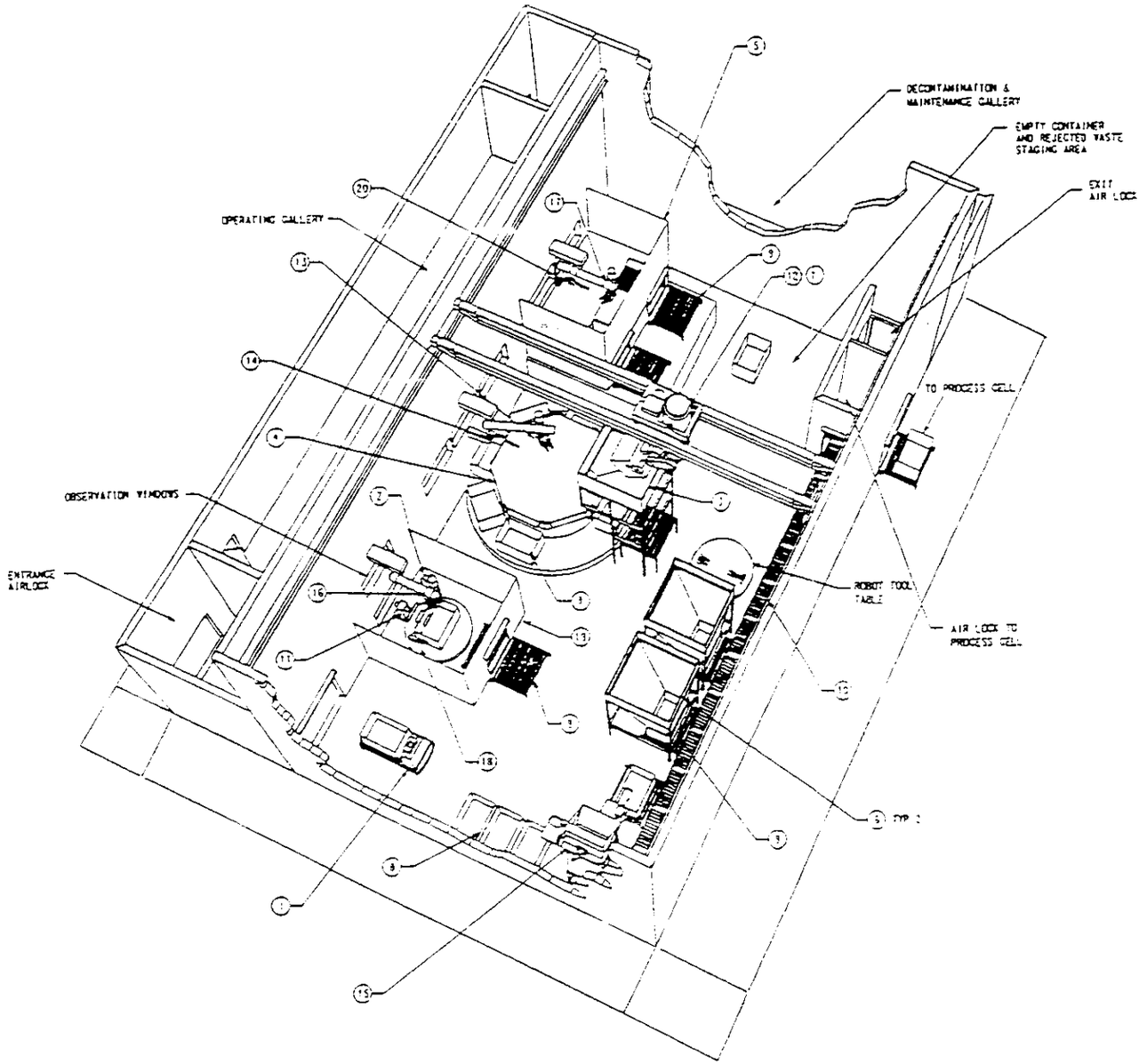
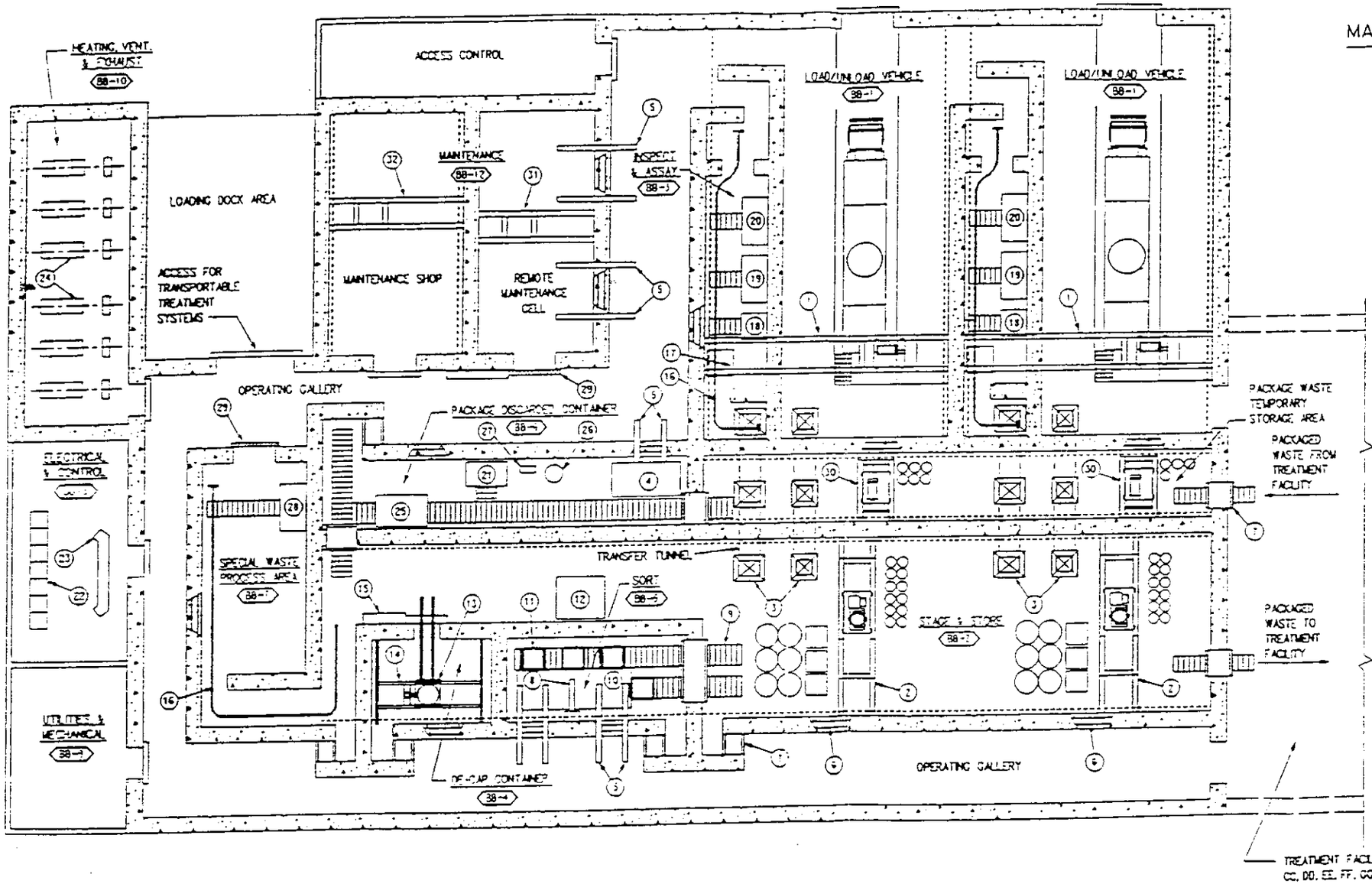
Figure 6.4-5. Open, Dump, and Sort Module.



EQUIPMENT LIST

1. SELF GUIDED VEHICLE
2. DE-CAP DEVICE
3. SORT HOPPER
4. SORT TABLE/ROTATING TABLE
5. SPECIAL WASTE GLOVEBOX
6. DUMP HOPPER
7. MAINTENANCE CRANE
8. BINS 4 (14"X4"X8")
9. BIN CONVEYORS 8' LONG
10. BIN CONVEYOR 70' LONG
11. BIN PUSHER
12. MAIN CELL GANTRY ROBOT
13. SORTING TABLE HYDRAULIC MANIPULATOR
14. SORTING MASTER SLAVE MANIPULATOR
15. BOX SIZE REDUCTION UNIT
16. DRUM OPENING GANTRY ROBOT
17. GLOVEBOX HYDRAULIC MANIPULATOR
18. CONTAINER GRAPPLER
19. DECAP ENCLOSURE
20. GLOVEBOX MASTER SLAVE MANIPULATOR

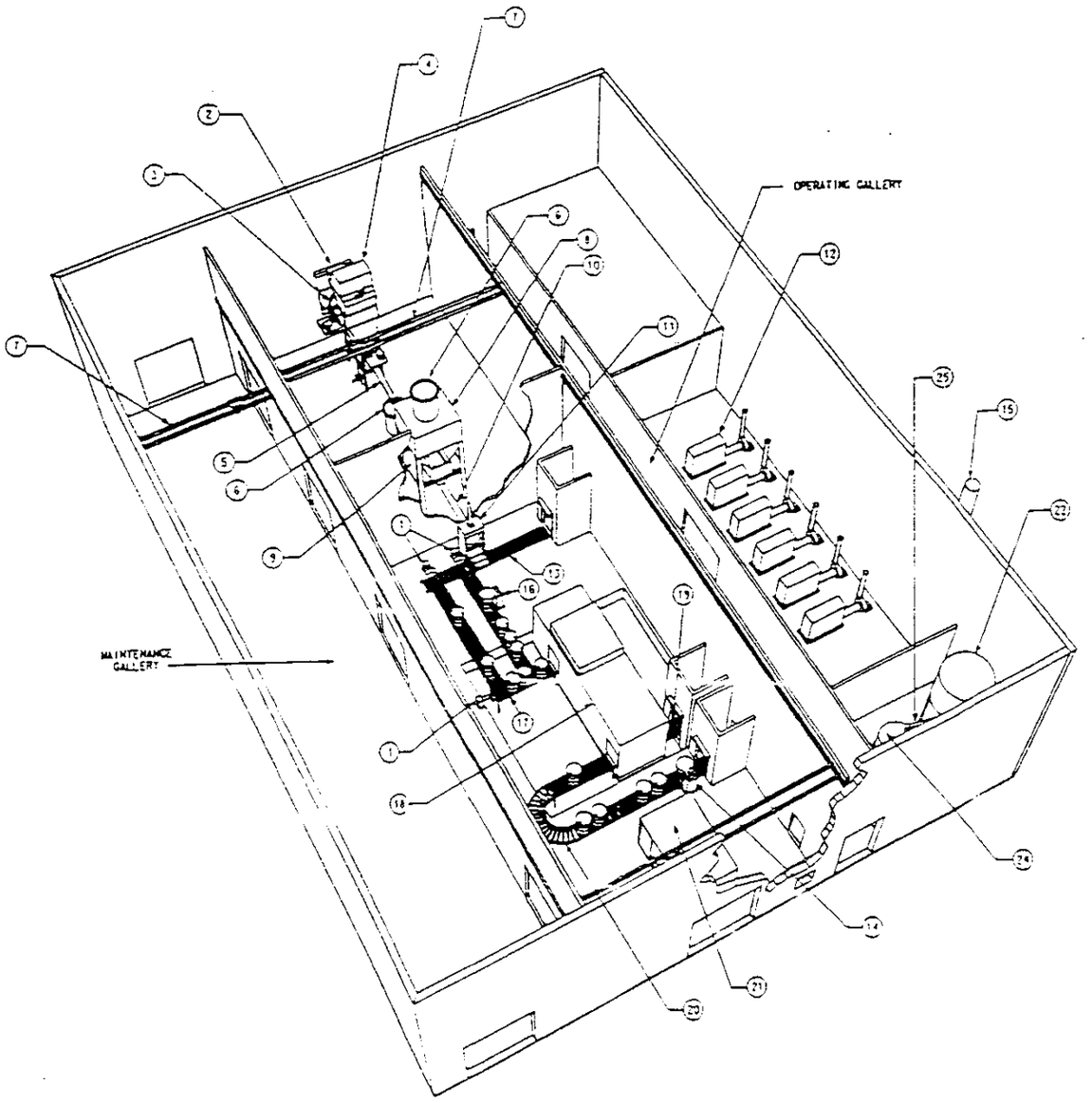
Figure 6.4-6. Treatment, Receiving, Preparation, and Shipping Module.



MAJOR EQUIPMENT LIST

1. BRIDGE CRANE 60 TON
2. GANTRY ROBOT 5 TON
3. TRANSPORT CART
4. SIZE REDUCTION DEVICE
5. MASTER-SLAVE MANIPULATOR
6. RADIATION SHIELD WINDOW (TYP.)
7. AIR LOCK (TYP.)
8. HYDRAULIC MANIPULATOR
9. BIN CONVEYOR
10. SORT TABLE
11. TRANSPORT BIN
12. DUMP HOPPER & CHUTE
13. DE-CAP TRASPORT CART & GRIP
14. DE-CAP GANTRY ROBOT/TOOLS
15. DE-CAP AREA SHIELDING DOOR
16. MONORAIL
17. WEIGHING DEVICE
18. ALPHA RADIATION MONITOR
19. GAMMA RADIATION MONITOR
20. REAL-TIME RADIOGRAPHY DEVICE
21. BALER
22. MOTOR CONTROL CENTER
23. MAIN CONTROL PANEL
24. AIR FILTRATION UNIT
25. DISCARDED CONTAINER DECON/RINSE
26. RINSE WATER STORAGE TANK
27. RINSE WATER PUMP
28. PORTABLE GROUTING UNIT
29. SHIELD DOOR/AIRLOCK
30. BRIDGE CRANE 5 TON
31. REMOTE MAINTENANCE CRANE
32. MANUAL MAINTENANCE CRANE

Figure 6.4-7. Shredding and Compaction Module.

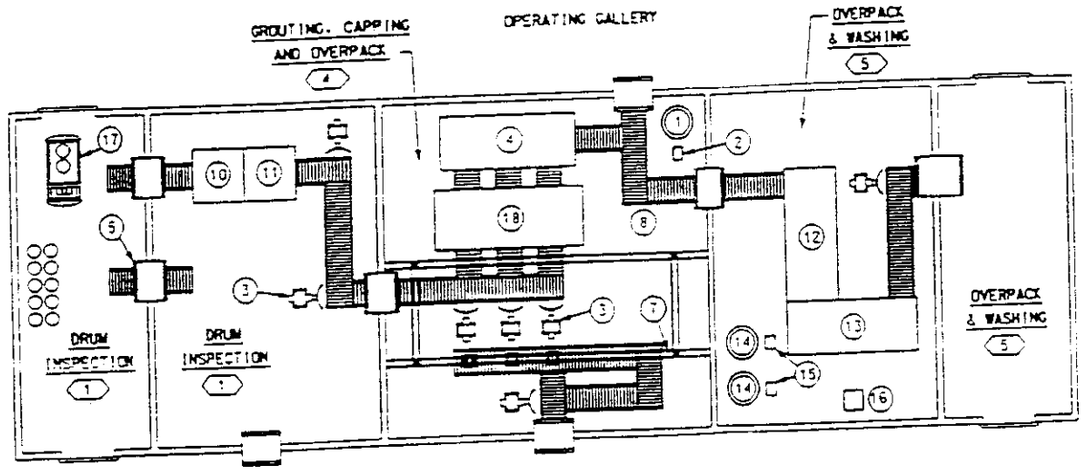


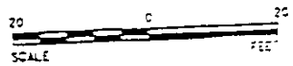
EQUIPMENT LIST

1. DRUM PUSHER
2. INCOMING WASTE BIN
3. SKIP
4. SHREDDER (2) WITH FEED HOPPER, DUST HOOD AND HYDRAULIC RAM
5. AUGER FEEDER
6. WASTE TRANSFER BIN
7. UNDERHUNG CRANE IN ENCLOSED PROCESS AREA
8. LIVE BOTTOM BULK STORAGE HOPPER
9. TERTIARY SHREDDER
10. AUGER FEEDER
11. SHREDDED WASTE COMPACTOR (30 TON)
12. HEPA FILTER AND FAN
13. DRUM STAGING CONVEYOR (POWERED ROLL)
14. OVERPACK TOP SEAMING STATION
15. STACK
16. DRUM TOP SEAMING STATION
17. SUPERCOMPACTOR FEED CONVEYOR (POWERED ROLL)
18. MODULAR SUPERCOMPACTOR UNIT
19. EMPTY OVERPACK STAGING CONVEYOR (POWERED ROLL)
20. SUPERCOMPACTED CONTAINER STAGING CONVEYOR (POWERED ROLL)
21. MODULAR HYDRAULIC POWER UNIT
22. STORAGE BIN
23. DRUM STORAGE CONVEYOR (GRAVITY) (NOT SHOWN)
24. DAT BIN
25. PNEUMATIC CONVEYOR

Figure 6.4-8. Packaging Module.

NOTE: AREAS ALLOCATED TO SUPPORT UNIT OPERATIONS ARE NOT SHOWN ON THIS PLAN. ENCAPSULATING AGENT STORAGE & FEED; AND GROUT PREPARATION UNIT ARE NOT SHOWN ON THIS PLAN.





EQUIPMENT LIST

1. GROUT DAY TANK
2. GROUT PUMP
3. DRUM PUSHER
4. OVERPACK CAPPING DEVICE
5. AIRLOCK (TYP.)
6. OVERPACK AND GROUTING SYSTEM
7. OVERHEAD CRANE
8. ROLLER CONVEYOR
9. CHEMICAL MIX TANK
10. CONTAINER ASSAY UNIT
11. GLOVE BOX ASSAY UNIT
12. OVERPACK WASH UNIT
13. DRIER UNIT
14. CHEMICAL STORAGE TANK
15. PUMP
16. BLOWER
17. SELF GUIDED VEHICLE
18. SOLIDIFICATION UNIT

Figure 6.4-9. CSHIP Module.

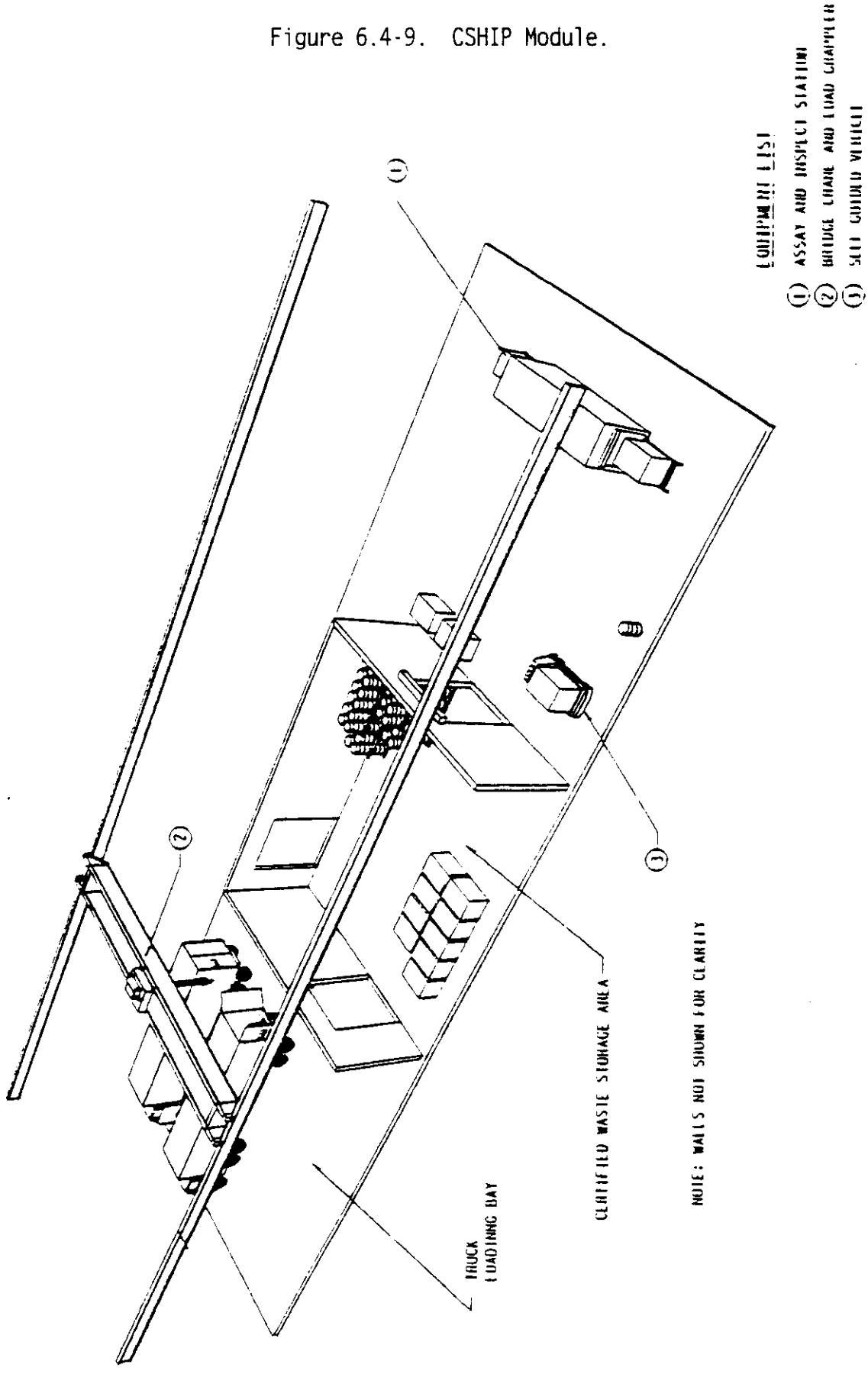


FIGURE 6.4-9
Certification and Shipping (CSHIP) Module

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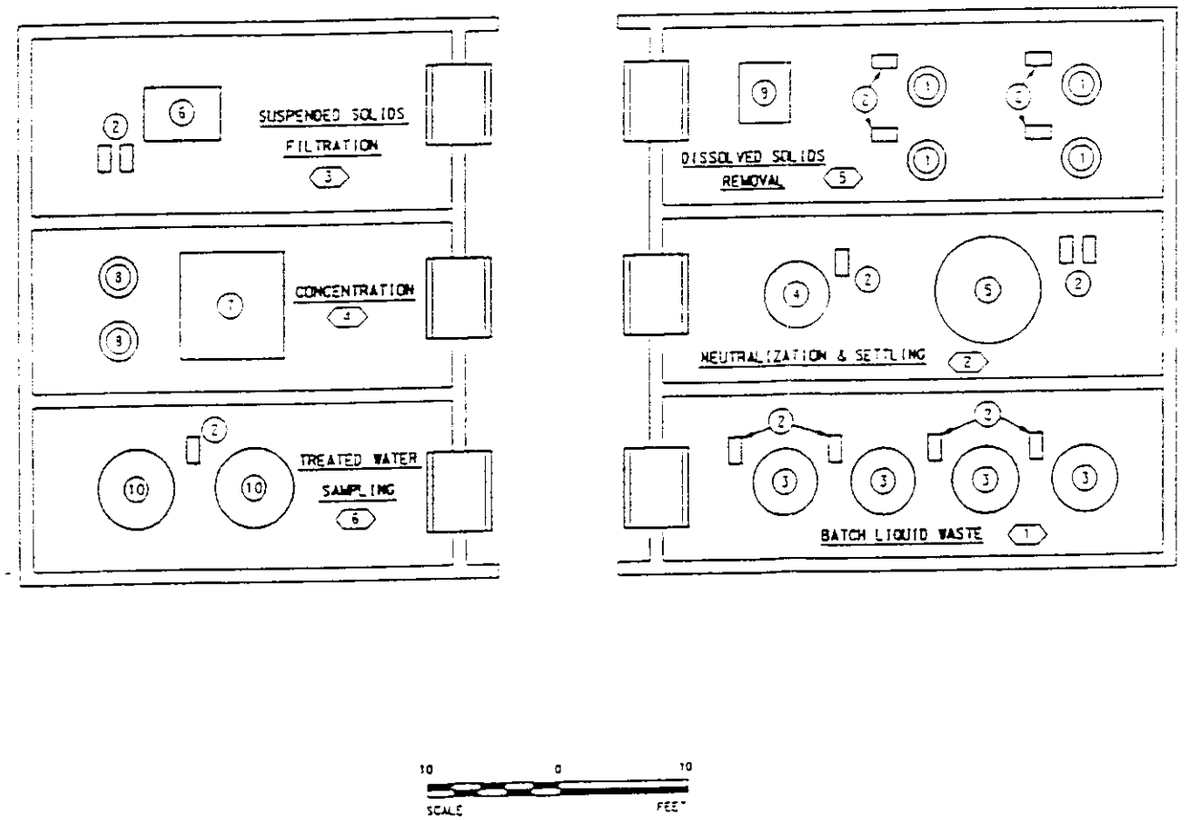
Figure 6.4-10. Neutralization Module.

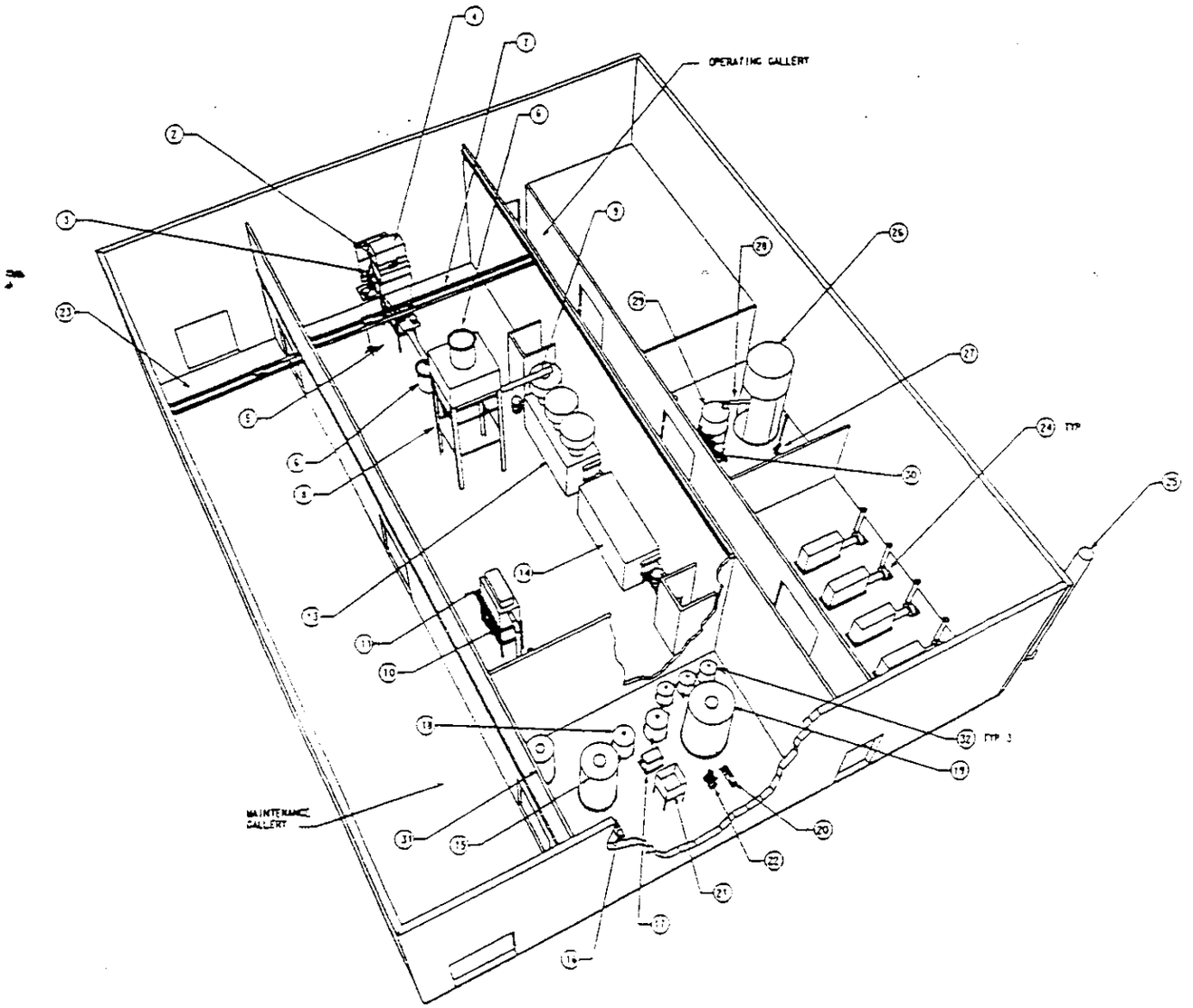
NOTE: AREAS ALLOCATED TO SUPPORT UNIT OPERATIONS ARE NOT SHOWN ON THE PLAN



EQUIPMENT LIST

1. CHEMICAL ADDITION TANK
2. PUMP
3. BATCH HOLD TANKS
4. NEUTRALIZER
5. SETTLER
6. FILTRATION UNIT
7. EVAPORATION UNIT
8. CARBON UNITS
9. ION EXCHANGE UNIT
10. TREATED WATER TANK

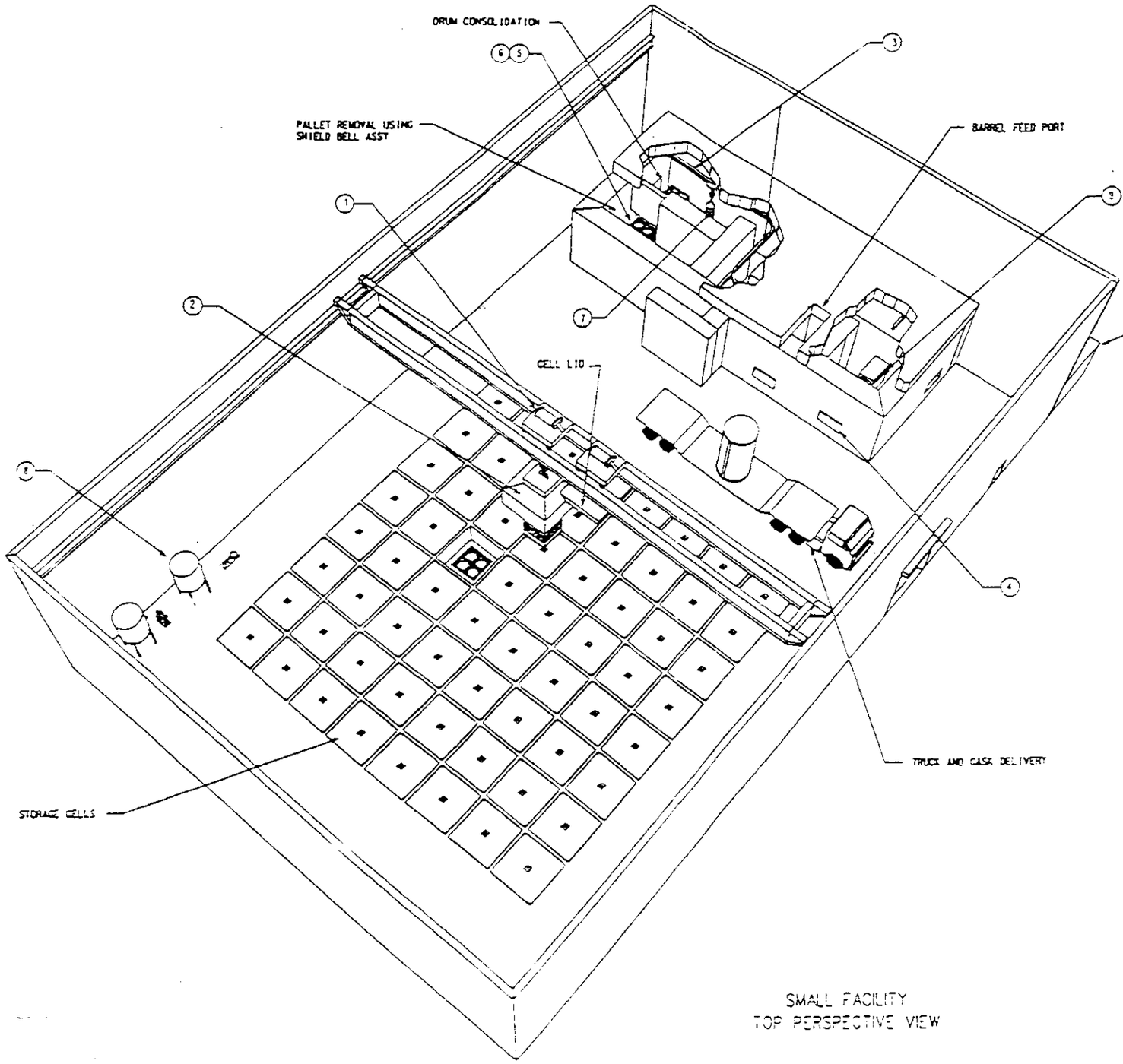
Figure 6.4-11. Grout Stabilization Module.



EQUIPMENT LIST

1. DRUM PUSHER
2. INCOMING WASTE BIN
3. BIN HOIST
4. SHREDDER (2) WITH FEED HOPPER, DUST HOOD AND HYDRAULIC RAM
5. AUGER FEEDER
6. WASTE TRANSFER BIN
7. UNDERHUNG CRANE IN ENCLOSED PROCESS AREA
8. LIVE BOTTOM BULK STORAGE HOPPER
9. AUGER FEEDER
10. DUST COLLECTOR, FAN AND HEPA FILTER
11. DRUM STAGING CONVEYOR (POWERED ROLL)
12. DRUM STAGING CONVEYOR (POWERED ROLL)
13. SOLIDIFICATION SYSTEM
14. DRUM CAPPING AND WASHING SYSTEM
15. RECEIVING TANK
16. PUMP
17. FILTER
18. ION EXCHANGE VESSELS
19. TREATED WASTE TANK
20. PUMP
21. SLUDGE TANK
22. PUMP
23. UNDERHUNG CRANE IN ENCLOSED MAINTENANCE AREA
24. HEPA FILTER AND FAN
25. STACK
26. BINDER STORAGE SILO
27. BLOWER
28. PNEUMATIC CONVEYOR
29. DAY BIN
30. DRUM STAGING CONVEYOR (GRAVITY)
31. PRECIPITATION TANK
32. ORGANIC REMOVAL FILTER VESSELS

Figure 6.4-12. Small Vault Storage Module.

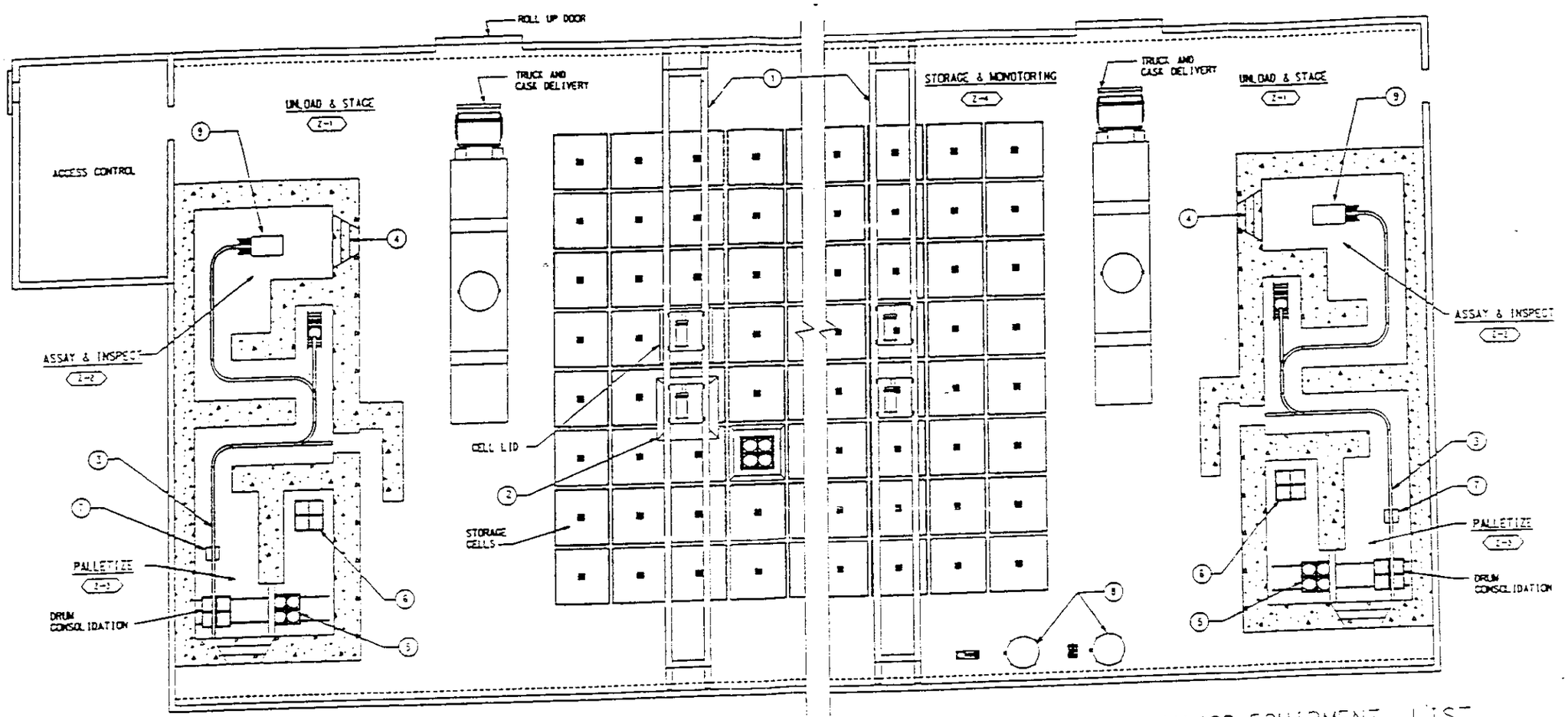


MAJOR EQUIPMENT LIST

1. 30 TON BRIDGE CRANE WITH 10 TON AUX.
2. SHIELD BELL
3. MONORAIL HOIST AND BEAM
4. RADIATION SHIELDING WINDOW (TYPICAL)
5. PALLET TRANSFER CART
6. PALLET
7. PALLET LIFTING RIG
8. LIQUID WASTE COLLECTION
9. INSPECT/ASSAY

SMALL FACILITY
TOP PERSPECTIVE VIEW

Figure 6.4-13. Large Vault Storage Module.



LARGE FACILITY FLOOR PLAN

SCALE: 1/8" = 1'-0"

MAJOR EQUIPMENT LIST

1. 30 TON BRIDGE CRANE WITH 10 TON AUX.
2. SHIELD BELL
3. MONORAIL HOIST AND BEAM
4. RADIATION SHIELDING WINDOW (TYPICAL)
5. PALLET TRANSFER CART
6. PALLET
7. PALLET LIFTING RIG
8. LIQUID WASTE COLLECTION
9. INSPECT/ASSAY

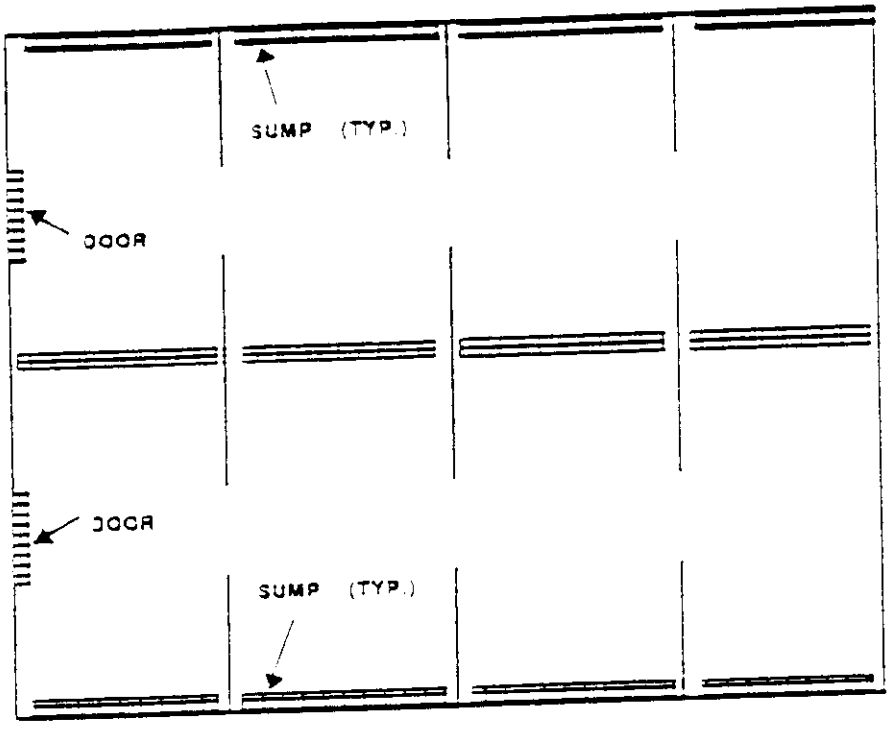
NOTES:

1. TO MEET THE STORAGE REQUIREMENTS FOR THE LARGE FACILITY, SEVEN OF THE BUILDINGS SHOWN ABOVE WILL BE REQUIRED. EACH LARGE BUILDING HAS 578 VAULTS.

2. TO MEET THE STORAGE REQUIREMENTS FOR THE SMALL FACILITY, TWO OF THE BUILDINGS WILL BE REQUIRED, WITH THE EXCEPTION THAT THE SMALL BUILDING HAS ONLY ONE TRUCK BAY, ASSAY/INSPECT AND PALLETIZATION AREA. EACH SMALL BUILDING HAS 492 VAULTS

3. ONLY ONE SET OF CRANES, ASSAY/INSPECT AND PALLETIZING SYSTEMS IS PROVIDED. IT IS ASSUMED THAT THESE SYSTEMS WILL BE MOVED FROM ONE BUILDING TO ANOTHER.

Figure 6.4-14. Contact-Handled Storage Module.



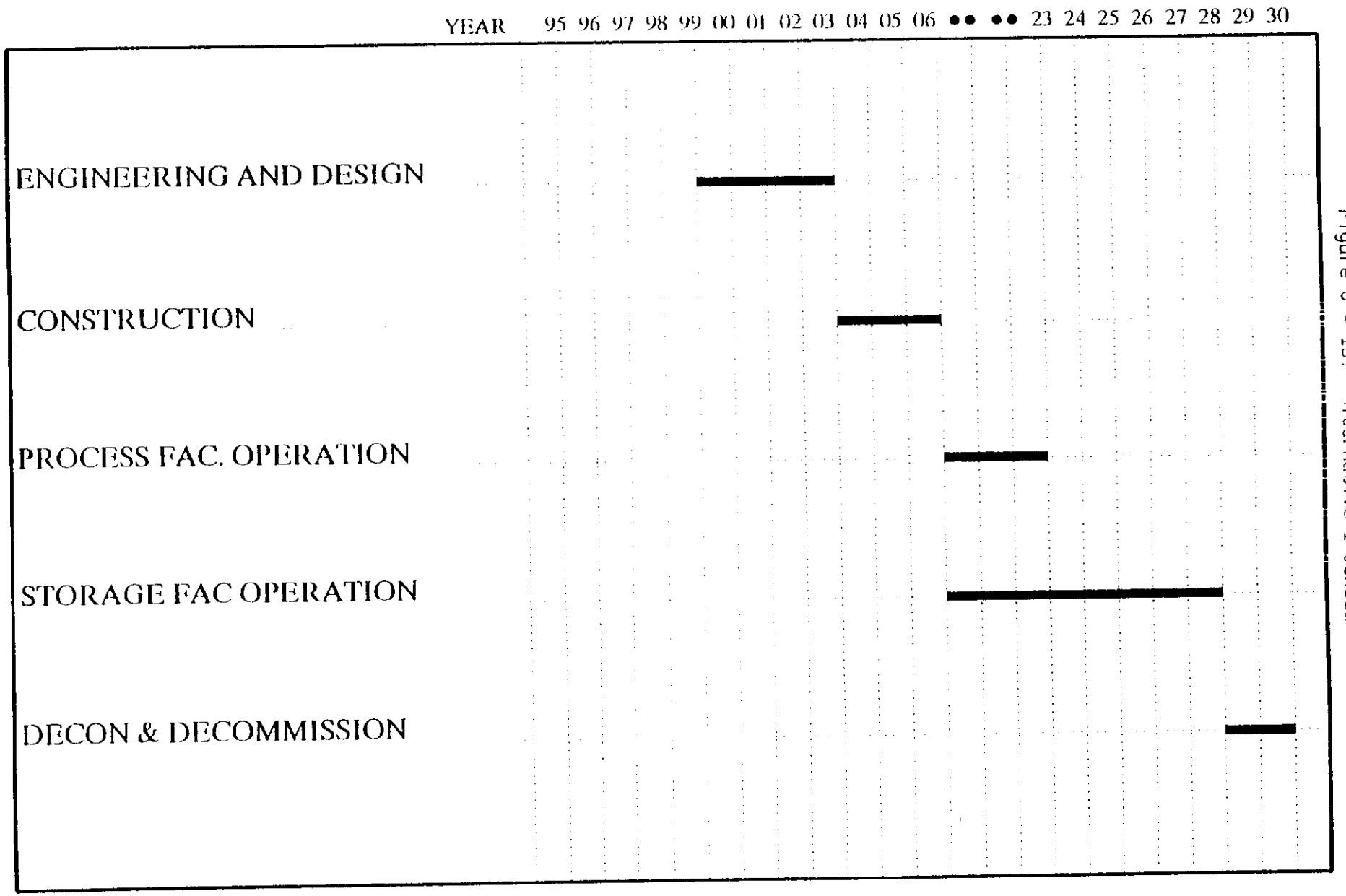


Figure 6.4-15. Alternative 1 Schedule.

Table 6.4-1. Alternative 1 - Facilities, Schedules, Capacities, and Waste Streams.

Facility	Schedule	Annual Processing and Storage Capacities (m^3)	Waste Streams	Capacity Allocation by Waste Stream[a]
Processing Facility	2006 - 2023	10,700	RH_TRU RH_TRUM RH_TRU_SUSPECT RH_LLMW Cs/Sr Capsules Miscellaneous Sources CH_TRU CH_TRUM CH_TRU_SUSPECT CH_LLMW Unirradiated Uranium	4% 18% 1% 51% <1% <1% 6% 7% 12% 1% <1% <1%
New RH Storage Area	1994 - 2028	63,800	RH_TRU RH_TRUM RH_LLMW RH_LLMW_GTCIII RH_LLW_GTCIII Miscellaneous Sources Cs/Sr Capsules Spent Nuclear Fuel Canisters	N/A
New CH Storage Area	1994 - 2028	48,800	CH_TRU CH_TRUM CH_LLMW CH_LLW_GTCIII CH_LLMW_GTCIII Unirradiated Uranium Sodium	N/A

[a] Capacity allocation to waste streams is based on total throughput volumes and may vary annually.

Table 6.4-2. Alternative 1 - Processing Facility (Operates from 2006 to 2023)

PROCESSING STATION (See Sections 6.4.1.1.1 - 6.4.1.1.9)	WASTE STREAMS	FUNCTIONS (From Sections 6.3.2.1, 6.3.2.2, 6.3.3.1, 6.3.3.2, 6.3.5.1, 6.3.5.2, 6.3.5.3, and 6.3.6)
Receive for Processing	RH-TRU RH-TRUM RH-TRU-SUSPECT RH-LLMW Cs/Sr Capsules Miscellaneous Sources Unirradiated Uranium CH-TRU CH-TRUM CH-TRU-SUSPECT CH-LLMW	Receipt for Processing
Heavily Shielded Hot Cell		
RH Cask Load In / Load Out	RH-TRU RH-TRUM RH-TRU-SUSPECT RH-LLMW CH-LLMW Cs/Sr Capsules Miscellaneous Sources	Cask Load In Cask Load Out Overpack Decontamination
Package Examination / Verification	RH-TRU RH-TRUM RH-LLMW Cs/Sr Capsules Miscellaneous Sources	Waste Packaging
LLMW Processing	RH-LLMW CH-LLMW	Waste Removal from Container Waste Removal from Overpack Waste Sorting Waste Size Reduction Waste Packaging Thermal Treatment Stabilization
TRU Processing	RH-TRU RH-TRUM RH-TRU-SUSPECT	Waste Removal from Overpack and Container Waste Removal from Container Waste Assay Waste Sorting Waste Size Reduction Restricted Waste Management
Contact-Handled TRU Waste Assay Area	CH-TRU CH-TRUM CH-TRU-SUSPECT	Waste Removal from Container Waste Removal from Overpack and Container Waste Sorting Waste Assay Overpack Decontamination

Table 6.4-2 (Continued). Alternative 1 - Processing Facility (Operates from 2006 to 2023)

Transuranic Waste Size Reduction and Packaging	CH-TRU CH-TRUM	Waste Size Reduction CH Waste Packaging
Transuranic Waste Glovebox Processing Area	CH-TRU CH-TRUM	Restricted Waste Management CH Waste Packaging
CH Low-Level Waste Size Reduction and Packaging	CH-LLW Unirradiated Uranium	Container Shredding Container Packaging Container Assay Waste Packaging
Ship to Storage or Disposal	Overpacks RH-TRU RH-TRUM RH-LLMW Cs/Sr Capsules Miscellaneous Sources CH-LLW CH-LLMW CH-TRU CH-TRUM Unirradiated Uranium	Waste and Overpack Shipping Waste Shipping

Table 6.4-3. Alternative 1 - Solid Waste Facilities, Schedules, Capacities, and Waste Streams.

Facility	Schedule	Annual Capacities Required to Meet Schedule (m^3)	Waste Streams	Capacity Allocation by Waste Stream[a]	Functions (From Section 6.3.2.2 and 6.3.3.2)
Overpack to Reuse	2006 - 2023	Infinite	Overpacks	N/A	N/A
LLW to Burial Grounds	1994 - 2023	Infinite	CH-LLW Sodium	N/A	Disposal
WRAP 1 for Assay / Certification	1997 - 2023	1580	CH-TRU CH-TRUM	61% 39%	Waste Receipt at WRAP 1 WRAP 1 Assay Shipment to WIPP
WRAP 2A	2000 - 2023	127	CH-LLMW	100%	Waste Receipt at WRAP 2A WRAP 2A Stabilization
CTTF	1997 - 2023	5	CH-LLMW	100%	Waste Receipt at CTTF Thermal Treatment
Mixed Waste Disposal Trench	1994 - 2023	Infinite	CH-LLMW RH-LLMW	N/A	Disposal
WIPP	2002 - 2023	2350	CH-TRU CH-TRUM RH-TRU RH-TRUM	39% 26% 17% 19%	Disposal

[a] Capacity allocation to waste streams is based on total throughput volumes and may vary annually.

Table 6.4-4. Alternative 1 Safety Class Summary.

FACILITY	WASTE TYPE	SAFETY CLASS
Processing	All	Safety Class 2
Storage Prior To Processing	Cs/Sr Capsules	Safety Class 2
	All Others	Safety Class 3
Storage Prior To Disposal	HLW Canisters & Cs/Sr Capsules	Safety Class 2
	All Others	Safety Class 3

Table 6.4-5. Alternative 1 Facility Summary.

FACILITY		SIZE m^2 (ft^2)
PROCESSING		6,724 (72,349)
REMOTE-HANDLED STORAGE	Prior to Processing	28,133 (302,711)
	Prior to Disposal	15,836 (170,400)
	Total	43,969 (473,111)
CONTACT-HANDLED STORAGE	Prior to Processing	1,662 (17,884)
	Prior to Disposal	26,918 (289,638)
	Total	28,580 (307,522)

Table 6.4-6. Alternative 1 Cost Estimate Summary

BREAKDOWN OF ALTERNATIVE 1 FACILITY COSTS

ALT. 1 TEC	(Costs per building category based on ALT and total SF/bldg in ALT 1)	% OF BLDG SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	2.06	2,015	35,404,756	11,725,946	47,130,702	17,444,277	64,574,979
2	CH TRU PROCESSING FACILITY	2.41	2,015	41,420,127	13,718,218	55,138,345	20,408,111	75,546,456
3	CH LLMW/LLW PROCESSING FACILITY	4.69	2,015	80,605,974	26,696,450	107,302,423	39,715,369	147,017,792
5	RLW CANISTER STORAGE	19.43	2,015	333,939,033	110,599,577	444,538,610	164,535,101	609,073,711
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	34.19	2,015	587,615,829	194,6166,548	782,232,377	289,524,195	1,071,756,571
9	CS/SR CAPSULE AND OVERPACK STORAGE	0.13	2,015	2,234,281	739,987	2,794,268	1,100,852	4,075,120
11	NEW CH WASTE STORAGE	34.36	145	42,491,000	14,072,888	56,563,888	20,935,741	77,499,629
12	UNIRRADIATED URANIUM STORAGE	2.74	145	3,389,000	1,122,426	4,511,426	1,669,795	6,181,221
	TOTAL	**852,864**	**1,322**	**1,127,100,000**	**373,292,040**	**1,500,392,040**	**555,333,440**	**2,055,725,480**

TEC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, AND WHC PM.

ALT. 1 TPC	(Costs per building category based on ALT and total SF/bldg in ALT 1)	% OF BLDG SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	2.06	2,821	49,566,691	15,147,802	64,714,493	22,719,417	87,433,910
2	CH TRU PROCESSING FACILITY	2.41	2,821	57,988,216	17,721,458	75,709,674	26,579,512	102,289,186
3	CH LLMW/LLW PROCESSING FACILITY	4.69	2,821	112,848,437	34,486,986	147,335,423	51,725,274	199,606,697
5	RLW CANISTER STORAGE	19.43	2,821	467,514,956	142,874,646	610,389,612	214,290,422	824,680,034
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	34.19	2,821	822,662,704	251,409,392	1,074,072,096	377,076,746	1,451,148,243
9	CS/SR CAPSULE AND OVERPACK STORAGE	0.13	2,821	3,127,995	955,929	4,083,924	1,433,750	5,517,674
11	NEW CH WASTE STORAGE	34.36	203	59,487,000	18,179,493	77,666,493	27,266,495	104,932,988
12	UNIRRADIATED URANIUM STORAGE	2.74	203	4,744,000	1,449,788	6,193,788	2,174,463	8,368,250
	TOTAL	**852,864**	**1,850**	**1,577,940,000**	**482,225,502**	**2,060,165,502**	**723,265,478**	**2,783,430,981**

TPC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, WHC PM, AND OPC

ALT 1 COSTS NOT INCLUDED IN ABOVE FIGURES

OM&R LCC		839,630,000	729,503,222	1,569,133,222	470,739,967	2,039,873,189
D & D		282,809,000	699,073,104	981,882,104	400,360,995	1,382,243,100

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6.5 ALTERNATIVE 2: MULTIPLE NEW MODULAR FACILITIES INTEGRATING (WHERE EFFECTIVE) STORAGE AND PROCESSING NEEDS FOR ALL WASTE AND MATERIAL STREAMS.

6.5.1 Process Description

Alternative 2 is a modularized concept consisting of new treatment and storage facilities coming on-line in stages over the next 15 years. Waste and materials that have common treatment requirements will be managed in the same processing module. Processing capability that will be available by the planned solid waste treatment facilities, such as WRAP 1, WRAP 2A, and the CTTF, will not be replicated in the new treatment modules. Instead, waste will be sent to these planned facilities as applicable.

Figure 6.5-1 illustrates the Alternative 2 process flow sheet. The waste streams requiring storage and processing are displayed on the left hand side of the figure. The 4 processing facilities and 10 storage facilities are shown in the center, with the onsite and offsite disposal sites and the planned solid waste treatment facilities shown to the right. The numbered lines indicate the stream number for flow of materials from waste generation to processing, storage, and disposal. The annual and total waste and material volume flow corresponding to each of these lines is also provided in Figure 6.5-1.

The operation schedule for the storage facilities are typically 30 to 35 years. The processing start-up dates range from 2001 (CH LLMW/LLW Processing) to 2006 (Remote Handled TRU Processing Facility), with all operations completed by 2023. The table also indicates the capacity requirements for all storage and processing facilities, the waste streams managed by each facility, and the percent of the processing facility capacity designated for each waste class.

Descriptions of each processing facility, the processing stations contained within each facility and the functions completed in each station are described below.

6.5.1.1 Remote Handled TRU Processing Facility. The Remote Handled Processing Facility will handle all remote handled TRU waste and materials that require processing prior to long-term storage or final disposition. The facility will have a receiving station, a heavily shielded hot cell for waste processing, two contact-handled repackaging stations and a shipping area. Descriptions of the facility stations are provided below.

6.5.1.1.1. Receive for Processing. A single receiving station will accept all remote handled waste packages by rail, truck or AGV. The area will be shielded and a remotely operated crane will be used to remove the waste from the transport vehicles.

6.5.1.1.2 Heavily Shielded Hot Cell. A heavily shielded hot cell for high dose rate waste processing will be used during all RH waste operations. The equipment areas that will be included in this containment include the following:

- RH Cask Load In/Load Out. Casks will be transferred from the receiving station to containment through an airlock area. In the airlock the overpack will be removed from waste package and transferred to the shipping station.

- Package Examination/Verification. This processing area will have assay/examination equipment for verifying the contents of the RH TRU waste and repackaging capability for all RH waste and materials.

- TRU Processing. The TRU station will provide size reduction, repackaging, and processing for TRU waste in accordance with the WIPP WAC.

6.5.1.1.3 **CH Low Level Waste Size Reduction and Packaging.** Containers and non-lead shielding used for shipping RH waste to the processing facility will be decontaminated to contact handled low-level waste and routed to a size reduction/repackaging station. The waste will be shredded, packaged into drums and moderate sized burial boxes, and transferred to the shipping station for transport to disposal. Assay equipment will also be used to validate that all containers do not exceed the limits of low level waste.

6.5.1.1.4 **CH Low Level Mixed Waste Packaging.** The shielding used to reduce the surface dose rate of containers may include lead. After the waste has been removed from the container and sent to the processing station, the lead shielding will be removed from the empty waste containers and repackaged as CH Low Level Mixed Waste. This waste will be transferred to the shipping station for transport to WRAP 2A for additional stabilization prior to onsite disposal.

6.5.1.1.5 **Ship to Storage or Disposal.** All waste and materials are transferred from the processing station to storage or directly to disposal. TRU waste is sent to storage to await shipment to WIPP, Cs/Sr Capsules and Miscellaneous Sources are sent to long-term storage, CH LLMW is sent to storage prior to additional stabilization in WRAP 2A, and RH LLMW and CH LLW is sent directly to onsite burial.

6.5.1.2 **Contact Handled TRU Processing Facility.** Contact Handled TRU waste will be processed and repackaged into drums and boxes suitable for final certification in WRAP 1 prior to shipment to the Waste Isolation Pilot Plant. The facility will have a receiving station, a TRU Waste assay area, a TRU glovebox for processing, LLW and TRU size reduction and repackaging stations, a LLMW packaging station and a shipping area. Descriptions of the facility stations are provided below and the corresponding functions.

6.5.1.2.1 **Receive for Processing.** All CH TRU waste in failed drums and large boxes will be received for processing by either rail, truck, or transport device from storage. Rail and truck receipt is available for large and moderate sized boxes from retrieval. Receipt of material from storage using AGVs or forklifts via the transport corridor will also occur. The receiving station will have crane capability for removing the large containers and overpacks from the transport vehicles.

6.5.1.2.2 **Contact-Handled TRU Waste Assay Area.** All waste will be sent to an assay station upon receipt. An assay is performed to separate the TRU waste from the LLW/LLMW.

6.5.1.2.3 **Low Level Waste Size Reduction and Packaging.** Containers used for shipping TRU waste to the processing facility will be decontaminated to low-level waste and routed to a size reduction/repackaging station. The waste will be shredded, packaged into drums and moderate sized burial boxes, and transferred to the shipping station for transport to disposal. Assay equipment will also be used to validate that all containers do not exceed the limits of low level waste.

6.5.1.2.4 **TRU Waste Glovebox Processing Area.** A moderately shielded glovebox will be used to provide any processing necessary to meet the WIPP WAC. Waste that requires absorption, immobilization, neutralization, and declassification will be sent to the glovebox.

6.5.1.2.5 **TRU Waste Size Reduction and Repackaging.** Many of the objects that enter this facility will be too large for certification in WRAP 1 and for acceptance by WIPP. Size reduction equipment will be used to cut large objects into smaller pieces for repackaging into drums and SWBs.

6.5.1.2.6 **LLMW Packaging.** After the waste has received the initial assay a portion will be recharacterized as LLMW. The LLMW will be sent to a packaging station, placed into an overpack, and returned to storage to await processing by the LLMW/LLW Processing facility.

6.5.1.2.7 **Ship to Storage or Disposal.** All waste and materials are transferred from the processing station to storage or directly to disposal. TRU waste is sent to storage to await final certification in WRAP 1. LLMW is sent to storage prior to additional stabilization in WRAP 2A and the CTTF, and LLW is sent directly to onsite burial.

6.5.1.3 **RH and CH LLMW Processing Facility.** This facility will accept all RH_LLMW and CH_LLMW in containers too large for WRAP 2A. In addition, unirradiated uranium will be processed in this facility and sent to storage to await final disposition. The facility stations include a receiving area, two size reduction and packaging stations, and a shipping station. Descriptions of the facility stations are provided below.

6.5.1.3.1 **Receive for Processing.** All CH_LLMW waste in large boxes will be received for processing by either rail, truck, or transport device from storage. Rail and truck receipt is available for large and moderate sized boxes from retrieval.

6.5.1.3.2 **LLMW Size Reduction and Packaging.** LLMW in boxes too large for WRAP 2A will be sent to a size reduction station. The large objects will be reduced in size using shearing equipment and will then be repackaged into drums and boxes up to 5'x5'x9'. RH LLMW will be sent to this station for size reduction, thermal treatment, and grout stabilization as necessary to land disposal requirements.

6.5.1.3.3 **Low Level Waste Size Reduction and Packaging.** All containers will be size reduced and repackaged as LLW for transport to burial.

6.5.1.3.4 **Ship to Storage.** All waste and materials are transferred from the processing station to storage. CH LLMW is sent to storage prior to additional stabilization in WRAP 2A or the CTTF.

6.5.1.5 **Storage Facilities.** The waste and materials will be stored in a number of new modular storage buildings. Figure 6.5-1 identifies 9 separate storage facilities (SNF is shown to demonstrate that the storage facilities for fuels will be integrated with the M-33 study). These may be separate buildings or designated areas within one facility. Waste is currently being stored in buildings across the site, and additional capacity will become available as required. Figures 6.5-2 through 6.5-9 illustrate the annual storage requirements for the different facilities. The sodium storage requirements (which are not shown graphically) are approximately 600 cubic meters from the years 2007 to 2008.

6.5.1.6 **Planned Solid Waste Facilities, Disposal Sites, and Overpacks.** The far right column of Figure 6.5-1 shows three disposal sites, three planned solid waste processing facilities, and the recycling of overpacks.

6.5.2 Facility Description

6.5.2.1 **Criteria.** In general, the processing and storage facilities will limit radiation levels to meet As Low As Readily Achievable (ALARA) guidelines. The design of the facilities will be based on the latest revisions of the applicable DOE, federal, national, and Westinghouse Hanford Company regulations, codes and standards in effect at the time of the facility designs. In addition, all applicable national consensus codes and standards, such as the American Concrete Institute, American National Standards Institute, and American Society of Mechanical Engineers, etc. will be used.

Safety Class of the facilities were chosen based on the processes or functions performed and the applicable waste type. Safety Classes are summarized in Table 6.5-1.

6.5.2.2 **Approach.** To meet Tri-Party commitments relative to the issuance of this document, an expedited approach was taken to determine facility attributes. This approach consisted of obtaining and reviewing over 40 existing solid waste documents (see section 6.5.6) to obtain a basis for determining new facility sizes and characteristics. The references utilized for this task (Feizollahi and Shropshire 1993 & 1994) were the best suited regarding typical facilities and equipment, or portions of facilities (modules), for processing and storing radioactive waste at government owned, contractor operated sites. Modules were selected that most accurately represented the required process or storage functions. Modifications to some of the modules in the reference will be required, in part, to compensate for differences between the waste characteristics assumed by the reference (size, form, etc.) and those required by M-33. The text has been written to account for attributes required by M-33 which were not part of the referenced modules capabilities. Engineering studies to precisely size and select equipment and facilities and establish exact integration between interfacing processes as described in Section 6.5.1, were not performed. Although the processing and storage modules that were selected were typical and were not uniquely designed for the exact processes at hand, they are sufficiently representative and accurate to obtain comparison cost estimates. For a summary of the modules selected see figure 6.5-10, Alternative 2 Module Selection Summary.

To obtain facility size, a method of scaling the data found within the existing references was employed. The references contained facility or module size with an associated thru-put or storage capacity. Thru-put or storage capacity of the M-33 facilities were then scaled with this information to obtain the new facility sizes (See Appendix tbd). The new facility sizes establish the basis for the cost estimates.

Total thru-put and storage capacities used as a basis for M-33 are found and described in Section 6.5.1. For comparison of M-33 processing thru-put data with the reference documents, the M-33 capacities were changed to a rate by dividing the volumes by the amount of time the processing facilities were required to operate. Mass flow rates were obtained using an average density when appropriate (Appendix tbd). Since required storage capacities are based on volume, modification of the M-33 volumes relative to density were not necessary. To size the M-33 facilities, maximum (peak year) capacities were used as the scaling factor.

6.5.2.3 General Plant Description. The objective of Alternative 2 was to evaluate multiple facilities for the purpose of providing all storage, processing and disposal requirements for all waste and materials defined in the scope of TPA milestone M-33-00. Following evaluation and selection of the applicable modules, and consideration of the design and function differences between storage and processing facilities, the complex will comprise three processing facilities, three remote-handled storage facilities, and two contact-handled storage facilities. One of the contact-handled storage facilities will be sub-divided into storage prior to processing and a storage prior to disposal. See Table 6.5-2 for a summary of facility size and identification. It should be noted that remote-handled storage facilities require a larger floor plan than the contact-handled storage facilities. This is because contact-handled storage facilities do not require floor space allocations for thick shielding walls, remote handling equipment, and other remote-handled facility attributes.

6.5.2.3.1 Remote Handled Processing Facility. Open, Dump, and Sort Module (OSORT). This module is intended to support the "Receive For Inspection" function as shown on the process flowsheet. The OSORT module shown in Figure 6.5-11 is designed to be contiguous with the treatment modules and is ideal for use with an integrated waste management facility that handles multiple waste streams. This module handles smaller waste forms such as boxes, drums, or metal bins that are assumed to be properly characterized before they are opened. The module opens and dumps the incoming waste containers and segregates the waste so it can be fed to a combination of treatment processes. This module is applicable to both contact-handled and remote-handled waste.

The module also has the capability to reduce the size of empty nonmetal containers. Metal containers must be transported to other modules for handling, such as a decontamination module for wash down and reuse or a metal melting module for processing.

Functional Operation: At the OSORT module the waste containers are decapped, and the waste is dumped onto sorting devices or into transport bins that carry it to the treatment operations.

Containers of waste are opened by remote means, then dumped and sorted remotely by manipulators and robots housed in a cell. The cell has a controlled environment and multiple barriers. Adequate hoods and supporting ventilation are provided to minimize the spread of dust and contamination. Containers enter the cell through airlock doors. Equipment maintenance is manually performed in a controlled environment by personnel equipped with protective clothing. In addition, the equipment can be retrieved and decontaminated before maintenance is performed.

After the waste containers enter the controlled cubicle environment through airlock doors, they are grouped into two categories: homogeneous waste and heterogeneous waste. Containers of homogeneous waste are opened, dumped, placed in transport bins, and transported to treatment modules. Containers of heterogeneous waste are opened, dumped, robot sorted, placed in transport bins, and then transported to treatment modules. Waste meeting disposal requirements without any further treatment are packaged in this module.

Containerized waste that is designated for segregation is dumped onto a sorting station table, where bulk metal, noncombustibles, partially combustibles, combustibles, special waste, and gas cylinders are removed. Various sorting technologies, such as robotic assisted sort tables, vibratory screens, and air classifiers, may be used in the sorting station. Any spilled liquid is collected and transported to other unit operations for treatment. This sorted waste material is also placed in transfer bins and moved to the treatment modules. Nonmetallic containers are cut into smaller pieces as required for processing.

Waste packages designated for direct disposal are distributed in multiple containers in such a way that eliminates criticality risks and does not exceed thermal heat generation criteria for individual containers.

To reduce gas generation rates in the disposal facility, waste designated for direct disposal may be repackaged in special drums in the OSORT module.

Treatment Receiving, Preparation, and Shipping Module (MODULE BB). This module is also intended to support the "The Receive For Processing" function as shown on the process flowsheet. The BB module shown in Figure 6.6-12 is one of the first parts of an overall complex needed for treatment, storage, and disposal of waste. It will be connected with the waste treatment modules. The BB module is intended to handle the larger waste forms such as the cesium and strontium transportation casks and PUREX tunnel equipment. It will be designed to also handle large boxes and other items which cannot be handled by the OSORT module. Waste not treatable in the OSORT and BB modules will be routed thru, in some instances, similar but adequately sized and designed processes.

The module is designed to remotely unload, store, inspect, open, and sort the incoming (untreated) waste and feed it to the treatment modules. It also receives, stores, inspects, certifies and ships the outgoing (treated) waste. When the incoming waste is not compatible with the treatment capabilities of a given treatment module, the BB module provides a special waste packaging operation to assure receipt at the treatment module is possible. These operations will include the necessary shielding and oversize cell operations necessary for the processing of large contaminated equipment

or high radiation waste forms. The module also has the capability to size reduce, package and return the empty waste containers for treatment or disposal.

The functions of the BB module are accomplished by 13 major unit operations including: load/unload, stage and store, inspect and assay, decap containers, sort, package discarded containers, and special waste packaging.

Functional Operation: Transportation vehicles are used to ship waste containers from the generators to the BB module. A loading and unloading unit operation equipped with a high capacity bridge crane with an auxiliary hoist receives, loads, and unloads containers such as cesium and strontium transportation casks, PUREX tunnel equipment, large boxes, drums, etc., which can not be handled by the OSORT module. Containers brought in large overpacks can also be unloaded. The loading and unloading unit operation removes high level containers from their shipping casks and places them in a staging and storage area suited for their radiation levels.

The staging and storage unit operation stores the containers and moves them within the unloading, staging, and surge storage areas. In addition, the unit operation transfers containers to and from the various interfacing unit operations. The surge and storage area is large enough to allow maneuvering of the containers during the staging operations and provide sufficient surge storage capacity to meet the desired operational reliability.

An assay and inspect unit operation determines radioactivity, physical properties, and other parameters that are necessary to categorize the containerized waste in accordance with the criteria established for the processing unit operations. In addition, the unit operation can sample the waste in the containers as required for characterization of the waste according to the Resources Conservation and Recovery Act (RCRA) requirements. Samples are sent for analysis to a laboratory. Assay functions can be accomplished by various devices, such as passive/active neutron (PAN) counting and Segmented Gamma Scan (SGS) instruments.

After the containers are assayed, they are weighed and measured to determine waste density. Contents of each container (such as metals, paper, glass, sludge, gas cylinders, and liquids) are determined by nondestructive examination. The nondestructive assay equipment will utilize a real-time radiography (RTR) device. Ultrasonic devices are also used. After examination, each container is labeled, and the properties of its contents are logged and entered into a computer database.

Containers holding waste which meet treatment criteria are sent to a decap unit operation similar to that in the OSORT module. Waste forms not meeting criteria are sent to a special waste packaging unit operation where special processing techniques are employed. This will likely be the case for large contaminated equipment.

If required, the waste container decap, dumping, and sorting operations are accomplished remotely by manipulators and robots housed in a cubicle that has a controlled environment and multiple barriers. Adequate hoods and supporting ventilation minimize the spread of dust and contamination. All operations are accomplished in a cell where containers enter the cell through airlock doors. Equipment maintenance is manually performed in a controlled

environment. In addition, the equipment can be pulled out and decontaminated before performing maintenance.

After the waste containers enter the controlled cubicle environment through airlock doors, they are grouped according to two categories: those that must only be opened and dumped, and those that require open, dump, and sort operations. After container caps are removed, the waste in the containers of the first category are dumped into bins and are directly transported to the treatment modules.

The waste in the containers that are designated for segregation is dumped onto a sorting station, which removes bulk metals, noncombustibles, semicombustibles, combustibles, and special wastes. Various sorting technologies, such as robotics assisted sort tables, vibratory screens, and air classifiers, may be used in the sorting station. Any liquid spilled during sorting is collected and sent to other unit operations for treatment. The sorted waste material is placed into transfer bins and transferred to the treatment modules.

The module also includes a discarded container packaging unit operation. In this unit operation both metallic and nonmetallic containers are cut into smaller pieces and are either placed in drums and sent for offsite disposal, or placed in bins and sent for treatment by one of the treatment modules (e.g., solidification, metal melting, or shredding and compaction). As an alterative, the unit operation can wash and decontaminate the containers and return them for reuse.

The major secondary waste from this facility is contaminated air generated during the handling operations. This air is collected by the ventilation system, filtered by high efficiency particulate air (HEPA) filters, monitored, and discharged to the atmosphere.

Packaging Module (PACKG). This module is intended to support both the "TRU Processing" and "LLMW Processing" functions as shown on the process flowsheet within the heavily shielded hot cell. The PACKG module shown in Figure 6.5-13 consists of ten unit operations that incorporate all buildings, systems, processes, equipment, controls, and accessories required to repackage incoming drummed solid waste in overpacks. Size reduction and packaging of large equipment, such as the PUREX tunnel equipment, will also be provided within this module and/or in module BB. The module can process solid waste and metal waste of various shapes and forms. It is applicable to both contact-handled and remote-handled waste.

Functional Operation: The packaging module is designed to process drummed waste by packaging it in .32 m^3 (85-gal) overpack containers. In the drum inspection unit operation, drummed waste is inspected for physical integrity. Following inspection, drums that meet the packaging module's acceptance criteria are transported to the overpack, grout, and cap unit operation; drums that fail are returned to the incoming drum storage area for return to their original location.

In the overpack, grout, and cap unit operation, a lift device picks drums and places them inside .32 m^3 (85-gal) overpacks. The overpacked drums are then transported to the grouting unit where the void spaces are filled

with grout. The overpacks are then capped and transported to the drum washing unit operation, where they are washed and dried before leaving the module.

Liquid waste generated during the operation is collected in a sump and directed to other unit operations for treatment.

Certification and Shipping Module (CSHIP). This module is intended to support the "Packaging Examination/Verification" function within the heavily shielded hot cell and the "Ship To Storage Or Disposal" function as shown on the process flowsheet. The assay, inspection, and certification activities for the "Ship To Storage Or Disposal" function are for verification purposes only.

The CSHIP module shown in Figure 6.5-14 has been designed to suit the large and unique waste forms such as the PUREX tunnel equipment, large boxes, and cesium/strontium capsules, as required.

The CSHIP module consists of three unit operations: incoming material storage, assay and certification, and truck loading. This module receives packaged waste containers from all treatment modules and provides temporary storage, radiological and physical characterization of the waste, and shipment of the containers. Processing of the required range of waste forms will be provided at this location or in conjunction with module BB. The module is applicable to both contact-handled and remote-handled waste.

The CSHIP module is used in conjunction with the treatment modules. The module includes all equipment needed for certification of the waste in compliance with the transportation, storage, and disposal regulations and requirements.

Functional Operation: Packaged waste containers arrive from treatment modules on conveyors, carts, or other transport devices. Containers are removed from the transport devices and placed in a staging area. The containers are then visually examined, tagged, logged, recorded, and transported to an assay-and-certification unit operation. In this unit operation, the containers are examined by radioassay devices to allow both alpha and gamma radioactivity classification in accordance with transportation, storage, and disposal criteria. Various devices, such as PAN counting and SGS instruments, may be used.

Next the containers are weighed and measured to determine waste density. The presence of material restricted by transportation, storage, and disposal criteria is determined by nondestructive examination by ultrasonic instruments or an RTR device. After examination, each container is labeled and its properties are logged and recorded into a computerized database. After inspection, the container is moved to a temporary storage area until readied for shipment to an interim storage or disposal facility. Containers that do not meet transportation dose criteria are shipped in a truck equipped with shield overpacks.

The CSHIP module is equipped with a bridge crane and a forklift. Containers can be loaded onto flat-bed trailer or van trucks. Containers can also be loaded into large transportation overpacks. This module is designed to be installed contiguous to a treatment module.

Shredding and Compaction Module (CMPCT). This module is intended to support each of the "LLMW Size Reduction And Packaging", "TRU Size Reduction And Packaging" and "LLW Size Reduction And Packaging" functions as shown on the process flowsheet. The CMPCT module shown in Figure 6.5-15 is used in conjunction with the OSORT and BB modules. It is applicable to both contact-handle and remote-handled waste. The shredding and compaction module functions either as an up-front process unit for feeding size-reduced waste to a given process train or as a self contained process unit where solids are size-reduced, compacted in drums, and transported to the certification and shipping module. An example of this operation is size reduction of PUREX dissolvers prior to TRU processing, and size reduction of PUREX silver reactors prior to LLMW processing.

Functional Operation: The module is designed to shred incoming solid waste and package it in .20 m^3 (55 gal) drums, compact the drums and repackage them in .32 m^3 (85 gal) overpacks. This module is capable of shredding, compaction, and repackaging. A dust collection and filtration unit is provided to treat air containing fugitive dust from the shredding operations.

After shredding, drums containing shredded waste is transported to the supercompactor unit operation where a lift device places the filled drums onto press conveyors. The operator selects a drum from one of the conveyors and feeds it to the press through an airlock. A device pierces the drum to release gasses that may be trapped. A high pressure compactor (supercompactor) compresses the drum and transfers it from the press to a staging conveyor (or turntable). A lift device picks up the compressed drum and places it into one of several overpacks located on an adjacent conveyor. After each overpack is filled, the operator feeds it to the grout station where grout is added to fill void spaces in the overpack. The overpack is then transported to the sorting machine where it is capped and scaled. The operator moves the sealed overpack to a drum washing unit where a high-pressure water spray jet is used to remove any loose contamination on the outside surface of the overpacks. The overpacks are then inspected prior to being released from the treatment module

Any liquid discharged during press operation is directed to a sump which pumps it to other unit operations for treatment. The compacted waste is ready for radioassay and final certification, which are included in the CSHIP module.

Maintenance Module (MAINT). This module does not directly support a function shown on the process flowsheet but is required to sustain normal plant operations. The MAINT module is equipped with a building for receiving and repairing failed equipment. This module is used in conjunction with the treatment modules. The maintenance shop will repair components contaminated with low-level radioactivity but not alpha emitters. Components contaminated with alpha particulate must be decontaminated in the alpha maintenance galleries before they are brought into the maintenance shop.

Functional Operation: Contaminated failed equipment and parts arrive at the shop in transfer carts. Parts are removed from the transport carts and are placed in a decontamination area where high-pressure spraying or other techniques are used to remove any loose contamination. After cleaning and decontamination, components are moved to maintenance tables. Maintenance

machinery and tools are used as needed. The shop includes an overhead crane and a jib crane for material handling, and a paint booth.

Treatment Front-End Support Module (TADMN). This module also does not directly support a function shown on the process flowsheet. It too is intended to support normal plant operations. The TADMN module includes all administrative and laboratory buildings required for waste management support functions. The treatment front-end support module is essentially the same for all treatment facilities regardless of their capacity.

Functional Operation: The treatment front-end support module incorporates all technical and administrative support functions needed to manage the operation of a waste management facility. These functions include security, access control including personnel decontamination (radioactive and hazardous), maintenance of uncontaminated areas and equipment, health physics and radiation badges, facility access control, sanitary facilities, work control and personnel support, internal and external (public relations) communications, spill or emergency response provisions (hazardous and radioactive), analytical laboratory, environmental field sampling, environmental regulatory reporting, and records management.

6.5.2.3.2 **Contact Handled TRU Processing Facility.** Modules which have not been previously described or those with significant differences will be addressed in detail in this section. Modules identical to those already described will refer back to the applicable section.

In general, the main difference between remote handled (RH) and contact handled (CH) TRU processing facilities is that the CH facilities will not require remote handling equipment, shielded facilities, and other RH features. In addition, the CH-TRU facility will be required to process approximately 10 percent of the long length transfer pumps, and as such will incorporate appropriate module modifications to handle these large waste items. The CH-TRU processing facility will not be required to process any cesium and strontium capsules or PUREX tunnel equipment.

Open, Dump, and Sort Module (Module OSORT). Refer to module OSORT in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Treatment Receiving, Preparation, and Shipping Module (Module BB). Refer to module BB in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Certification and Shipping Module (Module CSHIP). Refer to module CSHIP in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Shredding and Compaction Module (Module CMPCT). Refer to module CMPCT in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Neutralization Module (NEUTR). This module is intended to support the "TRU Waste Glove Box Processing Area" function as shown on the process flowsheet. The NEUTR module shown in Figure 6.5-16 must be used in conjunction with the GROUT module which is subsequently described. The NEUTR module as used in the reference is based on a liquid feed, not a solid waste feed as is intended for M-33. This module is assumed to approximately represent, for cost comparison purposes, a neutralization module specifically

designed for treating solid waste. For the purposes of this document it has been assumed that solid waste will initially undergo a dissolution step in the process, producing an aqueous phase which will be treated as described below.

The neutralization module collects and treats input aqueous waste that is corrosive (pH below 2.0 or above 10.0) or contains inorganic compounds requiring destruction. The corrosive aqueous waste is received at the module in cans, drums, or special transport containers having several different capacities. In addition to treating input aqueous waste, this module treats the secondary aqueous waste (floor drains, equipment drains, and chemical wastes) for the TRU waste treatment facility. The module has a number of unit operations that accomplish the required functions. It is applicable to both contact-handled and remote-handled waste.

Functional Operation: The neutralization module has all the unit operations needed for treating an incoming liquid waste having a range of RCRA-controlled toxic, heavy metal and inorganic contaminants. Toxic metal contaminants can include mercury, cadmium, chromium, and lead. The unit operations also have the capability to treat secondary liquid waste generated by the waste treatment facility, such as distillate from air pollution control, rinse water container wash down operations, and liquids collected from the module equipment and floor drains.

The incoming liquid waste is precharacterized before it is brought to the treatment modules. For bulk operations, the incoming waste is segregated into different groups: liquids with a low pH, liquids with a high pH, and liquids that require destruction of various inorganic compounds.

The neutralization unit operations have maximum flexibility and can be used in series, in parallel, or as stand-alone units. Flexible piping connectors are provided at the inlet and outlet of each treatment device. The waste is transferred from the transport container to appropriate batch tanks or directly to a desired treatment unit operation.

Typical steps for treating bulk quantities of the three waste categories are as follows:

Low-pH waste: Waste having a low pH and requiring no treatment other than neutralization is treated with a basic neutralizer compound and transported to the stabilization module. No further processing is performed in order to minimize concentration and potentially increase the criticality of the treated stream.

High-pH Waste: Waste high in PH is processed through the neutralization module by the addition of acidic neutralizer compounds. The final treatment pH selected is dependent on the quantity of suspended solids that the stream would produce. This amount is minimized in order to reduce the criticality of the stream. Any sludge generated from the neutralization process is removed and transported to stabilization. Supernate from the neutralization is also transported to stabilization.

Inorganic waste: Waste containing only inorganic compounds that require destruction are treated by reacting these compounds with various compounds that will convert the toxic compounds into non- or lesser-

toxic compounds. The resulting treated stream is transported to stabilization.

Grout Stabilization Module (Module GROUT). This module is also intended to support the "TRU Glove Box Processing Area" function as shown on the process flowsheet. The GROUT module shown in Figure 6.5-17 provides secondary waste treatment capability and is used at the end of the treatment modules. It is utilized to process the special case TRU waste. The module output is transported to the CSHIP module. The primary function of this module is to solidify solid and liquid waste and sludge that arrive from treatment modules and potentially from storage facilities. The module is applicable to both contact-handled and remote-handled waste.

The module consists of five main process unit operations that incorporate all buildings, systems, processes, equipment, devices, controls, and accessories required to prepare the incoming waste and stabilize it either by macro- or microencapsulation techniques.

Functional Operation: The module receives concentrated liquid waste, solids, or sludge via a pipeline or by special containers. A chemical addition unit is used to adjust the chemistry of the feed before it is fed to the solidification unit operation. A preparation and feed unit crushes and shreds incoming solid waste. The shredded waste is then collected in a storage hopper.

The microencapsulation unit operation solidifies concentrated liquid waste, sludge, or a combination of the two. The unit has a remotely operated in-drum solidification assembly equipped with intake tanks and hoppers for sludge, liquid waste, and grout. To accomplish the solidification process, a drum is placed onto a transfer cart. The cart moves the drum to various fill stations where feeders place sludge and liquid waste and binder in the drum. Next, the cart moves the filled drum to a mixing station where the drum is capped and tumbled to achieve the required mixture. The cart moves the drum for a repeat of the filling and mixing steps to maximize the fill efficiency.

The macroencapsulation unit operation solidifies bulkier solids such as spent filters, shredded solids, soils and pelletized debris. Macroencapsulation is accomplished by placing the solids in a drum, adding grout, and mixing the two components. In large-generator modules, a pugmill accomplishes this function.

After encapsulation, the operator remotely moves the filled container to a capping and washing unit. This unit operation provides for sample collection, capping of the container, and removal of loose contamination from the container surface by high-pressure spray water jets. The containerized waste is ready for processing through radioassay and final certification, which are included in the CSHIP module.

Maintenance Module (Module Maint). Refer to module MAINT in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Front-End Support Module (Module TADMN). Refer to module TADMN in section 6.5.2.3.1, the Remote Handled Processing Facility description.

6.5.2.3.3 **Contact Handled LLMW/LLW Processing Facility.** Modules which have not been previously described or those with significant differences will be addressed in detail in this section. Modules identical to those already described will refer back to the applicable section.

In general, the main difference between RH and CH-LLMW/LLW processing facilities is that the CH facilities will not require remote handling equipment, shielded facilities, and other RH features. In addition, the CH-LLMW/LLW facility will be required to process approximately 90 percent of the long length transfer pumps, and as such will incorporate appropriate module modifications to handle these large waste items. The CH-LLMW/LLW processing facility will not be required to process any cesium and strontium capsules or PUREX tunnel equipment.

Open, Dump, and Sort Module (Module OSORT). Refer to module OSORT in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Treatment Receiving, Preparation, and Shipping Module (Module BB). Refer to module BB in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Certification and Shipping Module (Module CSHIP). Refer to module CSHIP in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Shredding and Compaction Module (Module CMPCT). Refer to module CMPCT in section 6.5.2.3.1, the Remote Hardled Processing Facility description.

Maintenance Module (Module Maint). Refer to module MAINT in section 6.5.2.3.1, the Remote Handled Processing Facility description.

Front-End Support Module (Module TADMN). Refer to module TADMN in section 6.5.2.3.1, the Remote Handled Processing Facility description.

6.5.2.3.4 **Contact Handled Waste Storage Facility.** Modules which have not been previously described or those with significant differences will be addressed in detail in this section. Modules identical to those already described will refer back to the applicable section.

Contact-Handled Storage Module (STORE). This module is intended to support the "Storage Prior To Processing" and "Storage Prior To Disposal" functions for contact-handled waste as shown on the process flowsheet. The STORE module shown in Figure 6.5-18 consists of three unit operations. Waste that arrives from the source of origination is stored at a specified location depending on waste form. The module is equipped with a cleanup unit operation for responding to potential spills. The module also has permanent monitoring capabilities to ensure the integrity of the stored waste containers. The module should be used in conjunction with the SADMN module described below.

Functional Operation: The storage areas include features, such as spill collection and a combination of sloping floors and sumps, that achieve compliance with the storage requirement of RCRA. Designated storage areas are separated by 15 cm (6 in) high (minimum) concrete berms or full height partitions that extend the length of the storage bays. In bays located along the outside walls, floors slope to the rear of the module. Floors in the

remainder of the bays are sloped to the center. Area monitors are included for both gamma and alpha radiation control.

Storage Front-End Support Module (Module SADMN). This module does not directly support a function shown on the process flowsheet but is required to support storage facility operations. The SADMN module includes all administrative and laboratory buildings required for waste management support functions.

Functional Operation: The SADMN module incorporates all technical and administrative support functions needed to manage the operation of a waste management facility. These functions include security, access control including personnel decontamination (radioactive and hazardous), maintenance of uncontaminated areas and equipment, radiological control and radiation badges, ability access control, sanitary facilities, work control and personnel support, internal and external (public relations) communications, spill or emergency response provisions (hazardous and radioactive), analytical laboratory, environmental field sampling, environmental regulatory reporting, and records management.

Storage Receiving and Shipping Module (SRCSH). This module also does not support a function shown on the process flowsheet but is also required to support storage plant operations. The SRCSH module is used in conjunction with the STORE module and supplies all the necessary accommodations for receiving truck shipments, unloading containers, transporting containers to the storage, and the reverse operations, as needed, for shipping containers out of the storage facility

Functional Operation: Containers arrive on a transport vehicle and are unloaded using a forklift or overhead bridge crane, and placed in a staging area. The containers are visually examined, labeled, logged, recorded, and transported for inspection and assay. At the inspection and assay operation, the category of the received waste is verified. Note that some of the waste designated for "Storage Prior To Processing" will be assayed and certified at the WRAP 1 facility prior to being designated for "Storage Prior To Disposal". After inspection, the containers are moved to a storage area. The module is also used for shipping and loading containers that are ready for transport to disposal modules. The loading and shipping operations are the reverse of receiving and unloading steps.

The technical bases and requirements for SRCSH module are the same as those outlined in the BB and CSHIP modules, except that the assay, inspection, and certification functions are for verification purposes only. In addition, the SRCSH module is equipped with a computer inventory system that tracks the incoming and outgoing waste, as well as types of sampling and analysis that may be performed at the staging area (nondestructive).

Maintenance Module (Module Maint). Refer to module MAINT in section 6.5.2.3.1, the Remote Handled Processing Facility description.

6.5.2.3.5 Contact Handled Uranium Waste Storage Facility. Modules which have not been previously described or those with significant differences will be addressed in detail in this section. Modules identical to those already described will refer back to the applicable section. Note that

process flowsheet does not distinguish between storage prior to processing or storage prior to disposal.

Contact-Handled Storage Module (STORE). Refer to module STORE in section 6.5.2.3.4, the Contact Handled Waste Storage Facility description.

Storage Front-End Support Module (Module SADMN). Refer to module SADMN in section 6.5.2.3.4, the Contact Handled Waste Storage Facility description.

Storage Receiving and Shipping Module (SRCSH). Refer to module SRCSH in section 6.5.2.3.4, the Contact Handled Waste Storage Facility description.

6.5.2.3.6 **High Level Waste Canister Storage Facility. Enclosed Vault Storage Module (Module Z).** The enclosed vault storage facility shown in Figure 6.5-19 receives high level waste canisters from the treatment modules and holds them in shielded vaults for long-term storage. The facility is suitable for storage of waste having high gamma radiation and requiring remote handling.

Functional Operation: Treated waste is brought in a shield cask mounted on a transportation vehicle. At the vault storage facility, an unload and stage unit operation receives and inspects the vehicle and shield cask, and removes the cask cover. Using remote handling techniques, the unit operation removes the drums or overpacks from the shield cask and places them in a shielded assay inspection cubicle. When a removal operation is completed, the empty cask and trailer is inspected, the cask lid is attached, and the trailer is sent back to the parking area until further shipments are required. Decontamination of the transport vehicle and empty cask will be accomplished at the storage facility track bay.

At the assay/inspection cubicle, the containers are first remotely examined, labeled, logged, and recorded. An assay/inspect unit operation is used to determine radioactivity, physical properties, and other parameters that are needed to classify the waste for disposal. Various devices such as SGS and PAN assay instruments may be used. After radiological examination, the containers are weighed and measured to determine waste density.

The vault safely stores the waste for the desired period. A monitoring unit operation continuously monitors the storage confinement system and will be able to determine when corrective action needs to be taken to maintain safe storage conditions. Monitoring includes any potential leakage of drums.

Operations involving storage of waste drums or overpacks are accomplished remotely. Shielding is provided to reduce the worker's exposure to radiation.

Operation steps for shipment of the drums out of the storage facility is the reverse of the incoming drum operation steps discussed above. The storage facility does not generate secondary waste.

6.5.2.3.7 **Remote-Handled Storage Facility.** The remote-handled storage facility will handle all TRU, LLMW, GTC3 LLW and miscellaneous waste which must be handled remotely.

Enclosed Vault Storage Module (Module Z). Refer to module Z in section 6.5.2.3.6, the High Level Waste Canister Storage Facility description.

6.5.2.3.8 Cs/Sr Capsule and Overpack Storage Facility. Enclosed Vault Storage Module (Module Z). Refer to module Z in section 6.5.2.3.6, the High Level Waste Canister Storage Facility description.

6.5.2.4 Assumptions and Uncertainties. The assumptions used as a basis for determining facility sizes for alternative 2 are listed below.

1. Process and storage facility operational durations vary as depicted in the Facility Sizing Data Sheets (or table TBD). Facility Sizing Data Sheets are used in calculating facility sizes. Operational durations are based on the assumption that the projects are DOE line items and will require a 4 year project initiation cycle followed by a construction period of at least 2 years.

2. The average hourly waste flow rate was based on a facility operation of 250 days/year, 8 hours/day, at a 70% availability. This is equivalent to 175 days/year or 1400 hours/year of operation.

3. It was assumed that dry storage of cesium and strontium was acceptable and that the vault design depicted in Module Z will accommodate the cesium and strontium overpacks. This was assumed acceptable for cost estimating purposes.

4. Sodium storage following processing and "prior to disposal" was not incorporated within the alternative. All sodium was assumed to be converted to sodium hydroxide and utilized by the TWRS organization.

5. The availability of power and water utilities were not investigated for this alternative. It was assumed that sufficient utilities are available.

6. Although briefly mentioned in the description of some modules, the handling and disposition of all liquid and gaseous effluents were not investigated for this alternative. It is assumed that existing or planned facilities will be capable of handling the generated effluents of the new facilities.

7. Location of the new processing and storage facilities was assumed to be in the 200 Area plateau and that sufficient room is available to locate the facilities adjacent to each other or within close proximity of each other.

6.5.3 Cost

A breakdown of the life cycle cost for Alternative 2 is provided in Table 6.5-3. Presented is the total estimated cost, total project cost, operations and maintenance cost, and decontamination and decommissioning cost. The total life cycle cost for Alternative 2 including escalation and contingency is $8,016,032,512. This is summarized below:

Total Estimated Cost	$2,762,232,739
Other Project Cost	$ 973,840,133
Operations and Maintenance	$3,006,164,057
Decontamination and Decommissioning	$1,273,795,583
Total Life Cycle Cost	$8,016,032,512

The details of the capital cost estimate are provided in Appendix B. The personnel requirements and direct (no escalation, no contingency) operating and maintenance costs are presented in Appendix D.

6.5.4 Schedule

For an inclusive schedule of Alternative 2 depicting engineering, design, construction, operation and decommissioning, of both the process and storage facilities, see Figures 6.5-20 and 6.5-21 and Table 6.5-4. The facility operation dates shown were established to support existing and projected waste volume inventory requirements. Design duration was based on a standard four year DOE Line Item Project followed by a construction period of at least 2 years.

6.5.5 References

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Figure 6.5-1. Alternative 2: Multiple New Modular Processing Facilities. 1 of 2.

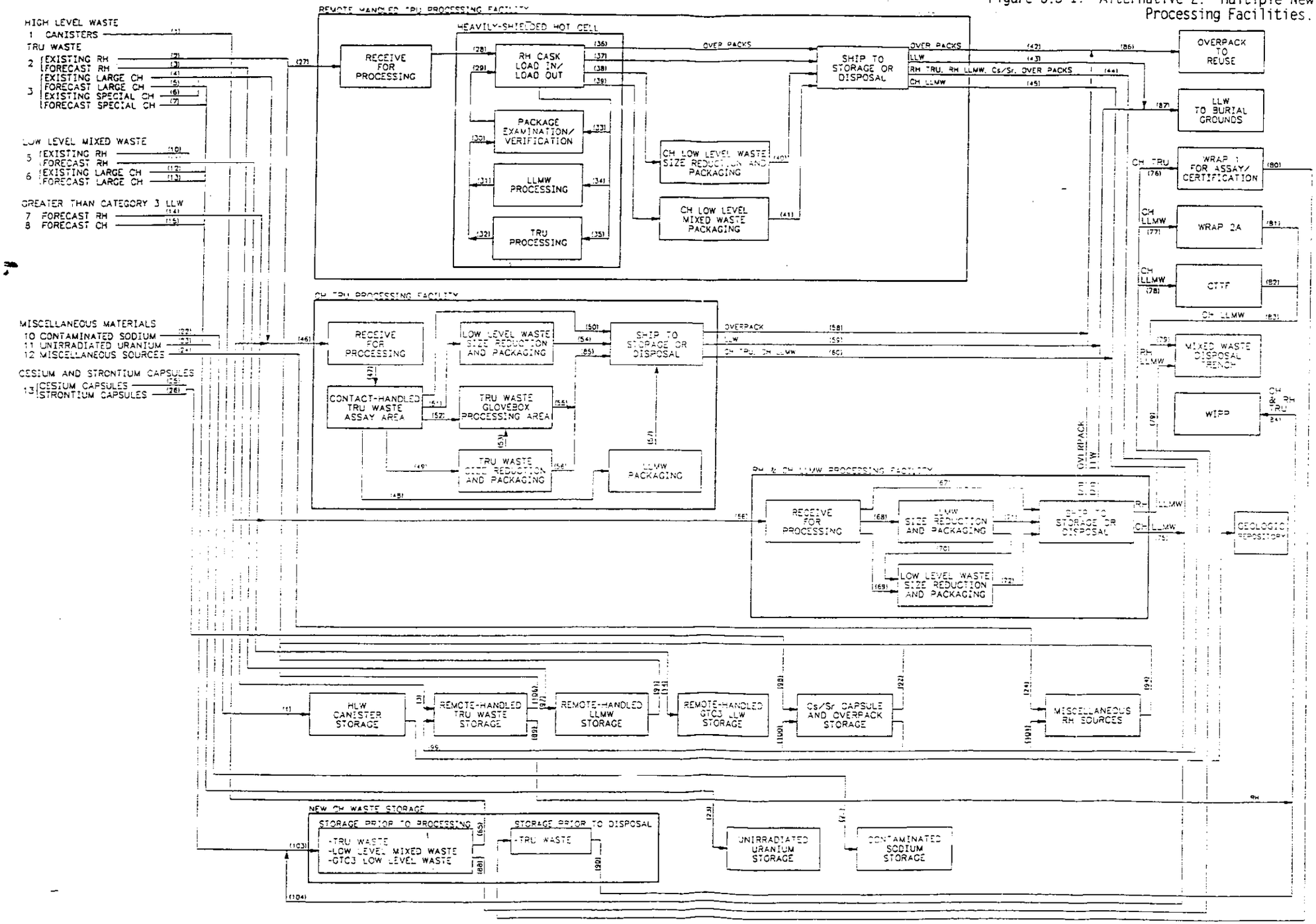


Figure 6.5-1. Alternative 2: Multiple New Modular Processing Facilities. 2 of 2.

No	Name	Total	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
1	HLW Canisters	8,569																	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451	451
2	Existing RH TRU	380														25	55		30	56	26	5	11	11			40		20	20	20						
3	Forecast RH TRU	41,316	1,533	228	153	169	175	153	192	180	203	208	4,069	7,724	7,707	258	225	248	493	579	585	1,523	1,585	1,900	1,325	1,945	1,505	1,437	1,192	1,162	1,194	399					
4	Existing Large CH TRU	7,289										607	707	893	587	720	720	573	547	487	487	257	307	140	30	20	40	20	20	20		50					
5	Forecast Large CH TRU	21,532	177	71	53	2,141	2,141	2,153	2,153	2,155	2,153	2,153	2,153	2,153	2,153	14	3	0	3	0	0	3	0	0	3	3	3	3	3	3	0	3					
6	Existing Special CH TRU	491										53	23	46	56	23	33	66	23	23	23	33	20									13					
7	Forecast Special CH TRU	1,892	2	69	49	13	13	37	220	7	44	56	23	38	45	45	51	51	26	26	20	115	110	110	104	104	98	98	92	92	92	0					
10	Existing RH LLMW	277	277																																		
11	Forecast RH LLMW	36,463	1,143	1,327	1,314	1,792	1,466	1,529	1,554	1,773	1,977	2,018	2,797	2,531	2,459	2,733	2,537	3,029	2,555	4,298	5,232	5,707	6,560	7,157	7,430	7,374	3,149	2,736	2,419	2,589	3,018	2,527					
12	Existing CH LLMW	650	550																																		
13	Forecast CH LLMW	980	75	22	22	22	22	22	22	22	22	22	22	22	47	22	22	22	48	22	22	22	48	22	22	22	13	33	22	22	48	22					
14	Forecast RH GTCIII	42,589	39	0	0	0	0	0	3	312	879	1,445	2,525	3,465	5,524	7,507	7,224	6,656	2,223	1,445	723	379	168	168	168	168	158	158	168	168	158	0					
15	Forecast CHGTCIII	46,703	50	2	2	33	33	94	48	[illegible]	388	1,585	2,723	3,548	5,537	7,570	7,203	5,725	2,402	1,322	736	1,198	487	487	472	472	456	456	441	441	441	2					
22	SODIUM	1,159															1,159																				
23	UNIRRAD UR	144								36	48	24		36																							
24	MISC SOURCES	15	15																																		
25	CS CAPSULES	2	2																																		
26	SR CAPSULES	1	1																																		
27	RH Receive for Processing	42,474													2,276	2,265	2,284	2,354	2,280	2,371	2,269	2,268	2,270	2,271	2,269	2,253	2,288	2,286	2,243	2,273	2,264	2,175					
28	RH Cask Load in	42,474													2,276	2,265	2,284	2,364	2,380	2,371	2,369	2,368	2,370	2,371	2,369	2,353	2,368	2,386	2,343	2,378	2,364	2,175					
29	RH Package Ex/Ver (out)	10,794													316	340	379	340	347	254	303	503	586	550	751	775	322	314	1,058	325	948	582					
30	RH LLMW & TRU to Package Exam/Ver	10,776													299	340	379	340	347	354	303	303	586	550	751	775	321	814	1,058	325	948	582					
32	RH TRU Processing (out)	10,776													299	340	379	340	347	354	303	503	586	650	751	775	321	314	1,058	325	948	582					
33	RH Package Ex/Ver (in)	19													17												11										
35	RH TRU Processing (in)	10,612													299	335	374	329	347	251	301	601	385	550	751	759	303	302	1,023	799	922	570					
36	RH Ship to Storage or Disposal (Entering Overpacks)	10,513													287	345	405	515	455	577	774	571	306	550	871	785	485	411	514	531	696	735					
37	RH Ship to Storage or Disposal (Entering RH, Cs/Sr, Misc)	20,544													551	534	704	533	719	909	946	1,223	1,341	1,250	1,622	1,560	1,337	1,225	1,521	1,257	1,593	1,237					
38	RH LLW Size Reduce & Package (in)	31,944													2,251	2,220	1,973	1,350	1,925	1,795	1,595	1,597	1,564	1,721	1,499	1,568	1,302	1,934	1,869	1,346	1,668	1,460					
39	RH CH LLMW Packaging (in)	0																																			
40	RH Ship to Storage or Disposal (Entering LLW)	5,389													410	404	396	370	385	259	319	329	313	344	300	314	280	387	374	369	334	292					
41	RH Ship to Storage or Disposal (Entering LLMW)	3																																			
42	RH Ship to Storage or Disposal (Exiting Overpacks)	10,513													287	345	405	515	455	577	774	571	306	550	371	785	465	411	514	531	696	735					
43	RH Ship to Storage or Disposal (Exiting LLW)	5,389													410	404	396	370	385	259	319	329	313	344	300	314	280	387	374	359	334	292					
44	RH Ship to Storage or Disposal (Exiting RH, Cs/Sr, Misc)	20,544													553	534	704	333	719	909	946	1,223	1,341	1,250	1,522	1,560	1,237	1,225	1,521	1,357	1,593	1,237					
45	RH Ship to Storage or Disposal (Exiting LLMW)	0																																			
46	CH TRU Receive for Processing	47,096										2,261	2,231	2,341	2,354	2,221	2,280	2,343	1,774	1,594	1,588	2,254	2,288	2,225	2,222	2,259	2,252	2,251	2,344	2,257	2,347	2,138					
47	CH TRU Waste Assay Area (in)	47,096										2,281	2,291	2,341	2,354	2,221	2,320	2,342	1,774	1,594	1,585	2,254	2,338	2,226	2,222	2,259	2,253	2,251	2,344	2,257	2,347	2,138					
48	CH TRU LLMW Packaging (in)	3,506										215	311	221	336	241	228	223	270	234	234	125	123	54	9	36	13	13	9	9	13	39					
49	CH TRU TRU Size Reduce (in)	16,784										374	360	396	385	360	371	357	286	246	246	973	997	1,200	1,102	1,274	1,312	1,290	1,238	1,338	1,302	1,079					
50	CH TRU Ship (Entering Overpacks)	13,310										1,195	1,182	1,219	1,274	1,296	1,285	1,235	1,024	387	337	511	466	205	34	137	58	68	34	34	68	148					
51	CH TRU LLW Size Reduce (in)	30,250										331	357	401	743	683	756	720	540	473	467	1,688	1,759	2,107	2,250	2,225	2,257	2,264	2,301	2,313	2,251	1,971					
52	CH TRU Waste Glovebox (Incoming Drums)	1,384										124	154	84	51	50	43	75	38	38	34	39	53	64	48	52	48	69	43	50	55	103					
53	CH TRU Waste Glovebox (Incoming Boxes)	52										12	15	12	3		12																				
54	CH TRU LLW Size Reduce (out)	6,056										166	171	150	149	127	151	144	108	95	93	328	352	421	450	445	453	453	460	463	452	394					
55	CH TRU Waste Glovebox (out)	2,571										272	240	192	124	100	130	150	78	75	59	79	117	128	96	125	96	138	36	100	110	206					
56	CH TRU Size Reduce (out)	15,732										262	244	284	384	360	359	357	286	246	246	973	997	1,200	1,102	1,274	1,312	1,290	1,238	1,338	1,302	1,079					
57	CH TRU LLMW Packaging (out)	3,506										315	311	321	336	241	338	338	270	234	234	125	122	54	9	36	13	13	9	9	16	39					
58	CH TRU Ship (Exiting Overpacks)	13,310										1,195	1,182	1,219	1,274	1,296	1,285	1,235	1,024	387	387	511	466	205	34	137	58	68	34	34	68	148					
59	CH TRU Ship to Storage or Disposal (Exiting LLW)	6,056										166	171	150	149	127	151	144	108	95	93	338	352	421	450	445	453	453	460	463	452	394					
60	CH TRU Ship (Exiting CH TRU and CH LLMW)	22,109										349	396	398	344	401	387	846	332	556	543	1,157	1,237	1,382	1,407	1,434	1,425	1,446	1,433	1,447	1,429	1,225					
65	CH Storage Prior to Processing (Exiting for Process)	30,017								364	253	760	383	704	510	521	595	559	442	389	340	1,514	1,722	2,091	2,247	2,217	2,274	2,253	2,347	2,252	2,221	1,990					
66	CH LLMW/LLW Receive for Processing	103,253								4,822	4,810	4,824	4,823	4,500	2,953	3,179	3,109	3,501	3,961	4,601	4,866	4,843	4,843	4,854	4,852	4,855	4,349	4,350	4,853	4,844	4,859	4,555					
67	CH LLMW/LLW Ship (Entering Overpacks)	90,096								3,721	3,815	3,963	3,712	2,787	2,251	2,509	2,335	2,333	3,479	4,225	4,487	4,558	4,505	4,833	4,602	4,625	4,250	4,408	4,279	4,391	4,435	4,220					
68	CH LLMW/LLW LLMW Size Reduce (Entering LLMW)	18,758								1,203	1,155	1,006	1,117	883	551	564	588	703	671	695	729	718	753	702	721	706	918	319	395	533	518	740					
69	CH LLMW/LLW LLW Size Reduce (Entering)	11,309								1,080	996	789	998	551	582	558	513	557	394	296	295	255	313	213	245	220	584	422	553	442	413	340					
71	CH LLMW/LLW LLMW Size Reduce (Exiting LLMW)	35,624								2,151	2,133	1,870	2,040	1,628	1,192	1,234	1,282	1,311	1,247	1,221	1,403	1,405	1,458	1,282	1,439	1,397	1,750	1,565	1,753	1,625	1,584	1,442					
72	CH LLMW/LLW LLW Size Reduce (Exiting)	2,362								216	199	158	200	130	115	112	123	111	79	59	59	51	53	43	49	44	117	64	111	38	83	58					
73	CH LLMW/LLW Ship (Exiting Overpacks)	30,096								3,721	3,315	3,963	3,712	3,787	2,251	2,509	2,385	2,322	2,479	4,225	4,487	4,558	4,505	4,833	4,602	4,625	4,250	4,408	4,279	4,391	4,435	4,220					
74	CH LLMW/LLW Ship (Exiting CH LLW)	2,352								216	199	158	200	130	118	112	123	111	79	59	59	51	53	43	49	44	117	64	111	38	83	58					
75	CH LLMW/LLW Ship (Exiting CH LLMW)	1,352								255	177	142	194	128	111	94	94	94	96	99	53	31	48	22	3	15	36	73	37	40	53	37					
76	WRAP 1 (incoming)	19,604										535	584	577	508	460	549	507	362	322	315	1,252	1,114	1,225	1,398	1,398	1,408	1,416	1,438	1,438	1,411	1,256					
77	WRAP 2A (incoming)	1,950								112	103	107	103	100	105	115	108	32	106	105	105	116	95	109	29	15	56	72	37	40	53	37					
78	CTTF (in)	2													3				3									0			0	0					
79	Mixed Waste Disposal Trench (RH)	23,672								1,896	1,956	1,725	1,646	1,510	1,281	1,140	1,139	1,213	1,151	1,252	1,349	1,374	1,410	1,361	1,436	1,352	1,564	1,492	1,716	1,586	1,531	1,405					
80	WRAP 1 (exiting)	19,604										535	584	577	508	460	549	527	362	322	315	1,052	1,114	1,225	1,298	1,398	1,403	1,415	1,436	1,433	1,411	1,256					
81	WRAP 2A (exiting)	3,900								196	207	214	205	223	213	205	217	207	212	186	234	209	214	193	86	3	201	141	79	79	105	74					
82	CTTF (out)	0													3				3									3			0	0					
83	Mixed Waste Disposal Trench (CH)	3,900								196	207	214	205	223	210	205	217	207	212	186	234	209	214	193	86	3	201	141	79	79	106	74					
84	WIPP	30,379										325	570	601	737	327	918	838	725	578	617	1,537	1,707	1,979	2,159	2,151	2,229	2,230	2,288	2,301	2,309	2,099					
86	Overpacks to Reuse	113,919								3,721	3,315	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
87	LLW to Burial Grounds	14,907								216	199	324	371	290	575	552	670	525	572	513	471	728	727	308	799	803	351	324	945	920	868	754					
88	CH Storage Prior to Processing (Exiting to Disposal)	21,556								112	103	742	787	877	513	574	557	599	489	427	420	1,168	1,209	1,437	1,427	1,413	1,494	1,489	1,473	1,478	1,485	1,223					
89	WIPP RH	10,778													299	240	379	340	347	354	303	500	588	550	751	775	321	314	346	384	945	538					
90	WIPP CH	19,504										525	570	601	487	480	539	498	352	322	215	1,037	1,119	1,223	1,408	1,386	1,408	1,416	1,242	1,417	1,353	1,460					
91	RH LLMW Storage (Exiting)	96,760								4,438	4,558	4,364	4,207	4,025	2,459	2,733	2,537	3,029	2,555	4,298	4,572	4,706	4,837	4,796	4,529	4,806	4,705	4,583	4,736	4,751	4,750	4,474					
92	RH Cs/Sr Storage (Exiting)	4													2																						
94	RH MISC Storage (Exiting)	15													15																						
97	RH LLMW Storage (in)	96,760	1,420	1,327	1,314	1,792	1,466	1,529	1,554	1,773	1,977	2,018	2,797	2,531	2,453	2,733	2,537	3,029	2,555	4,298	5,232	5,707	6,560	7,157	7,430	7,574	3,149	2,736	2,419	2,589	3,018	2,527					
98	RH Cs/Sr Storage (in)	4	4																																		
99	RH TRU Storage After Processing	20,525													535	524	704	533	719	909	946	1,223	1,241	1,250	1,522	1,560	1,206	1,225	1,521	1,257	1,593	1,237					
100	Cs/Sr Storage After Processing	4													2																						
101	Miscellaneous RH Storage After Process	15													15																						
102	RH Storage After Processing	20,544													553	634	704	533	719	909	946	1,223	1,241	1,250	1,522	1,560	1,207	1,225	1,521	1,257	1,593	1,237					
103	CH Storage Prior to Processing (in)	72,038	955	163	136	68	58	153	290	358	1,054	1,663	2,790	3,608	5,680	7,537	7,375	6,809	2,485	1,581	838	1,476	2,785	2,772	2,750	2,753	2,825	2,800	2,707	2,707	2,733	39					
104	CH Storage After Processing	25,061								255	177	1,092	1,189	1,025	354	395	981	939	725	925	502	1,217	1,285	1,404	1,410	1,449	1,512	1,319	1,470	1,487	1,483	1,362					
105	RH TRU Storage (Exiting)	41,316													2,252	2,239	2,254	2,222	2,256	2,239	2,173	2,272	2,294	2,311	2,259	2,253	2,287	2,246	2,238	2,277	2,233	2,275					

Figure 6.5-2. Alternative 2 Annual Storage Requirements for the High-Level Waste Canister Storage Area.

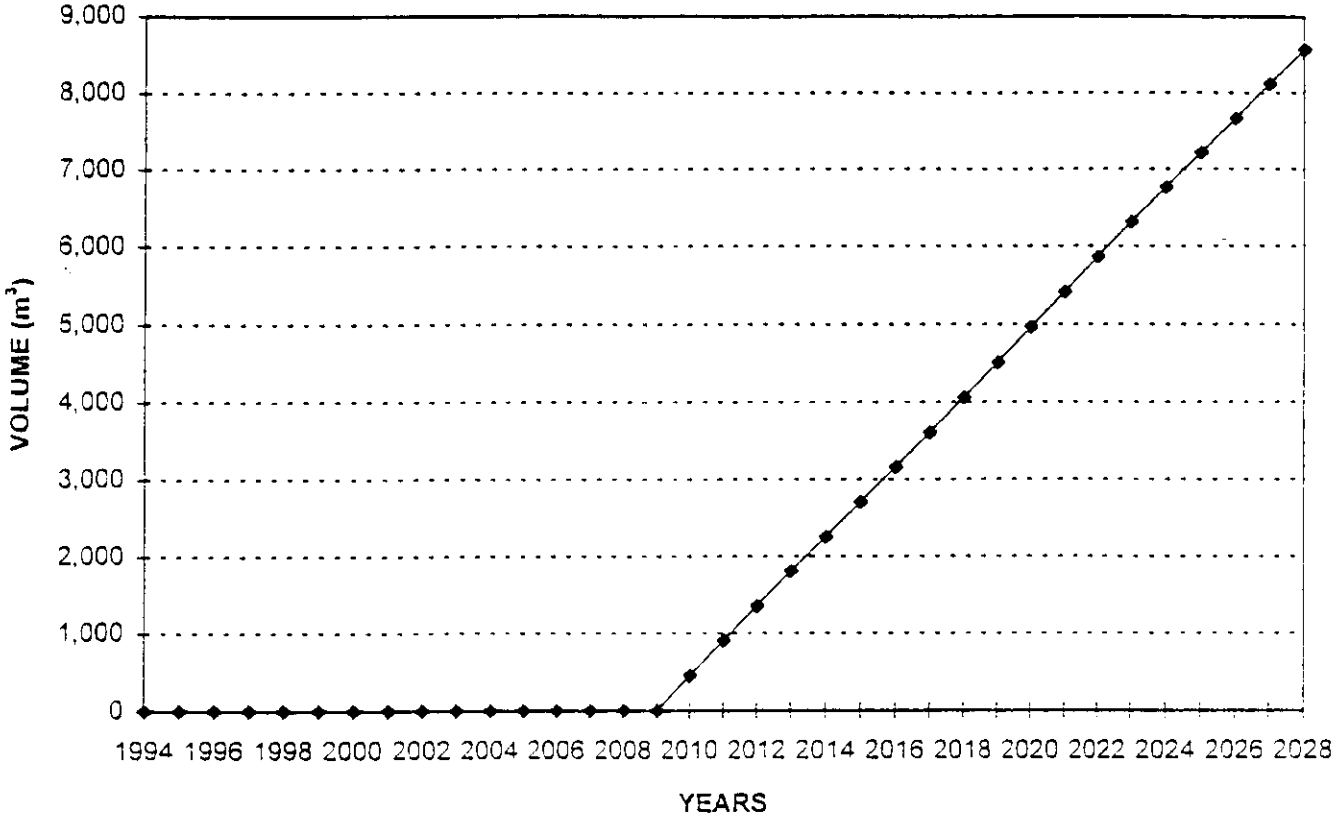


Figure 6.5-3. Alternative 2 Annual Storage Requirements for the Remote-Handled Transuranic Waste Storage Area.

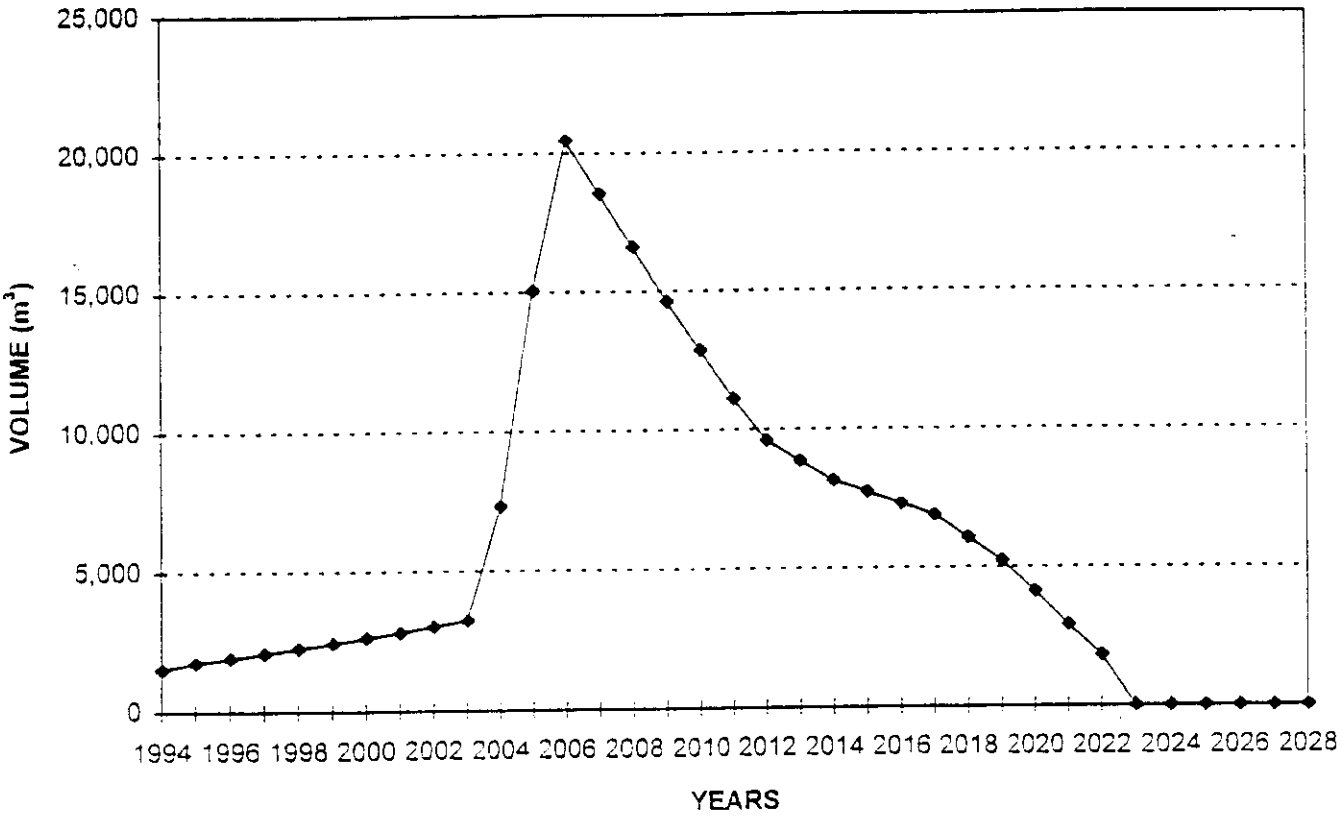


Figure 6.5-4. Alternative 2 Annual Storage Requirements for the Contact-Handled Waste Storage Area.

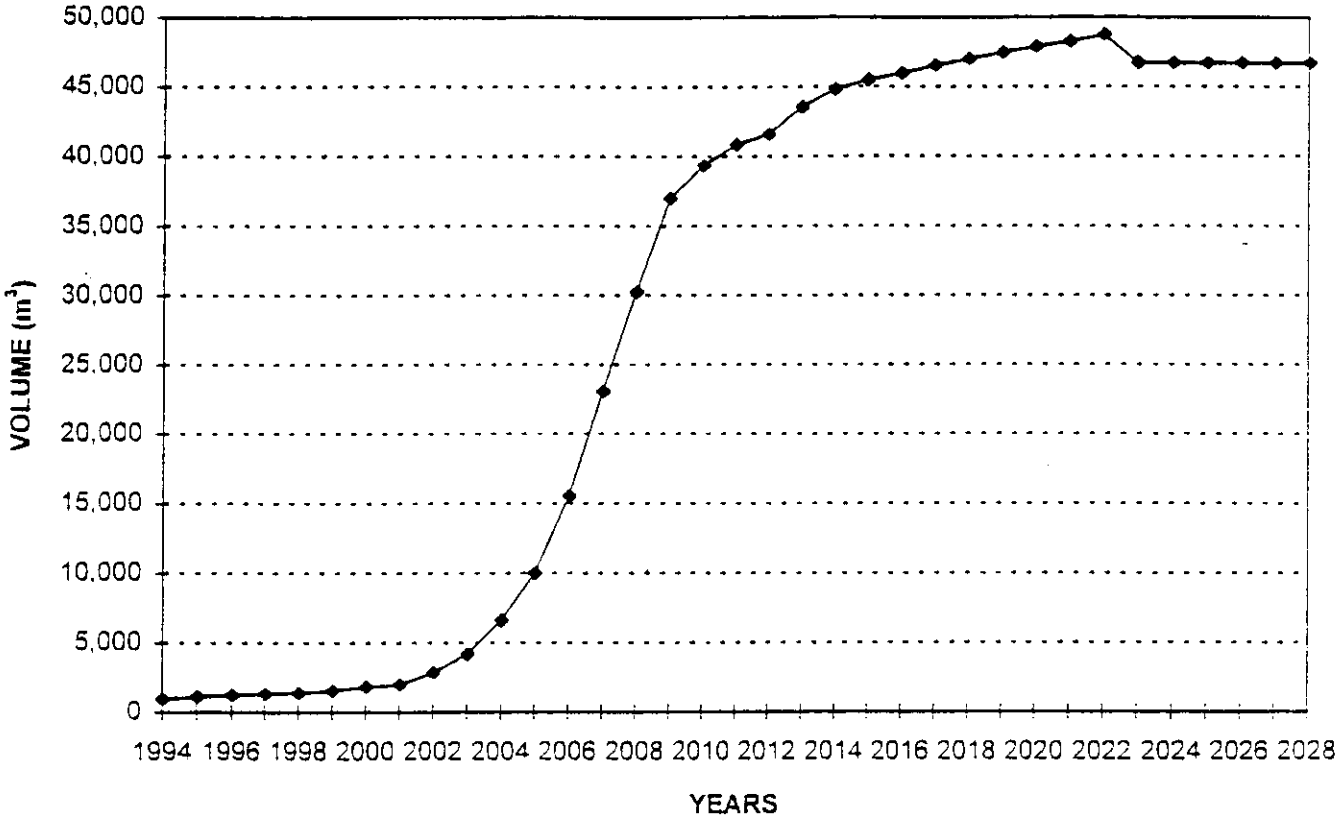


Figure 6.5-5. Alternative 2 Annual Storage Requirements for the Remote-Handled Low-Level Mixed Waste Storage Area.

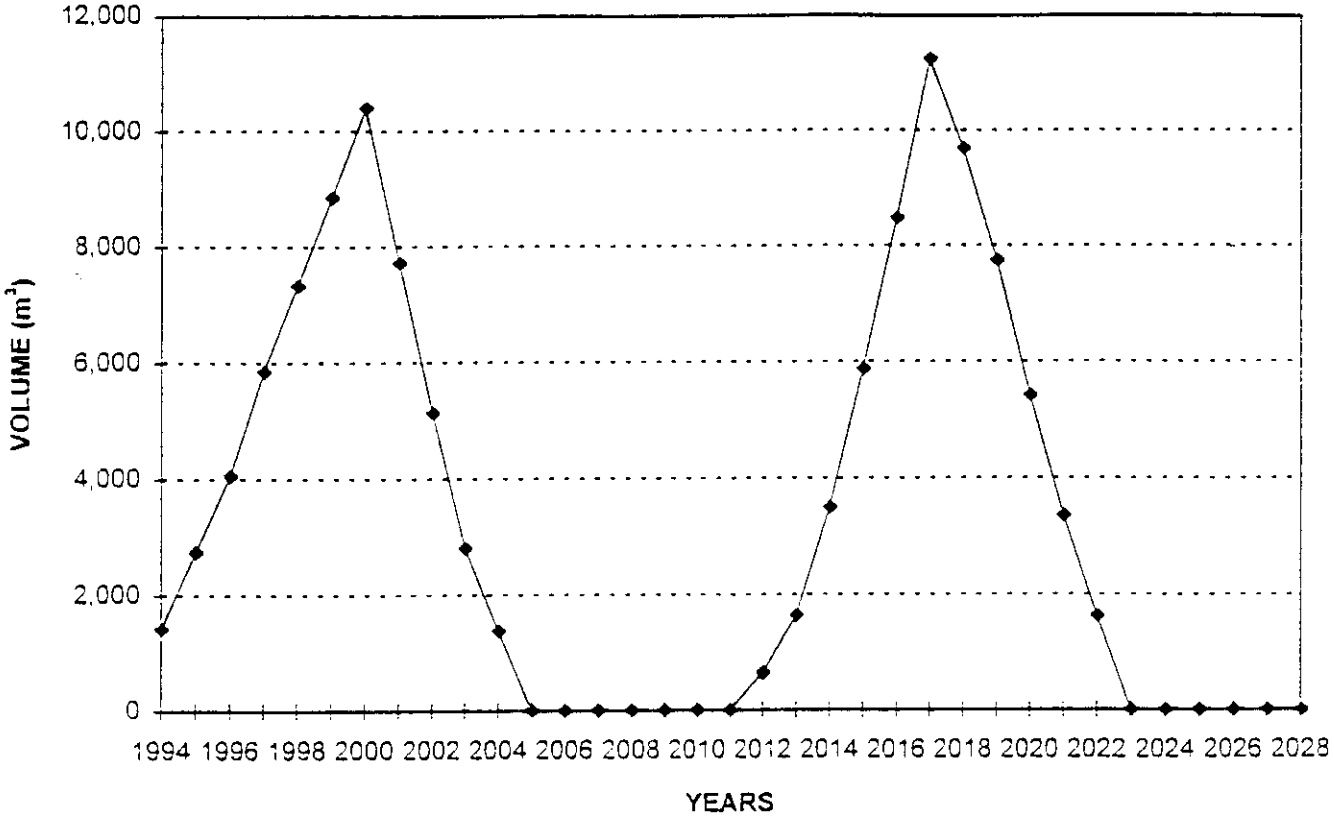


Figure 6.5-6. Alternative 2 Annual Storage Requirements for the Remote-Handled Greater Than Category 3 Low-Level Waste Storage Area.

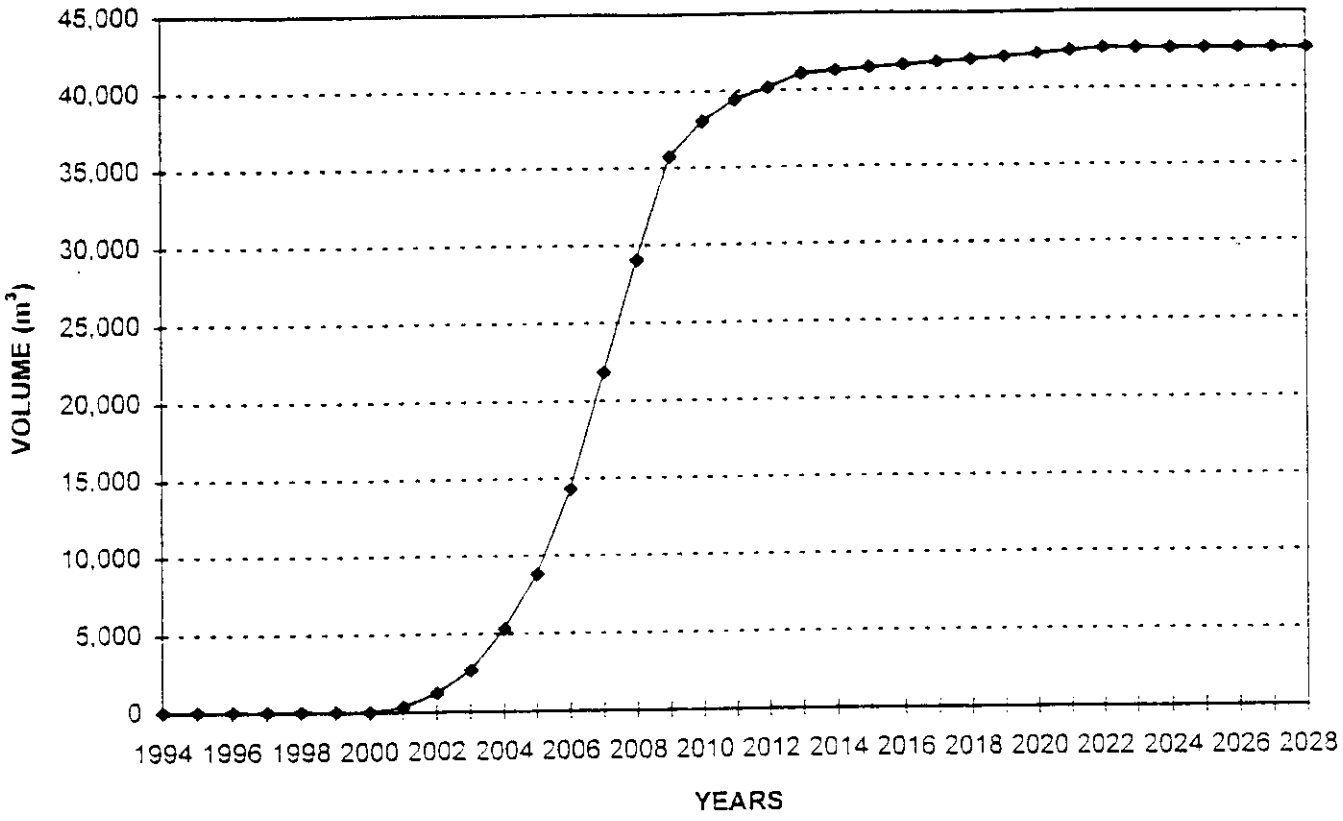


Figure 6.5-7. Alternative 2 Annual Storage Requirements for the Unirradiated Uranium Storage Area.

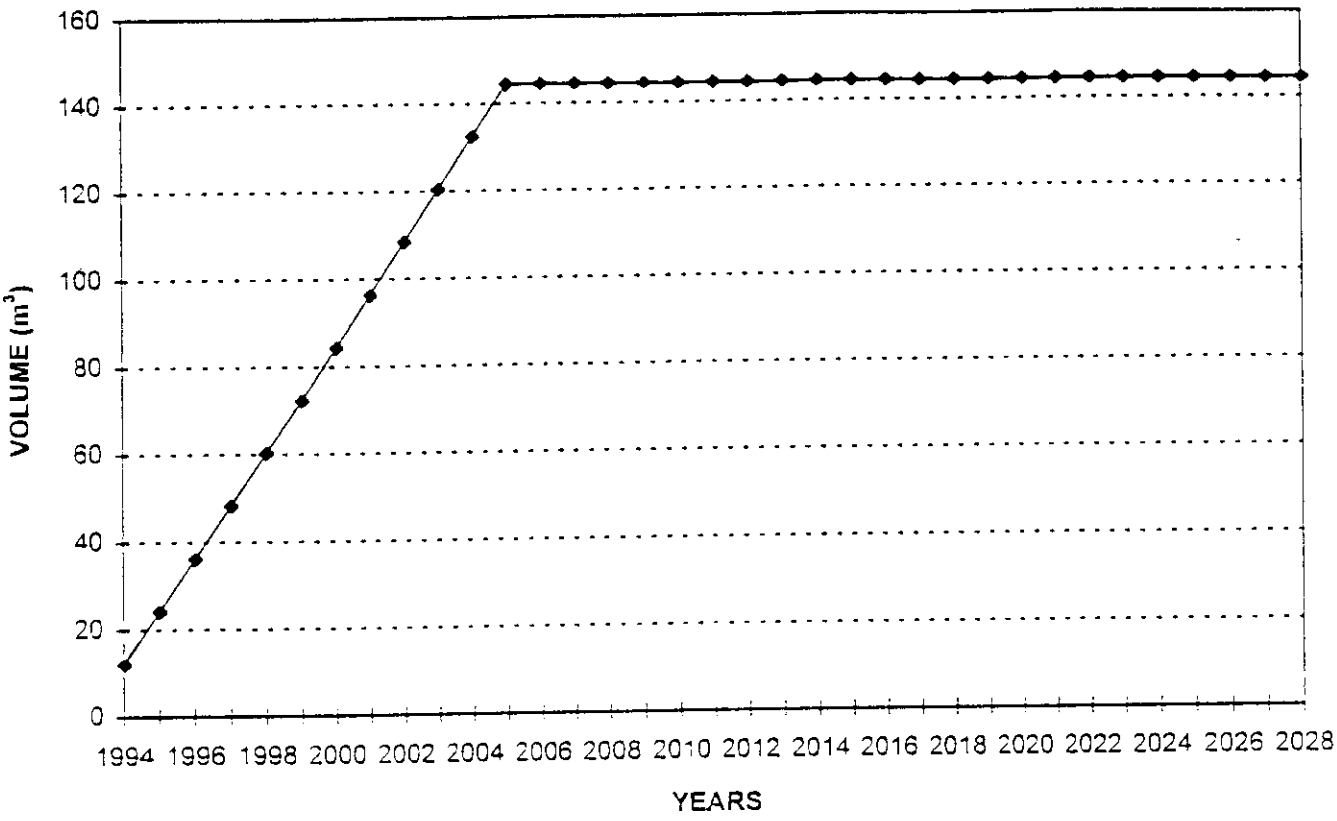


Figure 6.5-8. Alternative 2 Annual Storage Requirements for the Miscellaneous Remote-Handled Waste Storage Area.

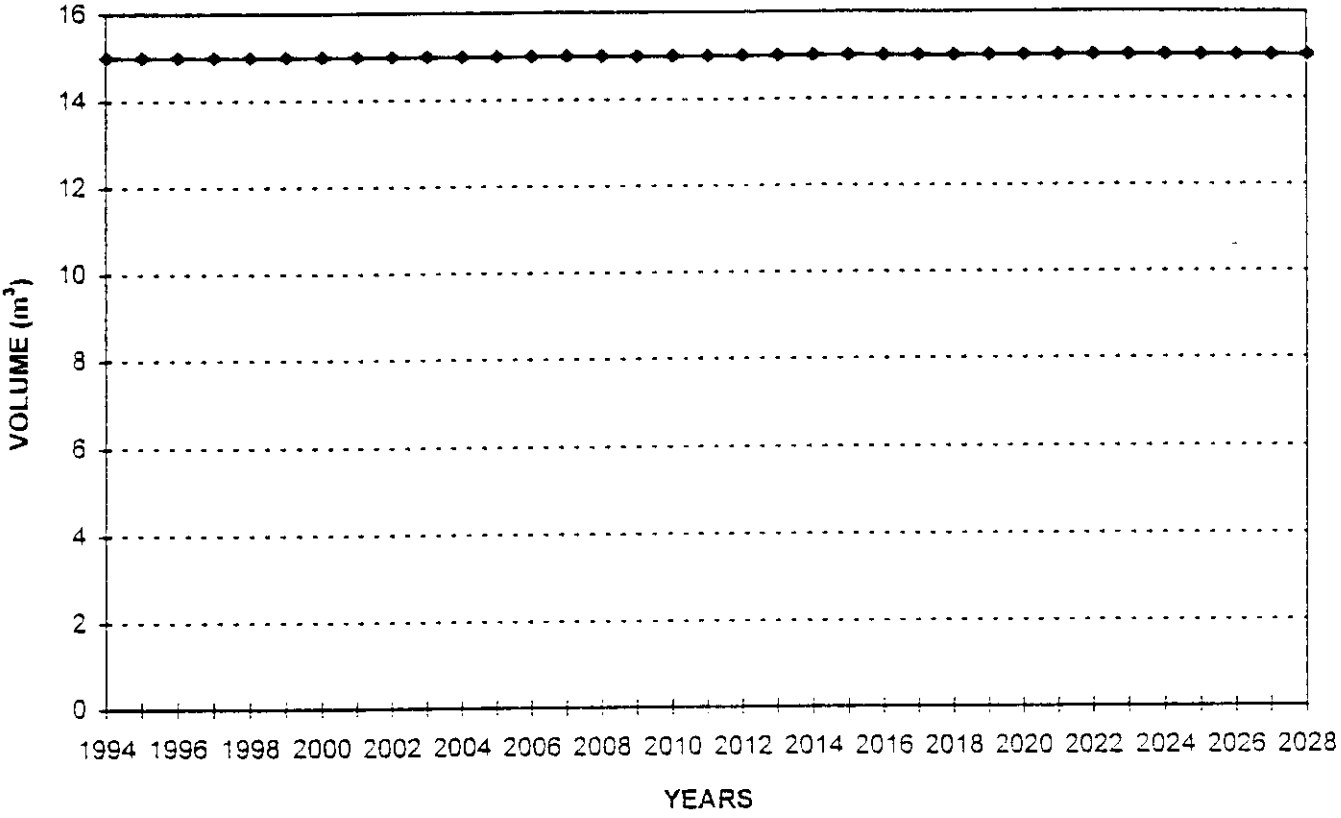


Figure 6.5-9. Alternative 2 Annual Storage Requirements Cesium/Strontium Capsule and Overpack Storage Area.

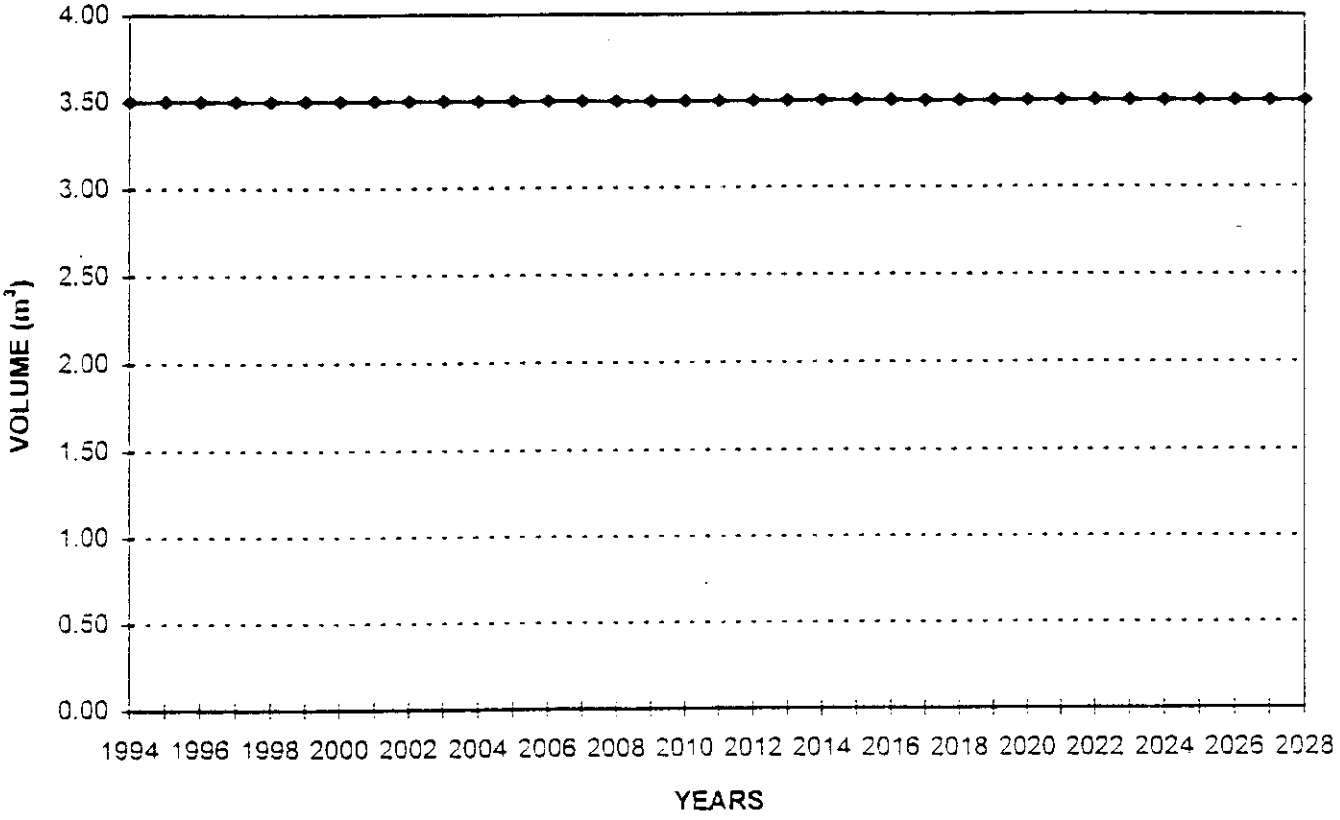


Figure 6.5-10. Module Selection Summary.

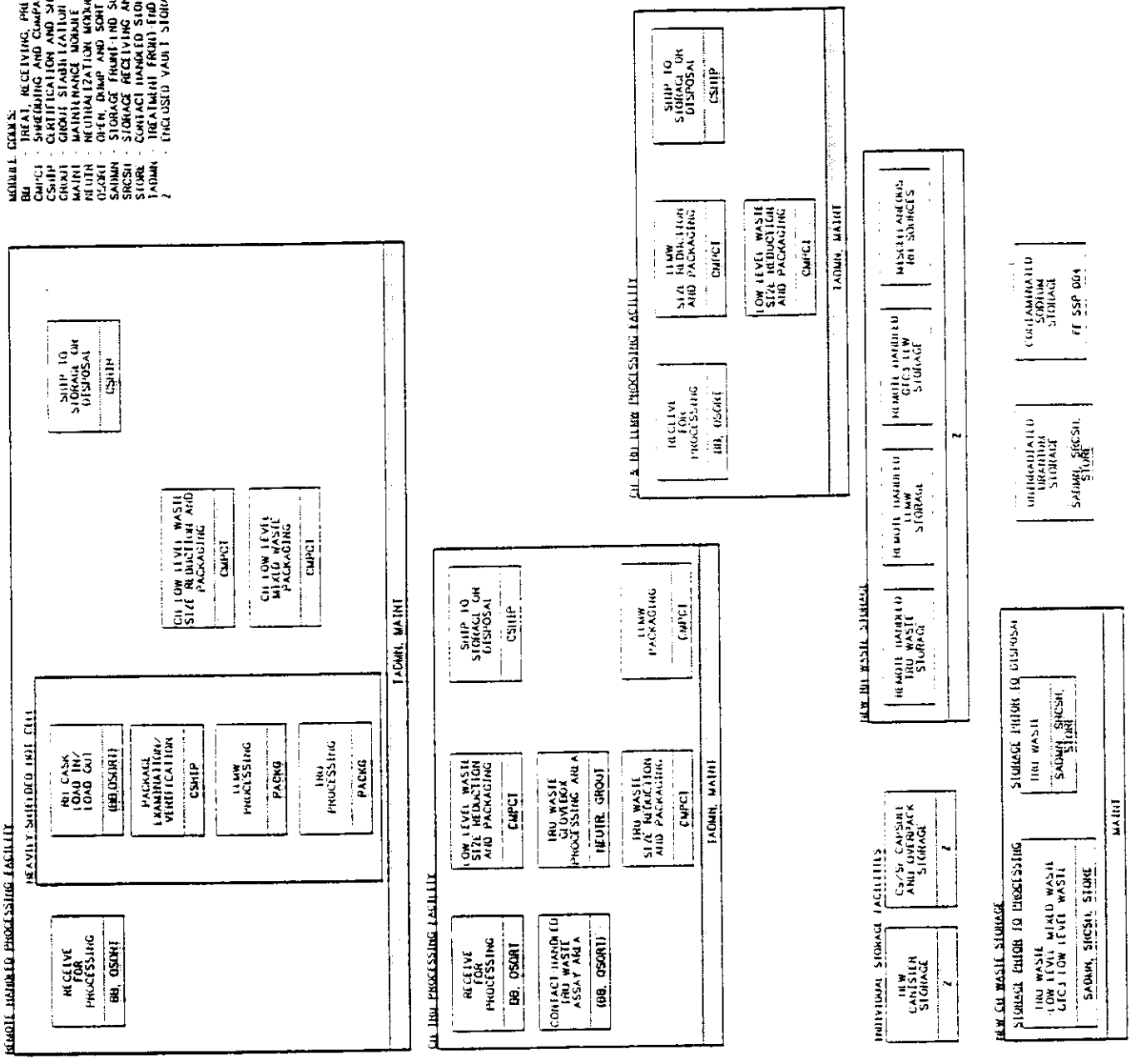
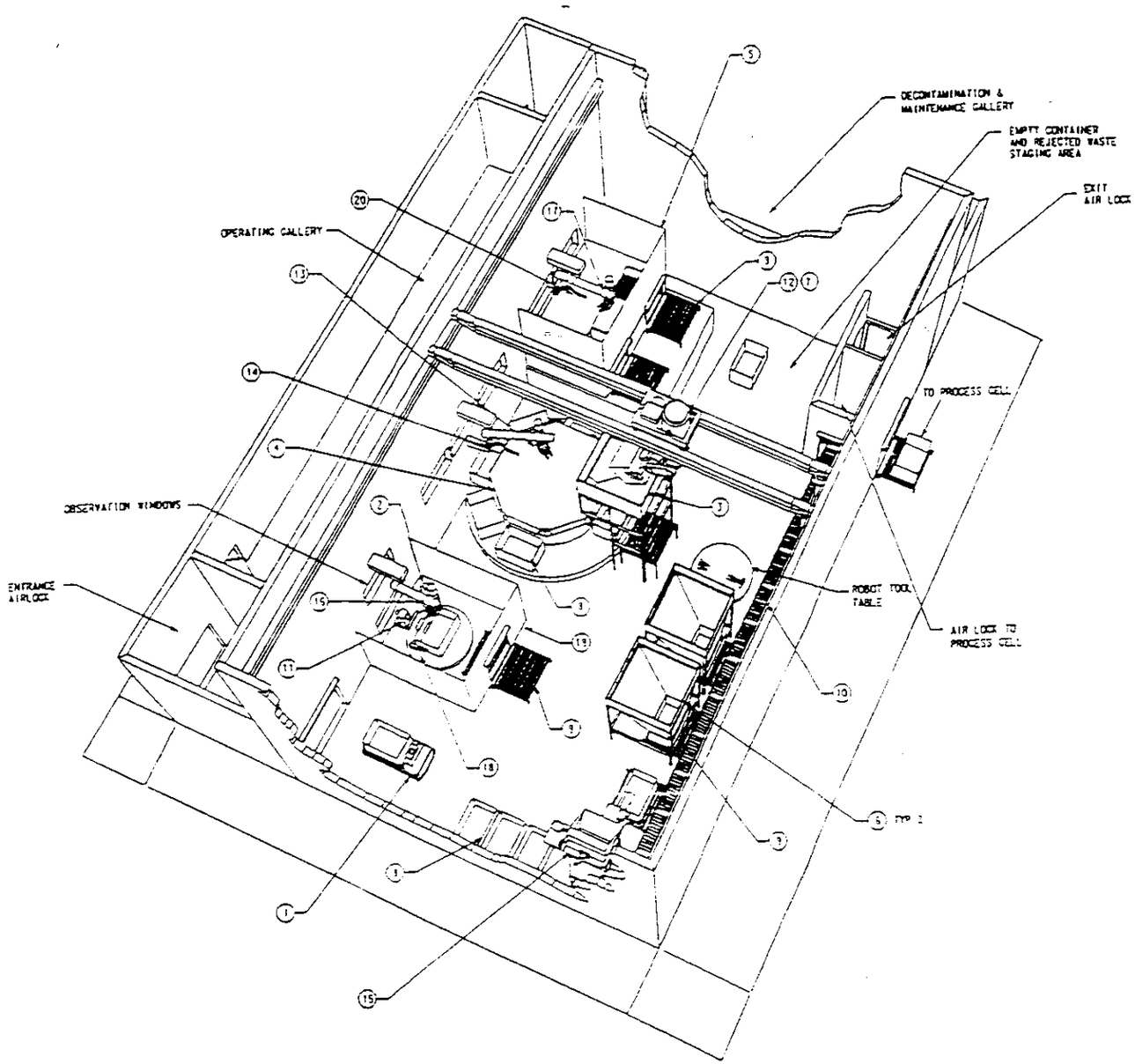


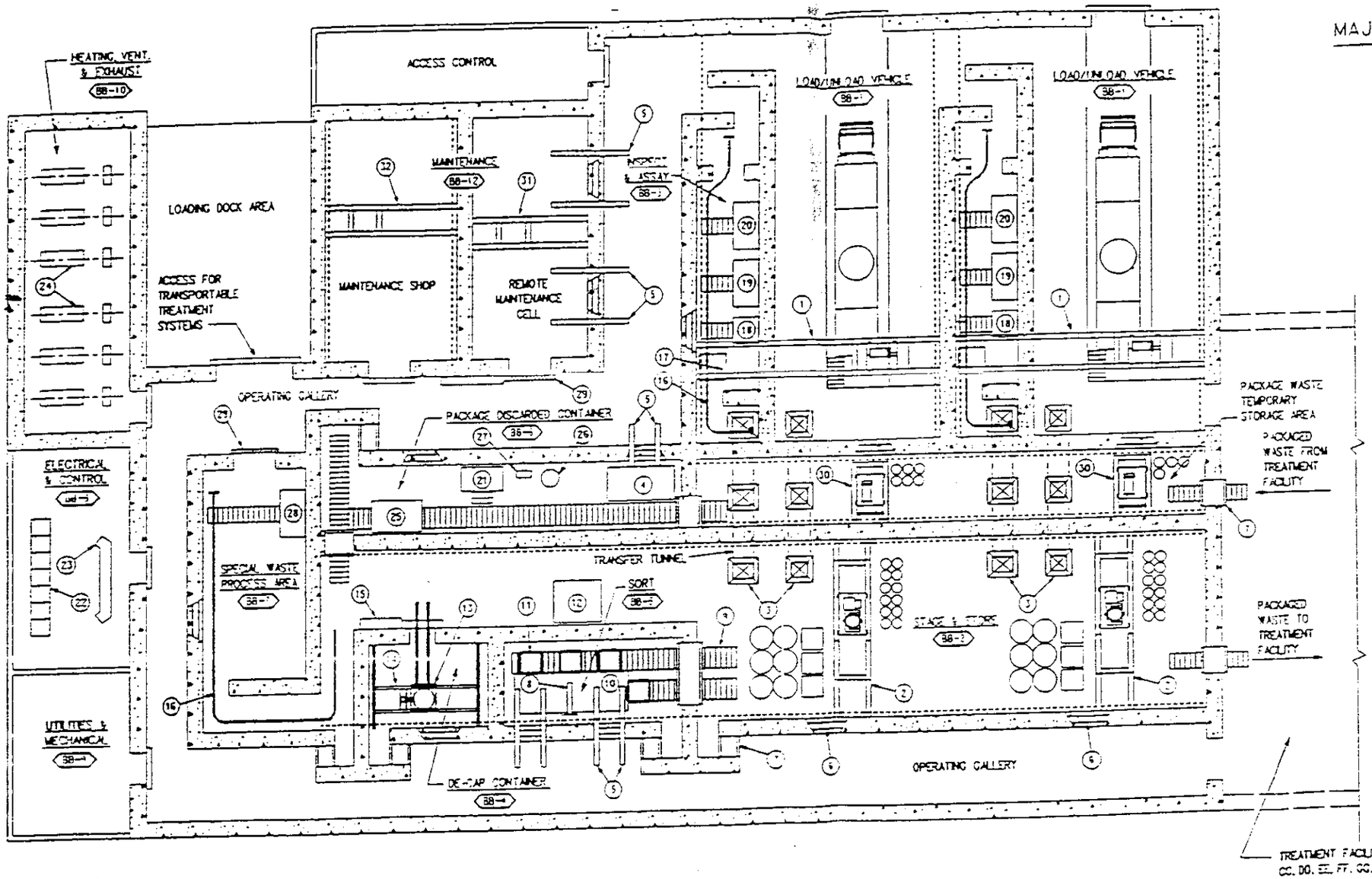
Figure 6.5-11. Open, Dump, and Sort Module.



EQUIPMENT LIST

1. SELF GUIDED VEHICLE
2. DE-CAP DEVICE
3. SORT HOPPER
4. SORT TABLE/ROTATING TABLE
5. SPECIAL WASTE GLOVEBOX
6. DUMP HOPPER
7. MAINTENANCE CRANE
8. BINS (14"X4"X6')
9. BIN CONVEYORS 9' LONG
10. BIN CONVEYOR 70' LONG
11. BIN PUSHER
12. MAIN CELL GANTRY ROBOT
13. SORTING TABLE HYDRAULIC MANIPULATOR
14. SORTING MASTER SLAVE MANIPULATOR
15. BOX SIZE REDUCTION UNIT
16. DRUM OPENING GANTRY ROBOT
17. GLOVEBOX HYDRAULIC MANIPULATOR
18. CONTAINER GRAPPLER
19. DECAP ENCLOSURE
20. GLOVEBOX MASTER SLAVE MANIPULATOR

Figure 6.5-12. Treatment, Receiving, Preparation, and Shipping Module.

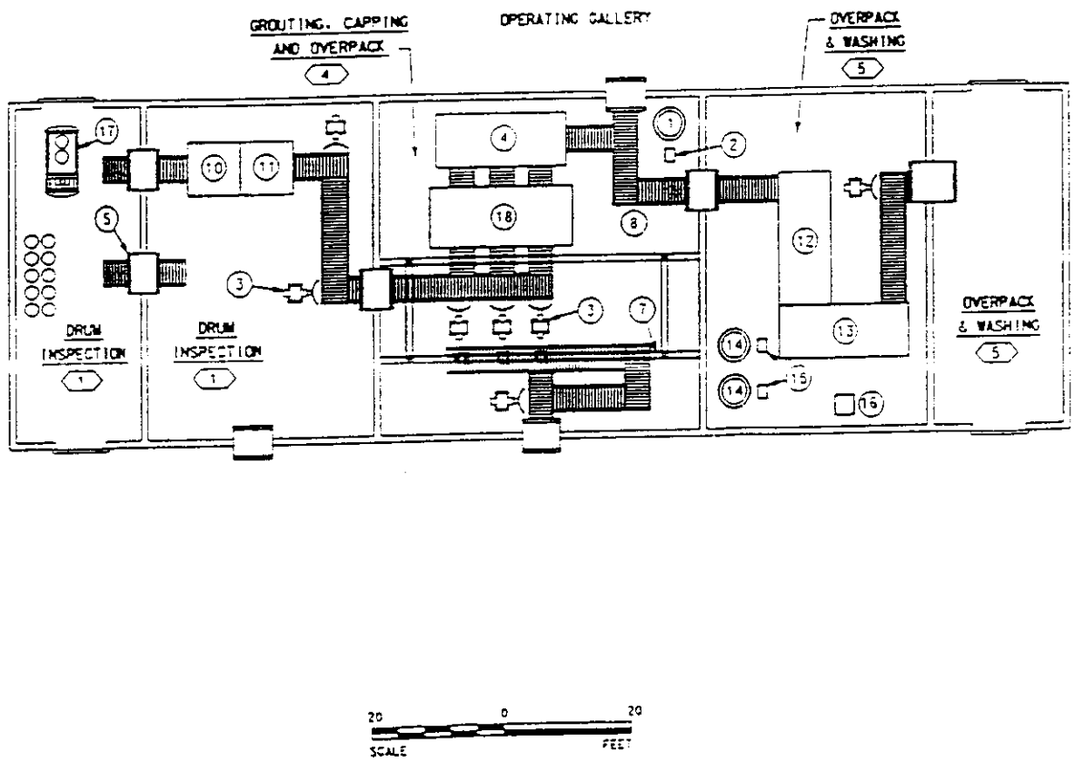


MAJOR EQUIPMENT LIST

1. BRIDGE CRANE 60 TON
2. GANTRY ROBOT 5 TON
3. TRANSPORT CART
4. SIZE REDUCTION DEVICE
5. MASTER-SLAVE MANIPULATOR
6. RADIATION SHIELD WINDOW (TYP.)
7. AIR LOCK (TYP.)
8. HYDRAULIC MANIPULATOR
9. BIN CONVEYOR
10. SORT TABLE
11. TRANSPORT BIN
12. DUMP HOPPER & CHUTE
13. DE-CAP TRASPORT CART & GRIP
14. DE-CAP GANTRY ROBOT/TOOLS
15. DE-CAP AREA SHIELDING DOOR
16. MONORAIL
17. WEIGHING DEVICE
18. ALPHA RADIATION MONITOR
19. GAMMA RADIATION MONITOR
20. REAL-TIME RADIOGRAPHY DEVICE
21. BALER
22. MOTOR CONTROL CENTER
23. MAIN CONTROL PANEL
24. AIR FILTRATION UNIT
25. DISCARDED CONTAINER DECON/RINSE
26. RINSE WATER STORAGE TANK
27. RINSE WATER PUMP
28. PORTABLE GROUTING UNIT
29. SHIELD DOOR/AIRLOCK
30. BRIDGE CRANE 5 TON
31. REMOTE MAINTENANCE CRANE
32. MANUAL MAINTENANCE CRANE

Figure 6.5-13. Packaging Module.

NOTE: AREAS ALLOCATED TO SUPPORT UNIT OPERATIONS ARE NOT SHOWN ON THIS PLAN. ENCAPSULATING AGENT STORAGE & FEED, AND GROUT PREPARATION UNIT ARE NOT SHOWN ON THIS PLAN.



EQUIPMENT LIST

1. GROUT DAY TANK
2. GROUT PUMP
3. DRUM PUSHER
4. OVERPACK CAPPING DEVICE
5. AIRLOCK (TYP.)
6. OVERPACK AND GROUTING SYSTEM
7. OVERHEAD CRANE
8. ROLLER CONVEYOR
9. CHEMICAL MIX TANK
10. CONTAINER ASSAY UNIT
11. GLOVE BOX ASSAY UNIT
12. OVERPACK WASH UNIT
13. DRIER UNIT
14. CHEMICAL STORAGE TANK
15. PUMP
16. BLOWER
17. SELF GUIDED VEHICLE
18. SOLIDIFICATION UNIT

Figure 6.5-14. Certification and Shipping Module.

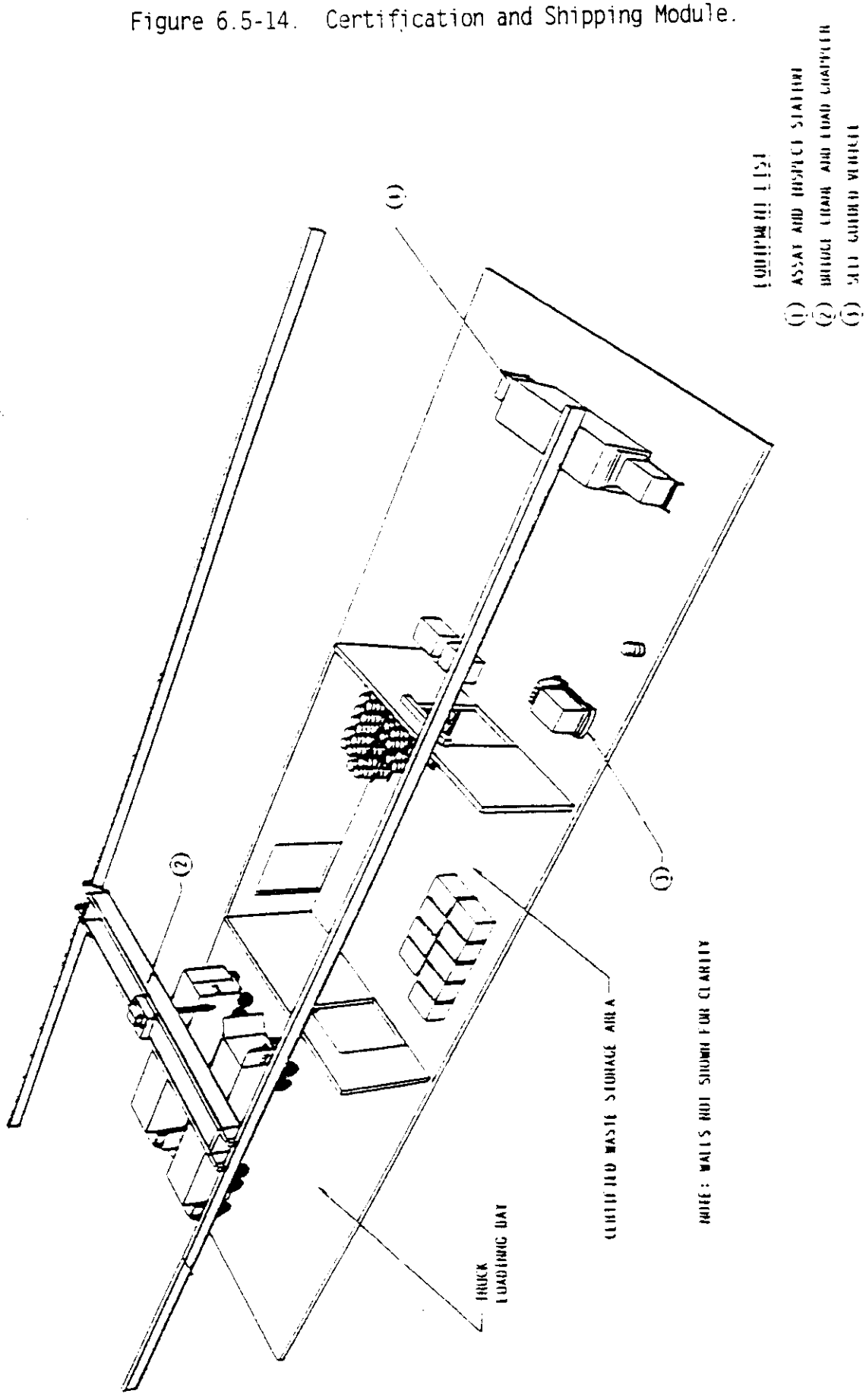


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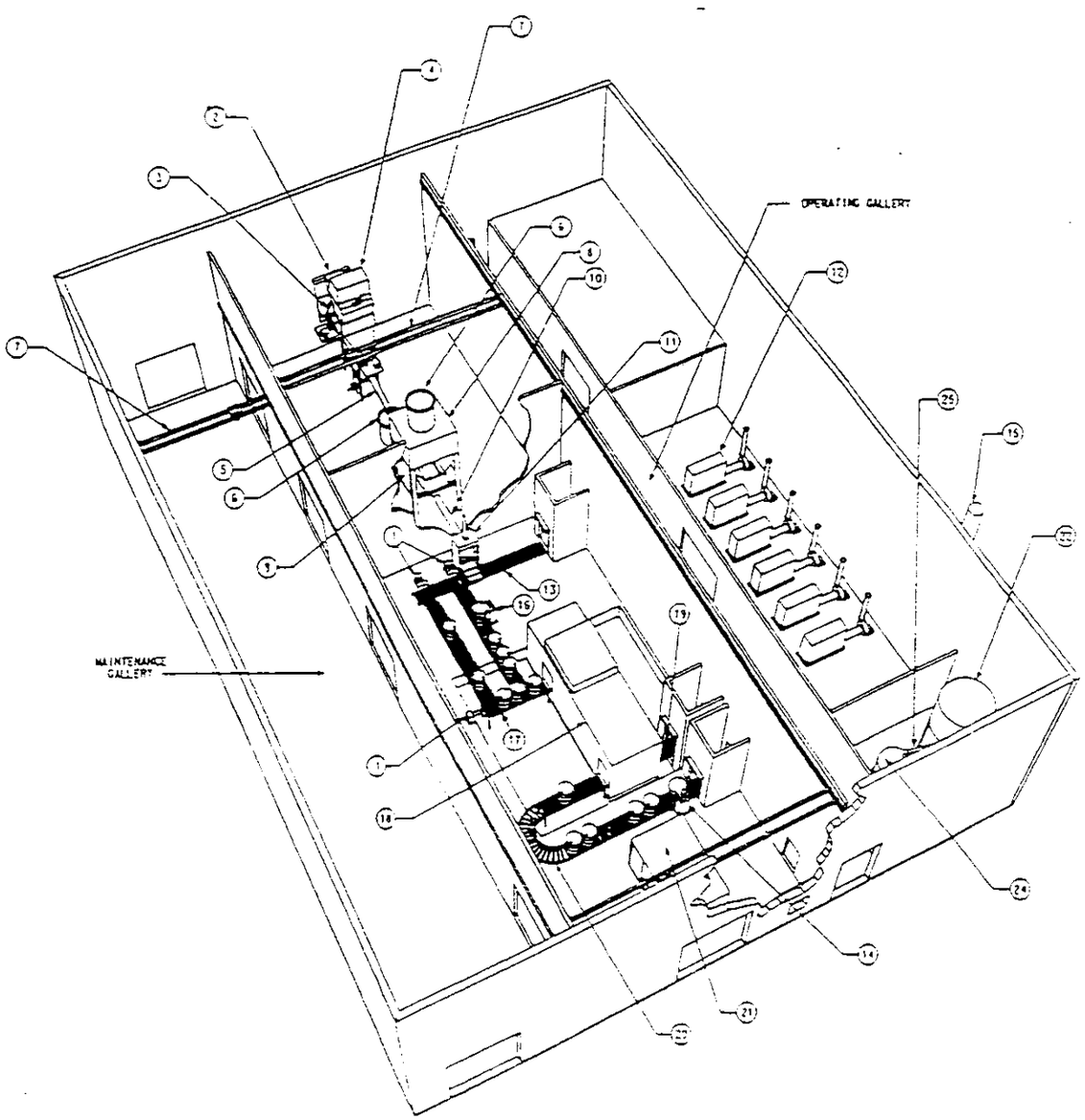
Figure 6.5-15. Shredding and Compaction Module.

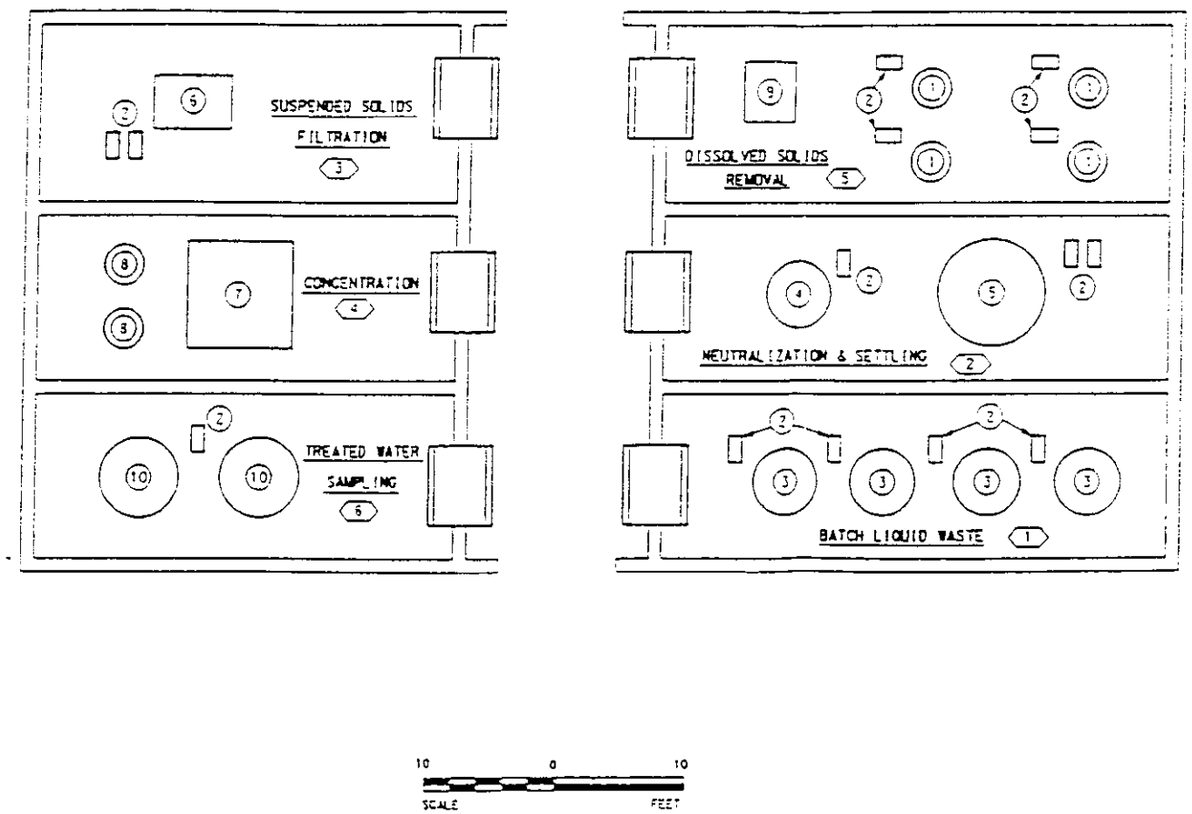


EQUIPMENT LIST

1. DRUM PUSHER
2. INCOMING WASTE BIN
3. SKIP
4. SHREDDER (2) WITH FEED HOPPER, DUST HOOD AND HYDRAULIC RAM
5. AUGER FEEDER
6. WASTE TRANSFER BIN
7. UNDERRUNNING CRANE IN ENCLOSED PROCESS AREA
8. LIVE BOTTOM BULK STORAGE HOPPER
9. TERTIARY SHREDDER
10. AUGER FEEDER
11. SHREDDED WASTE COMPACTOR (30 TON)
12. HEPA FILTER AND FAN
13. DRUM STAGING CONVEYOR (POWERED ROLL)
14. OVERPACK TOP SEAMING STATION
15. STACK
16. DRUM TOP SEAMING STATION
17. [illegible] TOP FEED CONVEYOR (POWERED ROLL)
18. MODULAR SUPERCOMPACTOR UNIT
19. EMPTY OVERPACK STAGING CONVEYOR (POWERED ROLL)
20. SUPERCOMPACTED CONTAINER STAGING CONVEYOR (POWERED ROLL)
21. MODULAR HYDRAULIC POWER UNIT
22. STORAGE BIN
23. DRUM STORAGE CONVEYOR (GRAVITY) (NOT SHOWN)
24. DAY BIN
25. PNEUMATIC CONVEYOR

Figure 6.5-16. Neutralization Module.

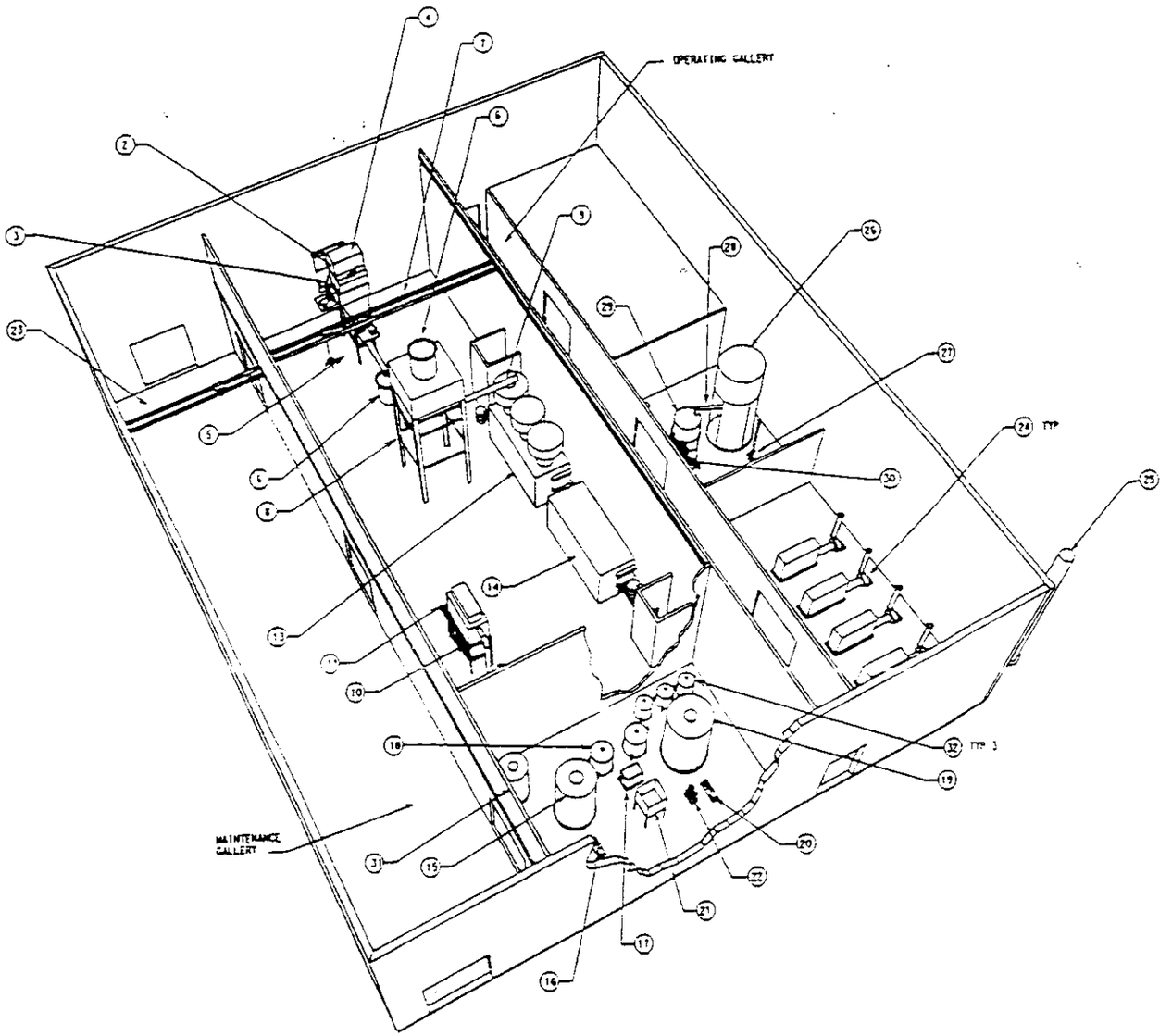
NOTE: AREAS ALLOCATED TO SUPPORT UNIT OPERATIONS ARE NOT SHOWN ON THE PLAN



EQUIPMENT LIST

1. CHEMICAL ADDITION TANK
2. PUMP
3. BATCH HOLD TANKS
4. NEUTRALIZER
5. SETTLER
6. FILTRATION UNIT
7. EVAPORATION UNIT
8. CARBON UNITS
9. ION EXCHANGE UNIT
10. TREATED WATER TANK

Figure 6.5-17. Grout Stabilization Module.



EQUIPMENT LIST

1. DRUM PUSHER
2. INCOMING WASTE BIN
3. BIN HOIST
4. SHREDDER (2) WITH FEED HOPPER, DUST HOOD AND HYDRAULIC RAM
5. AUGER FEEDER
6. WASTE TRANSFER BIN
7. UNDERHUNG CRANE IN ENCLOSED PROCESS AREA
8. LIVE BOTTOM BULK STORAGE HOPPER
9. AUGER FEEDER
10. DUST COLLECTOR, FAN AND HEPA FILTER
11. DRUM STAGING CONVEYOR (POWERED ROLL)
12. DRUM STAGING CONVEYOR (POWERED ROLL)
13. SOLIDIFICATION SYSTEM
14. DRUM CAPPING AND WASHING SYSTEM
15. RECEIVING TANK
16. PUMP
17. FILTER
18. ION EXCHANGE VESSELS
19. TREATED WASTE TANK
20. PUMP
21. SLUDGE TANK
22. PUMP
23. UNDERHUNG CRANE IN ENCLOSED MAINTENANCE AREA
24. HEPA FILTER AND FAN
25. STACK
26. BINDER STORAGE SILO
27. BLOWER
28. PNEUMATIC CONVEYOR
29. DAY BIN
30. DRUM STAGING CONVEYOR (GRAVITY)
31. PRECIPITATION TANK
32. ORGANIC REMOVAL FILTER VESSELS

Figure 6.5-18. Contact-Handled Storage Module.

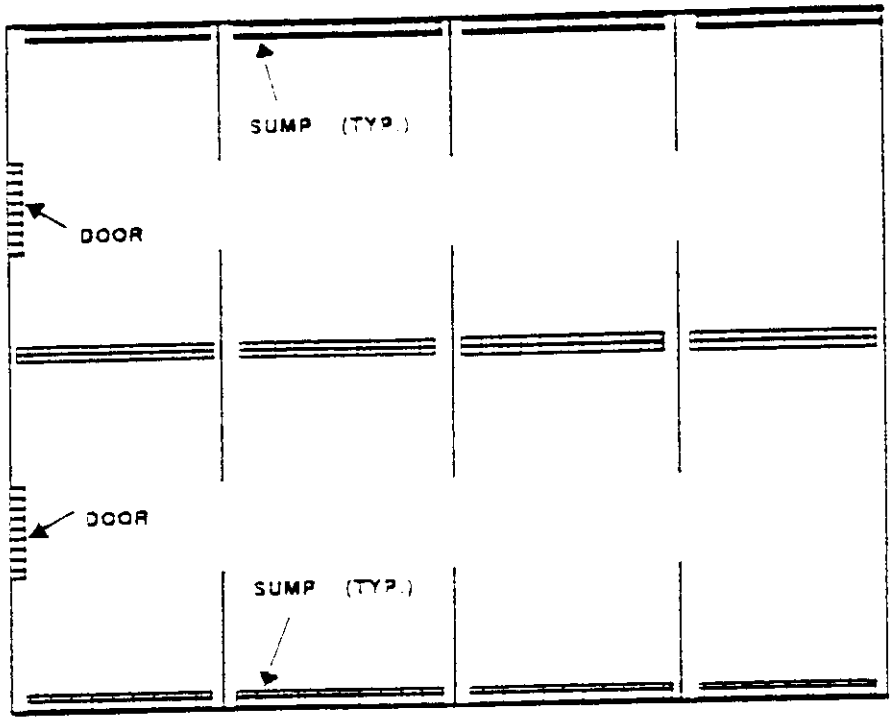


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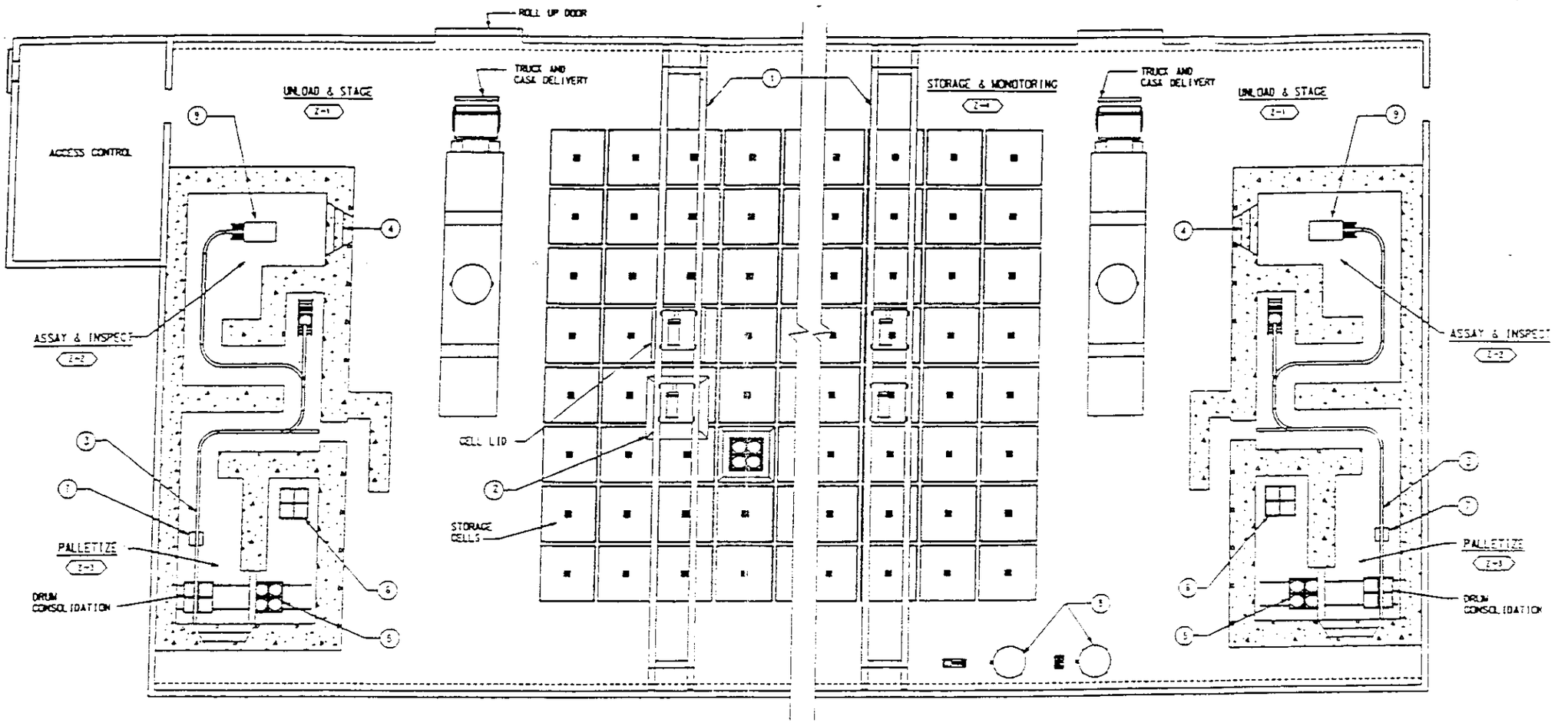
Figure 6.5-19. Vault Storage Module.



NOTES:

1. TO MEET THE STORAGE REQUIREMENTS FOR THE LARGE FACILITY, SEVEN OF THE BUILDINGS SHOWN ABOVE WILL BE REQUIRED. EACH LARGE BUILDING HAS 578 VAULTS.

2. TO MEET THE STORAGE REQUIREMENTS FOR THE SMALL FACILITY, TWO OF THE BUILDINGS WILL BE REQUIRED, WITH THE EXCEPTION THAT THE SMALL BUILDING HAS ONLY ONE TRUCK BAY, ASSAY/INSPECT AND PALLETIZATION AREA. EACH SMALL BUILDING HAS 492 VAULTS

3. ONLY ONE SET OF CRANES, ASSAY/INSPECT AND PALLETIZING SYSTEMS IS PROVIDED. IT IS ASSUMED THAT THESE SYSTEMS WILL BE MOVED FROM ONE BUILDING TO ANOTHER.

LARGE FACILITY FLOOR PLAN

SCALE: 1/8" = 1'-0"

MAJOR EQUIPMENT LIST

1. 30 TON BRIDGE CRANE WITH 10 TON AUX.
2. SHIELD BELL
3. MONORAIL HOIST AND BEAM
4. RADIATION SHIELDING WINDOW (TYPICAL)
5. PALLET TRANSFER CART
6. PALLET
7. PALLET LIFTING RIG
8. LIQUID WASTE COLLECTION
9. INSPECT/ASSAY

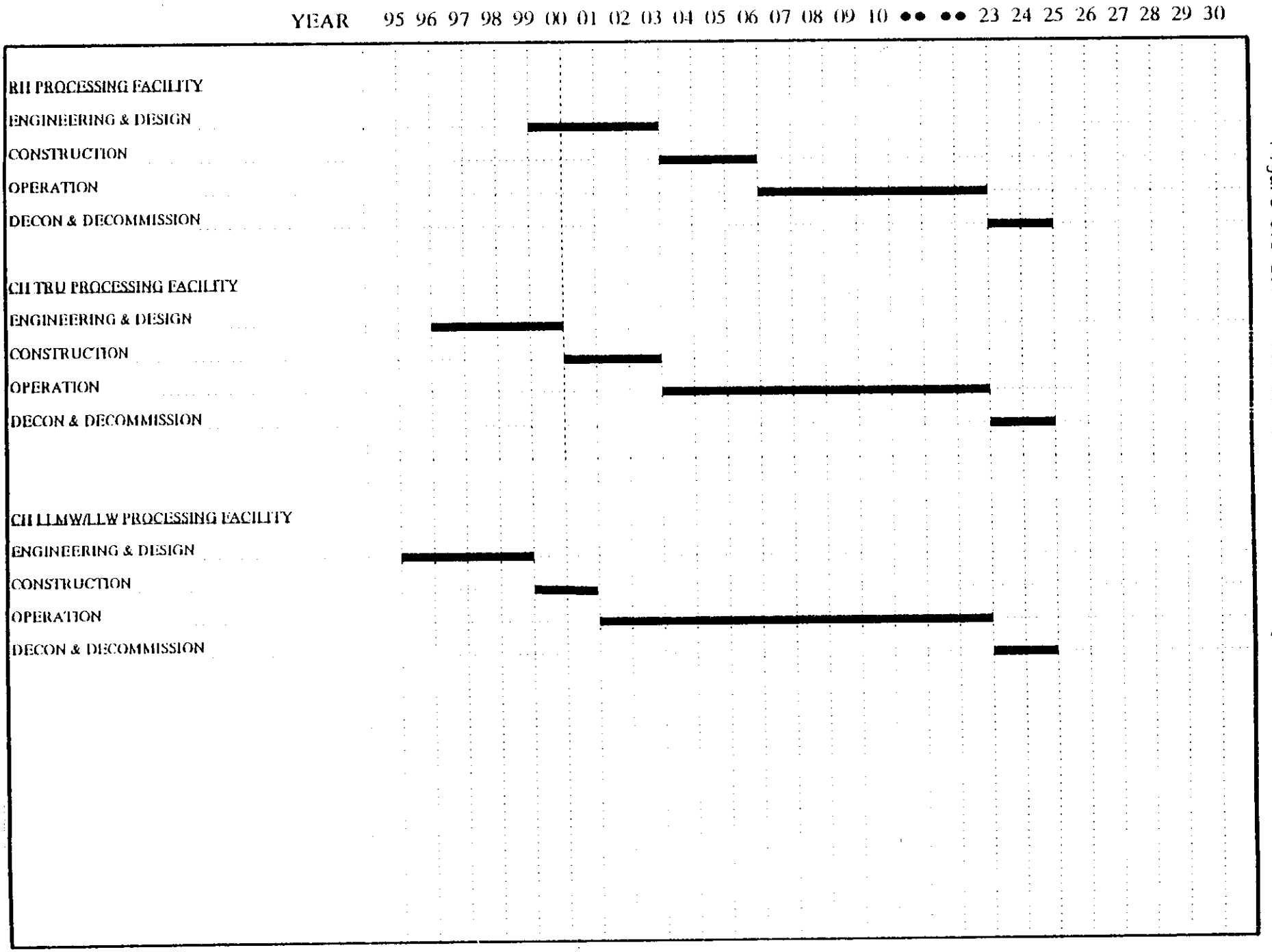


Figure 6.5-20. Alternative 2 Process Facility Schedule.

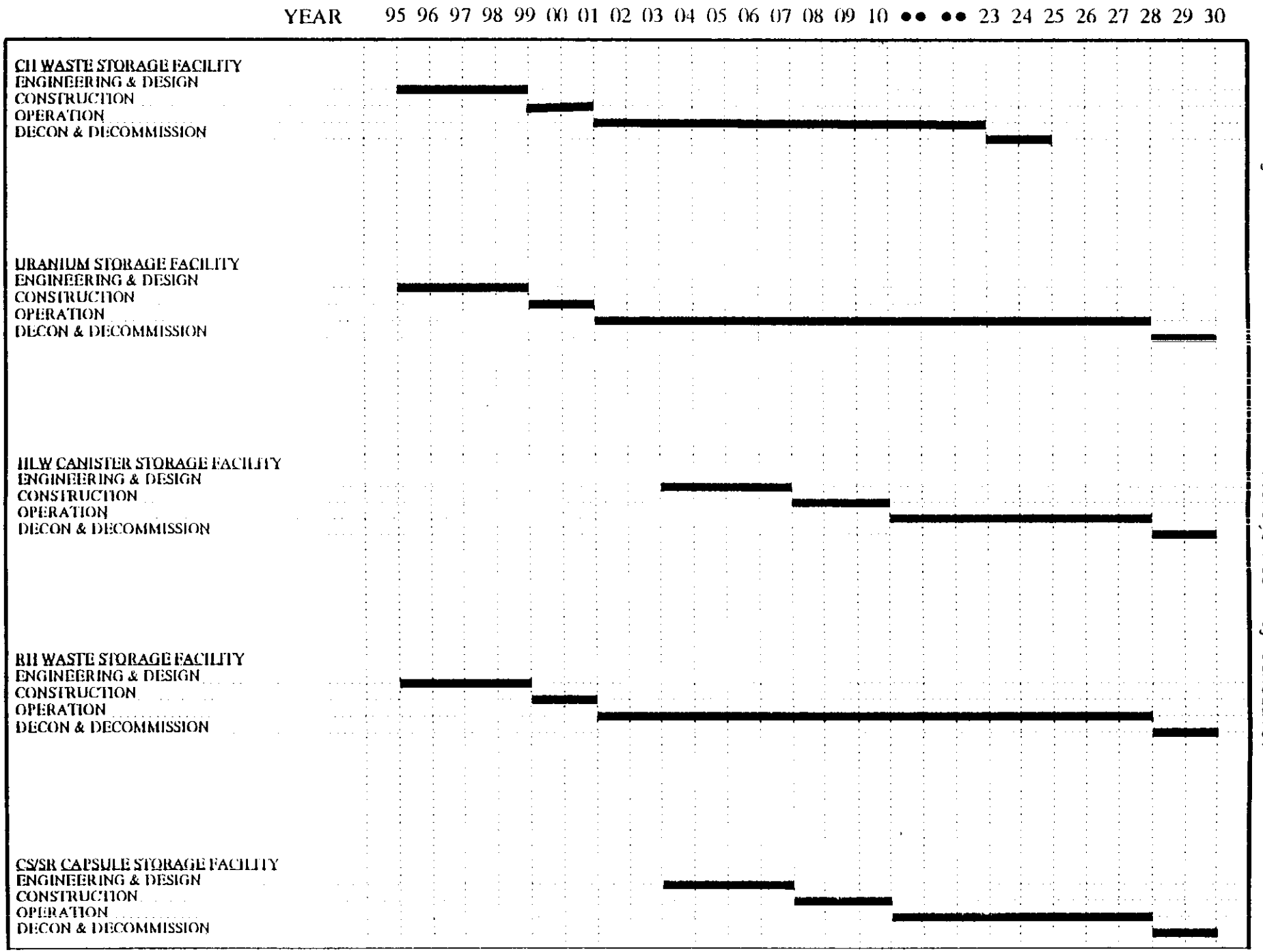


Figure 6.5-21. Alternative 2 Storage Facility Schedule.

Table 6.5-1. Safety Class Summary.

FACILITY	WASTE TYPE	SAFETY CLASS
Processing	All	Safety Class 2
Storage Prior To Processing	Cs/Sr Capsules	Safety Class 2
	All Others	Safety Class 3
Storage Prior To Disposal	HLW Canisters and Cs/Sr Capsules	Safety Class 2
	All Others	Safety Class 3

Table 6.5-2. Alternative 2 Facility Summary.

FUNCTION	FACILITY	SIZE m^2 (ft^2)
Processing	Remote Handled	1,346 (14,481)
	Contact Handled TRU	1,569 (16,879)
	Remote and Contact Handled LLMW/LLW	3,055 (32,868)
	TOTAL	5,970 (64,228)
Remote Handled Storage	HLW Canisters	3,270 (35,185)
	RH (General)	7,249 (78,030)
	Cs/Sr Capsule + Overpack	9 (100)
	TOTAL	31,072 (334,467)
Contact Handled Storage	TRU/LLMW/GTC3-LLW	2,662 (28,653)
	Unirradiated Uranium	6 (65)
	TOTAL	5,938 (63,918)
GRAND TOTAL		62,434 (672,056)

Table 6.5-3. Alternative 2 Cost Summary.

BREAKDOWN OF ALTERNATIVE 2 FACILITY COSTS

ALT. 2 TEC	BUILDING NAME	SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	18,101	2,492	45,101,000	15,829,721	60,930,721	22,529,142	83,459,864
2	CH TRU PROCESSING FACILITY	21,099	2,444	51,557,000	13,264,327	64,821,327	23,962,053	88,783,380
3	CH LLMW/LLW PROCESSING FACILITY	41,085	2,302	94,565,000	24,320,664	118,885,664	324,995,431	1,203,947,423
5	RLW CANISTER STORAGE	170,400	3,344	569,866,000	309,085,992	878,951,992	324,995,431	1,203,947,423
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	299,830	2,202	660,102,000	169,443,486	829,545,486	306,639,299	1,136,184,785
9	CS/SR CAPSULE AND OVERPACK STORAGE	1,128	3,095	3,491,000	837,137	4,328,137	1,600,181	5,928,317
11	NEW CH WASTE STORAGE	301,280	145	43,686,000	11,215,388	54,901,388	20,299,436	75,200,823
12	UNIRRADIATED URANIUM STORAGE	24,000	145	3,480,000	825,644	4,605,644	1,591,749	5,897,393
	TOTAL	876,923	1,678	1,471,848,000	544,822,359	2,016,670,359	745,562,380	2,762,232,739

TEC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, AND WHC PM

ALT. 2 TPC	BUILDING NAME	SQFT	DIRECT COST/SF	DIRECT DOLLARS	ESCALATION TOTAL	ESCALATED DOLLARS	CONTINGENCY DOLLARS	TOTAL DOLLARS
1	REMOTE HANDLED PROCESSING FACILITY	18,101	3,488	63,142,000	20,691,300	83,833,300	29,399,916	113,233,216
2	CH TRU PROCESSING FACILITY	21,099	3,421	72,179,000	16,926,493	89,105,493	31,247,303	120,352,797
3	CH LLMW/LLW PROCESSING FACILITY	41,085	3,222	132,391,000	31,104,953	163,495,953	57,328,176	220,824,129
5	RLW CANISTER STORAGE	170,400	4,682	797,812,000	402,747,161	1,200,559,161	421,477,581	1,622,036,743
6,7,8,10	REMOTE HANDLED TRU WASTE STORAGE REMOTE HANDLED LLMW STORAGE REMOTE HANDLED GTC3 LLW STORAGE MISCELLANEOUS RH SOURCES	299,830	3,082	924,143,000	217,255,246	1,141,398,246	400,195,127	1,541,593,373
9	CS/SR CAPSULE AND OVERPACK STORAGE	1,128	4,333	4,888,000	1,061,030	5,949,030	2,086,449	8,035,478
11	NEW CH WASTE STORAGE	301,280	203	61,160,000	14,354,120	75,514,120	26,483,255	101,997,375
12	UNIRRADIATED URANIUM STORAGE	24,000	203	4,872,000	1,050,850	5,922,850	2,076,911	7,999,761
	TOTAL	876,923	2,350	2,060,587,000	705,191,153	2,765,778,153	970,294,718	3,736,072,872

TPC COSTS INCLUDE: ENGINEERING, CONSTRUCTION, CONSTRUCTION MANAGEMENT, WHC PM AND OPC

OM&R LCC		1,279,340,000	1,033,093,890	2,312,433,890	693,730,167	3,006,164,057
D & D		318,972,000	583,968,920	902,940,920	370,854,663	1,273,795,583

Table 6.5-4. Alternative 2 Facilities, Schedules, Capacities, and Waste Streams.

Facility	Schedule	Annual Processing and Storage Capacities (m^3)	Waste Streams	Capacity Allocation by Waste Stream [a]
RH-TRU Processing Facility	2006-2023	2,370	RH-TRU RH-TRUM RH-TRU-SUSPECT Cs/Sr Capsules Misc. Material	14% 59% 2% <1% <1%
CH-TRU Processing Facility	2003-2023	2,350	CH-TRU CH-TRUM CH-TRU-SUSPECT	23% 27% 50%
RH and CH-LLMW Processing	2001-2023	4,850	CH-LLMW RH-LLMW	6% 94%
HLW Canister Storage	2010-2028	8,750	Canisters	N/A
RH-TRU Storage	1994-2023	20,600	RH-TRU RH-TRUM	N/A
RH-LLMW Storage	1994-2023	11,400	RH-LLMW	N/A
RH-GTC3 Storage	1994-2028	42,00	RH-LLMW-GTC3 RH-LLW-GTC3	N/A
Cs/Sr Capsule and Overpack Storage	1994-2023	4	Cs/Sr Capsules	N/A
Miscellaneous RH Material Storage	1994-2028	15	Misc. RH Material	N/A
New CH Waste Storage	1994-2023	48,800	CH-TRU CH-TRUM CH-LLMW CH-LLW GTC3 CH-LLMW GTC3	N/A
Unirradiated Uranium Storage	1994-2028	144	Unirradiated Uranium	N/A
Contaminated Sodium Storage	2008-2028	177	Sodium	N/A

[a] Capacity allocation to waste streams is based on total throughput volumes and may vary annually.

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6.6.1 PROCESS LOGIC FOR ALTERNATIVE 3

Figure 6.6.1-1 shows the basic flow path each waste stream must follow to reach disposal. To move from this basic process flow diagram to a facility-by-facility analysis, some basic assumptions were made. Basic assumptions used in evaluating waste stream treatment and disposal are presented in this section. Volumes, packaging requirements, and treatment rates are shown; assumptions associated with these activities are identified.

6.6.1.1 Basic Assumptions for Alternative 3.

6.6.1.1.1 General.

- All indicated waste volumes include packaging, except as noted. Interim storage is provided for all treated waste streams through the year 2028 except for those streams going directly to the low-level waste (LLW) burial ground. Interim storage volumes prior to disposal include packaging. The envelope volumes" for storage include space for container/package handling as noted.

- All existing Hanford requirements for waste from packaging are to be met (i.e., weight limitations, free liquid/absorbent limitations and requirements, sharp edges being covered, smearable surface contamination, void space, etc.). Waste contents received for interim storage or processing are assumed to be characterized. Containers received will have inventory sheets and radionuclide/hazardous constituents will be identified on a SDAR or equivalent.

- Process and treatment rates are based on facility operations until the year 2023 with the first three years of start-up at a reduced throughput: 25% of capacity the first year; 50% of capacity the second year; 75% of capacity the third year; and 100% of capacity through the year 2023. Operations are based on a five day work week with 35 actual work weeks per year. As a minimum, material handling equipment will be sized for 125% of design capacity. Some operations such as High-Level Waste (HLW) canister receiving will continue for 19 years, and cesium (Cs) and/or strontium (Sr) capsule overpack placement will be completed in one to two years. The processing of sodium is planned for a two year time frame.

  The estimated annual treatment rates for LLMW and TRU waste are shown in Table 6.6.1-1.

- Overpacking of Cs and Sr capsules is not in the scope of this analysis. Other activities, including the transportation cask loadout at the WESF and the receipt at the interim storage facility, are addressed. All operations will be all remote-handled.

- The Greater Than Category 3 (GTC-3) will be handled remotely. The miscellaneous sources will be handled remotely including cask load-in, packaging, loadout and receipt at the interim storage facility.

- Unirradiated uranium will be treated and handled as material, with storage provided.

- Regulatory issues and uncertainties of permitting are addressed in Exhibit 6.6.1-1. The status of each of these issues should be ascertained for each facility identified for processing the waste streams.

6.6.1.1.2 LLW and Hazardous Only Waste.

- All LLW and hazardous only waste in small boxes and drums will be processed and disposed of outside the scope of M-33.

6.6.1.1.3 TRU.

- All CH TRU waste in containers of less than 1.89 m^3 in volume (equivalent to seven 200-liter drums) will be processed at the WRAP-1 facility. This processing is outside this work scope.

- The TRU category of waste has been subdivided into TRU, TRUM, and Suspect TRU. The estimated total RH and CH TRU waste volume is 73,210 m^3. The estimated volume of RH TRU in containers is 41,696 m^3, with 31,514 m^3 as CH TRU. The RH TRU stream includes approximately 9,700 m^3 of Long-Length Contaminated Equipment (LLCE) from the tank farms. It is assumed that the Waste Isolation Pilot Plant (WIPP) will receive a "no-migration" determination to allow disposal of TRUM. Volume estimates are still being refined.

- This analysis excludes pre-1970 buried TRU waste and TRU contaminated soil.

- Processing for RH TRU and CH TRU in large containers will include the following steps for TRUM: (1) Unpacking, assaying, size-reduction, and fixation of RH TRU; and (2) Packaging and assaying to allow shipment to WIPP. Processing steps for CH TRU and Suspect TRU include: Unpacking, assaying, size-reduction, repackaging, and assaying to allow shipment to WRAP-1. Some overpack containers will be decontaminated and recycled. Lead shielding is not utilized for TRU (and LLMW) packaging.

6.6.1.1.4 Low-Level Mixed Waste.

- All CH LLMW in small containers [less than 6.3 m (1.5 m x 1.5 m x 2.7 m)] will be processed at the WRAP-2A and is outside the M-33 scope.

- Forecast RH LLMW includes equipment from PUREX, B Plant, T Plant, U Plant, and the Tank Farms; it also includes LLCE items more than 20 ft. (6.096 m) long. The LLCE items will be removed from Single-Shell Tanks (SSTs) and Double-Shell Tanks (DSTs) in the Tank Farms. It is assumed there will be approximately 2,000 LLCE items, with a corresponding volume of approximately 87,000 m^3 total, including shipping containers. Indicated total volume for LLCE is assumed to include a void volume of approximately 50%, and an equipment envelope volume of approximately 25%. The current waste stream includes 97,760 m^3 of RH LLMW and 1,630 m^3 of CH LLMW.

- Processing for RH LLMW and CH LLMW in large containers (greater than 576 cu. ft. or 16.31 m^3) will include: (1) Segregation of LLW and LLMW; (2) Size-reduction to fit the appropriate container; (3) Grout or

polyethylene extrusion to encapsulate RH LLMW; and (4) Final packaging of LLW and LLMW containers. The LLMW will not be decontaminated to allow further segregation of LLW from the LLMW stream. Size-reduced waste from the CH LLMW stream will be packaged in 55-gal (200-L) drums for storage and shipment to WRAP-2A. Outer shipment containers will be decontaminated and reused.

- Treatment options for LLMW are limited to sorting, disassembly, size-reduction by cutting, grout and polyethylene encapsulation processes, and repackaging. Size-reduction options are limited to existing practices such as saw cutting, shearing, or ultra high-pressure water. The decontamination technologies such as water-wash, electrochemical treatment, and ice- or CO_2 pellet-blast may be added to the system to reduce the LLMW volume, but are not currently considered in the waste processing model, which was adopted for this study. The RH TRU and RH LLMW will be handled remotely in hot cells. The CH TRU and CH LLMW streams will be processed in the same processing line used for RH TRU and RH LLMW, respectively.

- The Clem Report (WHC-SD-ES-303, Rev 0, Westinghouse Hanford Company, November 1994) was used to calculate an average volume per item for the LLCE. The average volume has been determined to be 202 cu. ft. (5.72 m^3) per item, with 2,000 items in the LLCE portion of the RH LLMW stream; actual waste volume is a small percentage of the volume estimate of 87,773 m^3 used in this analysis. Final disposal volume is assumed to be approximately 12,000 m^3 without size-reduction, and significantly less with size-reduction. If the grout facility is used for storage, this is assumed to be final storage with the vaults being filled with grout after each layer of LLCE segments is added.

  Exhibit 6.6.1-2 provides a simple statistical analysis of the LLCE as described in the Titzler report. Based on six standard-size containers for LLCE, the average equipment piece had a volume of approximately 3% of the container volume (which increased from 87,773 m^3 to 102,268 m^3), with a maximum equipment envelope volume of approximately 14.5%.

  Data review indicated a maximum allowable envelope volume per container of approximately 30% of the exterior volume; however the largest equipment item (per container) had an average volume of approximately 18%. The expected hard volume of equipment is close to 7% of the container volume.

6.6.1.1.5 Greater than Category 3 LLW and LLMW.

- Waste classified as Greater Than Category 3 LLW (GTC-3) includes both RH and CH LLMW and LLW. The only requirement for this waste category is interim storage prior to processing and/or disposal.

- The total estimated GTC-3 waste volume is approximately 89,200 m^3, all of which is forecasted. Most of this waste stream is LLW. The GTC-3 waste stream will be in 200-L drums, 4-ft x 4-ft x 8-ft boxes (3.62 m^3), and miscellaneous boxes. The waste stream will begin to accumulate in 1997, although some waste may already be in storage. Storage requirements are assumed to be a Safety Class 3 building, with adequate ventilation and security. Storage of LLMW from the GTC-3 stream must

also meet waste segregation and secondary containment requirements of 173-303 WAC. Storage requirements are assumed to be 4-ft x 4-ft x 8-ft boxes (128 cu. ft. or 3.62 m^3) stacked two high for LLW, and 1.5-m x 1.5-m x 2.7-m steel boxes or 200.1 liters for LLMW. The storage facility will allow for 100% excess space for access ways and aisles. The initial storage area is assumed to contain 25,000 boxes. Surface area for each box is assumed to be 2.97 m^2, with a required building floor area of 75,000 m^2.

6.6.1.1.6 Sr and Cs Capsules.

- The WESF fabricated 2,217 Cs and Sr capsules, starting in the late 1970s. Total inventory includes 1,577 Cs and 640 Sr capsules. Some capsules are located at different storage facilities, including Pacific Northwest Laboratories (PNL) and off-site facilities. Capsules not at WESF are being recalled from commercial use after a leaking capsule was detected at an off-site commercial facility. The WESF currently has 1,089 Cs and 635 Sr capsules. To date, 245 Cs and 30 Sr capsules have been cut or destroyed.

- Capsules are made of two concentric tubes that provide double containment of the radioactive CsCl and SrF_2 salt materials. The inner containers of the Cs (Sr) capsules are 5.72 cm (2.25 in.) in diameter, 48.39 cm (19.05 in.) in length; and 5.72 cm (2.25 in.) in diameter, 50.10 cm (19.725 in.) in length, respectively. The outer Cs (Sr) containers are 6.67 cm (2.625 in.) in diameter, 51.05 cm (20.10 in.) in length and 6.67 cm (2.625 in.) in diameter, 52.77 cm (20.775 in.) in length respectively. Average, worst-case heat dissipation rate is assumed to be 195 watts for Sr capsules, and 146 watts for Cs capsules in the year 2006.

- The 275 capsules that have been cut or destroyed will require packaging for shipment to an interim storage facility or for continued storage at WESF.

- All canisters are to be overpacked if shipment to interim storage is required. The interim storage facility must be capable of placing canisters in overpacks that are specially designed canisters designed for heat dissipation, secondary containment, and shipment to an off-site repository.

- It is theoretically possible to dry-store capsules if core temperatures are kept below an acceptable threshold. Total heat generation rate of the capsules is approximately 360,000 watts (at the end of year 2005), excluding safety factors. Alternative 3 outlines the use of FMEF as an interim storage location, where capsules would be housed in storage tubes originally intended for dry storage of high-Pu-content spent fuel. Preliminary calculations indicate dry storage in these storage tubes at FMEF is feasible with forced-air convection cooling. More detailed information on ranges of heat generation rates of individual capsules (only average values are currently available), and more elaborate heat transfer calculations would be required to verify cooling capacity in a natural-convection, passive cooling mode (WHC-EP-0616, Rev.0, Westinghouse Hanford Company).

6.6.1.1.7 HLW Canisters.

- The HLW canisters (from vitrification) require storage prior to disposal only. Canister volumes are assumed to be 1.26 m^3 and produced at a rate of 358 per year for a 19-year period. The estimated number of canisters is 6,802. The indicated volume is for canisters only. The LLW vitrified waste canisters are excluded from this analysis.

- The HLW Canisters are assumed to be 686 mm in diameter by 4.57 m in height (2.25 ft. in diameter with an overall height of 15 ft.). Each canister has a weight of approximately 3.35 Tonnes (7,300 lbs). The heat-generation rate is estimated at approximately 77 watts per canister. This estimate was developed in back-of-the-envelope calculations.

- Any high level waste remaining in a failed melter will be removed by TWRS. The melters will be disposed as low level waste. The melters will not have any hazardous characteristics once the high level waste is removed. Failed HLW vitrification melters, since they are strictly low level waste are excluded from this analysis.

6.6.1.1.8 Miscellaneous Material.

6.6.1.1.8.1 Contaminated Metallic Sodium. There are two sources of spent contaminated sodium listed in the current waste inventory. These streams are the Hallam Nuclear Power Facility (HNPF) at 144 m^3 and Sodium Reactor Experiment (SRE) at 33 m^3. The HNPF sodium is being stored in five 15,000-gallon, 56,775 liter tanks at the 2727-W Building. The SRE sodium is being stored in 158, overpacked 55-gal (200 liter) drums at CWC. The sodium has been in storage since 1977 and 1967, respectively. The sodium is being held for future use. The total quantity of sodium is 177 m^3.

6.6.1.1.8.2 Unirradiated Uranium. The inventory of unirradiated uranium (UU) consists of depleted, natural, and low-enriched material in various forms such as the following:

- Completed fuel assemblies;
- Unfinished fuel assemblies;
- Metal billets and slabs;
- Trioxide powder;
- Dioxide powder and pellets; and
- Thorium oxide.

This material is stored in wooden or metal boxes, 55-gal (200-liter) drums, and T-hoppers. Powder and pellets are stored in cans, pins, assemblies and drums. The material is stored in various Hanford Site locations in the 200 West, 300 and 400 Areas. Some containers and fuel assemblies may have surface contamination. Except for the possible decontamination of external surfaces, treatment is not anticipated for this waste form. Minimum requirements are for consolidation of the IR to a single location and holding for possible sales.

6.6.1.1.8.3 Miscellaneous Sources. This waste stream consists of approximately 15 m^3 of various material forms encompassing powders (fines), residues, reactor parts, and borosilicate glass canisters. The waste is considered LLW, LLMW and RH TRU (which may be glove box components). These waste forms are stored in various buildings in the 300 Area. Activities

associated with this waste form are limited to packaging and interim storage prior to disposition. Table 6.6.1-2 indicates estimated quantities of the miscellaneous sources. Storage volume requirements have not been determined but considering requirements for shielding, the assumed volume increase is by a factor of 4.

6.6.1.1.9 **Metallic Sodium**. The contaminated Hallam and SRE sodium will be processed as planned under the Hanford Site Sodium Management Plan. Requests for off-site treatment for use or disposal is being evaluated. The second option will evaluate the potential for on-site use of sodium byproducts. The third disposition option is to react the sodium in the FFTF Sodium Reaction Facility when it is available.

6.6.1.1.10 **Container Sizes**. Specifications for typical containers used for receiving and shipping of waste types are listed in Table 6.6.1-3.

6.6.1.2 General Characteristics of Waste Streams to be Processed.

6.6.1.2.1 **TRU Characteristics**. The RH and CH TRU contain TRU, TRUM, and Suspect TRU. The Suspect TRU waste to be retrieved may contain up to 50% LLW. The TRUM stream will be processed in the same manner as the other TRU waste and will be stabilized in one of the processing facilities for disposal at the WIPP. Suspect TRU waste will be assayed at the retrieval location. Containers that are found to contain greater than 100 Nanocuries of Pu/gram will be repackaged, if necessary, and sent to the TRU processing facility. The TRU processing facility will provide the capability for inspecting, assaying, sorting of the container contents, and repackaging TRU.

Part of the forecast RH TRU waste stream is spent ion exchange resin from treating DST farm supernatant. This waste stream is estimated at 2,000 m^3 and is contained in 16,000 m^3 of concrete shielding (large containers). Treatment requirements for this type of waste may be different than just size reduction. The spent resign and concrete shielding represent approximately 40% of the RH TRU feed stream. Approximately 10% of the LLCE is considered RH TRU waste and will be processed as RH TRU. At approximately 10,000 m^3, this stream represents approximately 25% of the total RH TRU feed stream.

The CH TRU Waste Stream to be processed is comprised of all containers other than 55-gal drums. The CH TRU containers will be size-reduced and packaged as LLW after the waste contents have been removed at the processing facility.

6.6.1.2.2 **LLMW Characteristics**. The RH and CH LLMW contain both radioactive and hazardous constituents. All LLMW to be processed will have adequate characterization documentation to identify the physical form and relative size of the waste material and the radionuclide and chemical (hazardous) contaminants and quantities present.

The volume of RH LLMW to be processed is 96,760 m^3. Of this volume, approximately 87,000 m^3 is LLCE of more than 6.1 m in length. Most of the LLCE are larger pieces of equipment such as pumps, thermocouples, spargers, etc., which are to be removed from the DSTs and the SSTs in the Tank Farms. There are assumed to be 2,000 individual LLCE items with an average containerized volume of approximately 45 m^3 per item. The 87,000 m^3 total is based on the exterior dimensions of the waste containers. Due to the non-

uniform shape of the LLCE items, the actual volume of the items is much less than the shipping container volumes. The actual dimensions of more than 200 LLCE items were used to calculate an average volume per LLCE item. This average volume is 202 cu. ft. (5.72 m^3), which translates into a total volume of 11,486 m^3 for all 2,000 items. The shipping or overpack containers for the RH LLMW will be decontaminated (if needed) and returned to the system after the waste contents have been removed at the processing facility.

The volume of CH LLMW to be processed is 1,630 m^3. The CH LLMW is in containers larger than 1.5 m x 1.5 m x 2.7 m (8.33 m^3) metal boxes. Waste in these containers will be size-reduced (if necessary) and repackaged into 55-gal drums for shipment to, and processing at, the WRAP-2A. The CH LLMW containers received at the RH and large container CH LLMW processing facility are not considered reusable and will be size-reduced and disposed of as LLW.

6.6.1.3 Processing Operations.

6.6.1.3.1 TRU Processing Operations.

6.6.1.3.1.1 Processing Facilities Considered. To maintain the scope and cost of facility upgrades and operations at a minimum, only one facility will be used to process both the RH and CH TRU waste. There were several existing facilities which were initially determined capable of performing the TRU processing mission and these are evaluated in this report. Two facilities were evaluated in some depth for TRU processing: T Plant and the Maintenance and Storage Facility (MASF). The FMEF was initially considered as a possible TRU processing facility. This option was not deemed viable for two reasons:

(1) The facility layout (compartmentalization and limited crane access) is not easily reconfigured to achieve the required throughput; and

(2) Processing operations by their nature would result in large areas of the facility becoming contaminated, thereby incurring significant decontamination and decommissioning (D&D) costs and precluding future use of the facility for clean operations.

The 300 Area hot cells were also considered initially, but were not pursued because they are configured and sized for processing small quantities of RH wastes, and the upgrades required to the cells, coupled with the cost involved in upgrading a second facility to achieve the required throughput, would be much higher than the conversion of one large facility for all CH and RH operations.

6.6.1.3.1.2 Processing Logic Overview. The overall TRU processing logic, Figure 6.6.1-1, for both RH and CH TRU waste was based on the process logic diagrams utilized in the PNL model. Figures 6.6.1-2 and 6.6.1-3 provide an overview of the process logic used in RH TRU and CH TRU processing for Alternative 3. As discussed previously, the same facility would be utilized for both RH and CH TRU operations. The same RH processing line would be used for CH operations, except that some steps would be bypassed because the primary purpose of CH processing is to size-reduce and repackage waste in 55-gal drums for shipment to WRAP-1, where final processing would occur.

The RH TRU processing is intended to size-reduce, package in RH canisters and assay the waste for shipment to WIPP. The overpack containers

or transportation casks used for shipping the RH TRU to the processing facility will be surveyed, decontaminated if necessary, and returned to the system for reuse. The present waste stream projections do not indicate the presence of lead shielding in the shipping containers; therefore, a separate LLMW processing line is not required.

6.6.1.3.1.3 Detailed Processing Logic for RH and Large Container CH TRU Waste.

6.6.1.3.1.3.1 Waste Receipts. Waste receipts are estimated at 73,210 m^3 for the project life, and include equipment, debris, void space, and some container volume. To be consistent with the PNL model, 31,715 m^3 of reusable overpacks are considered as part of the receipts, but are not considered part of the TRU treatment requirements.

Receipts include an estimated 48,734 m^3 of RH TRU and 31,514 m^3 of CH TRU. Both waste streams can contain Suspect TRU and Suspect TRUM. Process logic has assumed that the CH/RH TRU processing facility capacity will be sufficient to treat the total waste system.

The RH TRU receipts may be in any size container ranging from 200-L drums, small boxes, and large containers of up to 1,600 cu. ft. (45 m^3). A complete breakdown of the distribution of container sizes for the waste receipts is not available. Half of the waste is expected in containers of approximately 1,000 cu. ft. (28.3 m^3) or smaller, with the other half expected in containers of approximately 1,600 cu. ft. (45 m^3). Some waste containers may be larger than 45 m^3, but for this analysis, waste in containers larger than 45 m^3 are excluded. An average size container is expected to be 28.3 m^3 (1,000 cu. ft.).

The CH TRU will be received in containers larger than a WRAP-1 Standard Waste Box (SWB), a 67-cu.-ft. (1.9-m^3) container capable of holding up to seven 200-L drums. The largest containers are assumed to be equal to that of the RH TRU. An average size of a CH TRU container is assumed to be 28.3 m^3 (1,000 cu. ft.).

Information is not available as to the volume of the TRU containers or the equipment items in the containers, or if the containers have shielding. Container volume is assumed to be 20% of the incoming receipts requiring processing. To be conservative, the envelope volume of the equipment is assumed to be approximately 30% of the container volume, and the hard equipment volume is assumed to be half of the envelope volume.

Envelope volume is defined as the minimum outline dimension of an equipment item. For example, a pump 10.9 m long, with a 0.33-m flange and 9-in. shaft has an envelope dimension of 0.33 m x 0.33 m x 10.9 m, or approximately 49 cu. ft. Actual hard volume would be approximately 0.566 m^3. Envelope volumes have been used for processing and disposal requirements.

Some CH/RH TRU (Suspect) waste may be sent to the CH/RH LLMW facility for processing as CH/RH LLMW. The volume of this stream could be approximately 5,000 to 15,000 m^3 and would reduce the throughput requirement for the RH TRU and large-container CH TRU processing facility. The Suspect CH TRU waste could be sent directly to the LLW Buried Trench if the waste stream could be analyzed, and determined not to be TRU waste, before shipment to the

process facility. Process logic assumes that this waste stream will be processed as TRU within the CH/RH TRU process line. If the waste stream is designated as CH or RH LLMW before it is shipped to the TRU processing facility, or while it is being handled in the TRU processing facility, then shipment to the LLMW processing facility could be an option.

The CH TRU and RH TRU waste streams are assumed to be free of organics and lead. All waste containers will be received by truck or rail shipments. The products or output from the RH TRU and Large Container CH TRU treatment facility are:

- Packaged LLW in plywood boxes to the LLW Burial Ground;
- Packaged CH TRU in 200-L drums and SWBs to WRAP-1;
- Packaged RH TRU in canisters to WIPP; and
- Decontaminated overpacks for reuse.

6.6.1.3.1.3.2 Treatment Options. Treatment options for both RH TRU and CH TRU are shown in Figures 6.6.1-2 and 6.6.1-3. Part of the waste received is a reusable overpack container. If an overpack is received, it will be removed and recycled. The first step in the process is to unload the container. Treatment options are based on the receipt of an average-size container of 28.3 m^3. Annual receipts and treatment are based on 21.5 years of full operation or 69 average containers per year of RH TRU (1,473 containers total), and 52 average containers per year of CH TRU (1,114 containers total). A single RH treatment line is provided for both streams. The two waste streams will be separated during processing and assayed prior to shipment.

(1) Nondestructive Assay. All incoming waste containers will be checked for TRU waste. If a container is found to not contain TRU, the option is available to send containers received as Suspect TRU to the RH and CH LLMW processing facility.

(2) Unpacking. After a container is unpacked, two streams will be processed as follows for an average container of 28.3 m^3:

Container	100% of incoming volume with interior volume of 80%;
Void Space	50% of incoming volume;
Envelope	30% of incoming volume; and
Hard Equipment	Half of incoming envelope volume.

Containers are size-reduced by an approximate factor of 5, and packaged in plywood boxes. With an incoming volume of 28.3 m^3, incoming boxes are size-reduced to a volume of approximately 5.7 m^3, and the pieces are placed in 1.9 boxes, with a volume of 3.6 m^3, each, for shipment to the LLW burial ground. The estimated volume in the box represents a packing efficiency of approximately 85%. The exterior volume of the container will add an additional volume.

(3) Size-Reduction/Separation. The requirement for CH TRU is size-reduction and repackaging for shipment to WRAP-1. The CH waste stream is equipment and debris of various sizes. Equipment items will be size-reduced to fit into 200 liter (200-L) drums or SWBs. For this analysis, the size will be reduced to fit 200-L drums. Maximum length of a segment going into a 200-L drum is approximately 600 to 700 mm. The waste stream is sorted prior to size-reduction; small pieces are removed

waste stream and placed into 200-L drums. After size-reduction, volume is expected to be reduced to approximately 6.7 m^3 to 8.5 m^3. The total CH waste stream will be packaged in 200-L drums with an 85% to 90% fill volume and sent to WRAP-1. Based on the incoming container volume, volume reduction is estimated at approximately 70%. Drum packaging efficiency will add an additional 1.5 m^3 to the waste volume for an overall volume reduction of 65%. This will require packaging and assaying of approximately 50 drums per average container.

The requirement for RH TRU is size-reduction and repackaging, stabilization (fixation), and final assay for shipment to WIPP. The waste acceptance criteria for WIPP (WIPP-DOE-069, Rev. 4.0) indicate that all RH TRU will be sent to WIPP in RH casks (see Figure 6.6.1-4 and Exhibit 6.6.1-3). It is assumed that this waste stream will be size-reduced to fit into either a 200-L drum or a WIPP canister. The same rationale applies to this waste stream as to the CH TRU. The cut or size-reduced waste volume from the average container will be approximately 6.5 m^3 to 8.5 m^3. The packaged waste volume will have approximately the same volume increase as CH TRU waste.

(4) Repackaging. Requirements for repackaging have been stated previously. Weight limitations or restrictions on the Pu gram equivalent per container (<325 g for WIPP) may require more extensive repackaging. Packaging requirements are based on the Hanford Site Waste Acceptance Criteria (WHC-EP-0063).

(5) Stabilization. RH TRU will be stabilized by either polyethylene fixation or grout encapsulation. It is expected the packed drums, or containers will be filled with either grout or polyethylene. The additive would fill void space in the containers and could be as high as 20% to 30% of the container volume. A volume increase for fixation is not included in volume estimates.

(6) Estimated average volume reduction--Based on an average container of 28.3 m^3, the estimated volume of waste is:

CH TRU to WRAP-1	6.7 m3 to 8.5 m^3	200-L drums
RH TRU to WIPP	6.7 m^3	200-L drums (or WIPP canisters)
Contingency	2.0 m^3	
Containers	6.9 m^3	Plywood box to LLW Burial Ground

Theoretical volume reduction for the average container is estimated at 4.25 m^3. This analysis estimates a volume reduction to approximately 8 m^3 to 10 m^3, or approximately a 65% to 75% reduction in volume, including overpack. This volume reduction excludes reusable overpacks and LLW going to the LLW Burial Ground. Storage volume will increase, allowing for container and handling requirements.

6.6.1.3.2 LLMW Processing Operations.

6.6.1.3.2.1 Processing Facilities Considered. As in the case of TRU processing, both RH and CH processing operations will be performed in one facility. The RH and CH processing were combined to limit project cost to the upgrades and operation of one facility, rather than two separate facilities. This approach is also justified by the fact that the CH LLMW volume of 1,630 m^3 is small in comparison to the volume of RH LLMW of 96,760 m^3.

The facilities evaluated in this report for LLMW processing under Alternative 3 are the T Plant, MASF, and the Grout Vaults. The FMEF and 300 Area hot cells were not considered viable because the size and configuration of these facilities would not allow handling of LLCE. Modifications to the FMEF hot cell facility to handle only the non-LLCE were considered not to be cost-effective.

6.6.1.3.2.2 Processing Logic Overview. The RH LLMW processing will involve unpackaging, verification of waste forms, initial size-reduction of waste forms, further size-reduction if necessary, and stabilization/encapsulation. The CH LLMW will be size-reduced to fit into 200-L drums and packaged for shipment to the WRAP-2A. Processing of the CH LLMW in drums will be performed at the WRAP-2A. Figures 6.6.1-5 and 6.6.1-6 provide the detailed process logic for RH and CH LLMW process for the MASF and T Plant.

The process logic for the Grout Vault Facility is simplified by the elimination of stabilization/encapsulation of individual waste containers and repackaging for shipment for the LLCE waste stream. In the Grout Vault option, LLCE items will be size-reduced and placed directly into a disposal vault. The disposal vault would be filled to a predetermined depth (approximately 1 m) and a grout mixture would be added to fill voids and to act as an encapsulation medium. The detailed process logic for use of the Grout Vault Facility for LLMW processing and disposal is provided in Figure 6.6.1-7.

6.6.1.3.2.3 Detailed Process Logic for RH and CH LLMW.

6.6.1.3.2.3.1 Waste Receipts. Waste receipts are estimated at a total of 111,192 m^3 for the life of the project, and includes both equipment\waste and container volume. LLCE will be transported in containers with an estimated total volume of approximately 87,773 m^3. This volume is assumed to contain approximately 2,000 equipment pieces. This waste stream is assumed to be RH and represents approximately 90% of the total RH LLMW volume. LLCE is defined as having a length of over 20 ft (6.1 m). The waste stream includes approximately 9,000 m^3 of other RH waste.

The overall waste volume includes 1,630 m^3 of CH waste in large containers. A large container is defined as having a volume of greater than 500 ft^3 (14.16 m^3). The total RH LLMW stream is considered to be LLCE from the Tank Farms and non-LLCE contaminated equipment coming from the Tank Farms and some of the canyon facilities in the 200 Area. The RH and CH LLMW stream is assumed to be all equipment with little or no contained organic matter. The organic content of the waste stream is still being defined.

The LLCE will be shipped to the treatment facility in containers with an average size of approximately 45 m^3. Estimated volume of the equipment inside

the container is assumed to have an outline envelope (maximum diameter squared time length) volume of 402 ft^3 (11.4 m^3), with an actual volume of 202 ft^3 (5.7 m^3). The Westinghouse Hanford Company supporting documents, WHC-SD-WM-ES-303, and WHC-SD-WM-ES-265 were used as source documents for volume estimates. Container size can be as large as 71 ft long x 8 ft x 8 ft, with a volume of 4,550 ft^3. (21.6 m x 2.44 m^2, a volume of 128.9 m^3). An average container is assumed to have the approximate dimensions of 8 ft x 10 ft x 20 ft, with a volume of 1,600 ft^3, (2.44 m x 3.1 m x 6.1 m or 45 m^3). The actual volume of the LLCE items is assumed to be approximately 13% of the total shipping volume.

The remaining 9,000 m^3 of RH LLMW will be received at the facility in containers of almost any size and configuration, from 55-gal (200-L) drums to 6.3-m-long containers.

Some CH or RH TRU (Suspect) waste may be rerouted to the LLMW facility for processing as CH or RH LLMW. The anticipated volume of this stream could add an additional 5,000 to 15,000 m^3 to the overall feed requirement. As this waste stream may be relatively small, there may not be an impact on the RH LLMW to be processed.

The CH LLMW will be received in containers of larger than 14.16 m^3 with a configuration of approximately 5 ft x 10 ft x 10 ft (500 ft^3 or 14.16 m^3) to 8 ft x 10 ft x 20 ft (1,600 ft^3 or 45 m^3), with an average container size of 6 ft x 8 ft x 12 ft (576 ft^3 or 16.3 m^3). The estimated volume of CH LLMW represents approximately 2% of the total LLMW stream. This waste stream will be handled as RH because of the small volume.

All waste containers will be received by truck or rail shipment. If T Plant is used, rail shipments will also be accepted. Containers are considered metallic or metallic lined with concrete shielding. The containers are assumed to be lead free, and the container volume is assumed to be approximately 20% of the incoming volume. Some containers will be 55-gal (200-L) drums.

6.6.1.3.2.3.2 Treatment Options. Treatment options for both RH LLMW and CH LLMW are depicted in Figures 6.6.1-5 and 6.6.1-6. Waste is received in containers and the first step in the process is to unload the container. Treatment options are based on the receipt of an average size container of 45 m^3. The facility will process an average at 4,867 m^3/Yr. for 21.5 years. The number of containers is expected to be approximately 112 containers per year.

(1) Unpacking and Container Handling--After the container is unpacked, two streams will be processed as follows for an average container of 45 m^3:

Container	100% of incoming volume with interior volume of 80%;
Void Space	50% of incoming volume;
Envelope	30% of incoming volume; and
Hard Equipment	Half of incoming envelope volume.

Containers are size-reduced by an approximate factor of 5, and packaged in plywood boxes. With an incoming volume of 45 m^3, incoming boxes are size-reduced to a volume of approximately 9 m^3, and the pieces are placed in 3.5 boxes, with a volume of 3.6 m^3, each, for shipment to the LLW burial ground. The estimated volume in the box represents a packing

efficiency of approximately 70%. An 80% packing efficiency was used for this analysis. The exterior volume of the container will add an additional volume.

The resultant disposal volume of the shredded containers is expected to be 9.8 m^3 to 15 m^3 on the average, for each incoming container requiring disposal (see Table 6.6.1-4). Interim storage is not provided for the waste stream destined for the LLW Burial Ground. Reusable containers from the LLCE overpacks will be surveyed, decontaminated if necessary, and returned to the system for reuse. Figures 6.6.1-8 and 6.6.1-9 indicate typical container dimensions and the cutting plan for volume reduction.

(2) Size-Reduction/Separation - The second waste stream is equipment and debris of various sizes. In the case of the Grout Vaults, size-reduction of RH LLMW is performed to obtain segments not longer than approximately 3 m, with a weight of less than 2,000 kg. For T Plant or MASF, the pieces will be size-reduced to fit into either 200- L drums or a High-Integrity Container (HIC) with a volume of 8.3 m^3. The T Plant and MASF will size-reduce to less than 3 ft (1 m) to use a conveying/container system for remote handling. Waste that is containerized will be packed to 85% to 90% full. Maximum length of a segment going into a HIC is 2.4 m, and the width is less than 1.2 m.

Prior to size-reduction, the waste stream is sorted. Approximately 5% of the waste stream does not require size-reduction, and is removed and sent directly to the stabilization area. The volume of this stream is estimated at 0.54 m^3. The remaining waste stream is size-reduced. After size-reduction, the total volume is expected to be reduced by approximately 50% or 11.1 m^3, and includes approximately 50% void space. This sorting step may not be required.

(3) Repackaging and Stabilization (Encapsulation) - Size-reduced waste segments from the RH LLMW stream are placed into a HIC at an 85%- to 90%-full level. Considering a net packing volume of the cut pieces, the estimated 5.5 to 11 m^3 of the size-reduced equipment segments will fill approximately 1.6 containers or approximately 13 m^3. The effective packing density is expected to be close to 50%, with the reduced envelope volume allowing a degree of nesting. Envelope volumes have been used for estimating processing and disposal requirements.

The expected volume reduction of incoming RH LLMW is estimated to be approximately 70% to 75%, based on packaging the waste in HICs. Waste from the RH LLMW stream placed in a HIC will be stabilized by adding a grout mix to the container. The grout will fill the void space between the placed segments. This void space is estimated to be approximately 40% to 50%.

Size-reduced waste segments from the CH LLMW stream will be packaged in 200-liter drums for shipment to WRAP-2A. The PNL model used in this study does not allow for stabilization and packaging for final disposal of the CH stream within the same facility as the RH stream. Given the small quantity of CH LLMW in large containers, it would likely be more cost effective to stabilize and dispose of the size-reduced CH LLMW in the same facility where the RH LLMW stream is being processed. This may also be true for Alternatives 1, 2, and 4 where a common facility is used for processing the RH LLMW and size-reducing the CH LLMW in large containers.

(4) Estimated Average Volume Reduction - Based on an average container of 45 m^3, the estimated volume of waste going to either the Grout Facility or to storage is shown in Table 6.6.1-5.

The theoretical volume reduction is estimated at 5.7 m^3. This analysis estimates a volume reduction to approximately 13 m^3 or approximately a 70% reduction in volume. If the incoming volume is 98,400 m^3, the volume in containers would be approximately 24,600 m^3; 2% of this waste volume is CH and would be sent to WRAP-2A. The packed volume of the waste going to the Grout Vaults would be approximately 60% to 75% of the indicated volume, or approximately 15,000 m^3 to 18,000 m^3. The estimated void volume would be filled with grout.

6) Size-Reduction Equipment - For purposes of this study, size-reduction equipment is assumed to be existing state-of-the-art units of a mechanical nature. Size-reduction equipment such as high-pressure water blast units, plasma arc units, and acetylene torches could improve size-reduction capacity and performance but were not included in the cost estimates for Alternative 3. The use of laser technology should also be evaluated and considered if any of the Alternative 3 options proceed to conceptual design.

Shredding equipment will also be required. Some size-reduction will be required ahead of shredding, as it is unlikely that large equipment items can be fed to a shredder. Shredders are only considered for containers and shipping packages. Steel drums can be shredded with minimum difficulty, but, the number of drums to be shredded is probably insignificant.

6.6.1.4 Storage Operations.

6.6.1.4.1 **Waste Material Requiring Storage**. The storage operations considered within the scope of this report include storage prior to processing, and storage prior to off-site disposal. The pre- and post-processing storage functional requirements, with the exception of the space required are identical. Therefore, it has been assumed that both the pre- and post-processing storage functions of the same waste streams materials would be performed in the same facility (facilities). The waste volumes required storage depend on the forecasted generation rates over time provided by the on-site waste generator facilities and the operational schedule and throughput of the processing facilities. The waste volume forecasts used in this study were assumed to be fixed. For Alternative 3, the processing throughput requirements were determined by dividing the entire forecasted waste volume, plus current inventory, by the operational period, in years. The operational

period is assumed to end in the year 2023 and begins when the processing facility construction and startup activities have been completed (assumed to be in the year 2001). The throughputs and the operational schedules of the processing facilities were input into the PNL model. The model was then run to calculate the storage volume requirements for each waste stream for each year out to 2023. These storage volumes are summarized in Table 6.6.1-6. The fourth column, indicated as Package Year, represents the year in which the maximum storage requirements must be provided.

The two treatment scenarios are: (1) RH and CH TRU are processed in the same facility on two completely independent treatment lines; and (2) RH and CH TRU are processed in one facility in a commingled process line (RH and CH TRU are interchangeable to accommodate projected surges in either stream).

Option one identifies storage of the pre- and post-treated TRU in separate facilities, assuming a commingling process scenario. This process scenario would allow for the leveled process rate of 3,400 m^3 each year to the year 2023, including a three-year period to ramp-up to a full productivity rate. A pre-treatment storage facility would be constructed as soon as practicable, and would be sized to accommodate the maximum pre-treatment waste stream projection of 20,000 m^3, which is in the year 2006. A processing facility would accept pre-treated waste from this facility, process/treat and repackage as required for both RH and CH, and transfer to the post-treatment storage facilities.

This first of three storage options for post-processing is for separate storage facilities that would be designed for both remote WIPP storage containers and CH drums. These facilities would be sized to accommodate the projected net storage requirements of the combined RH and CH processed TRU waste. The maximum net storage required for post-treated TRU waste is 47,500 m^3, including storage containers and access space for handling. The facilities would encompass three units designed to accommodate storage for 16,000 m^3 of waste, each, for a total of 48,000 m^3. Construction of the storage facilities would be scheduled for completion as the projections of the storage requirements dictate. This will allow out-year funding to be levelled throughout the project's entire life-cycle.

Current projections indicate that the first of three post-treatment storage facilities must be constructed and operable by the year 2001 to store the first 16,000 m^3 of waste; the second facility would be in operation by the year 2008 to store an additional 16,000 m^3; and the third facility would be completed and in operation by the year 2015 to provide the remaining storage of the 48,000 m^3 of processed RH and CH TRU. The last projected pre-treatment stream is projected for the year 2023 and the pre-treatment storage facility will be nearing the end of it's 30-year design life-cycle expectancy. This report finds that, as a contingency, the facility should be maintained for the potential of additional, as yet unknown, pre- or post-processing storage requirements. After completion of processing, all known RH and CH TRU, the facility may be decommissioned.

The two additional storage options for the same commingled process logic are post-process storage in a single structure, or complete elimination of post-process storage. A single-storage facility would require administrative controls for the separation of RH and CH waste. The facility would require dual design parameters for CH and RH material requirements. Additionally, the

large facility would require a one-time large construction budget to design and construct a facility to store 48,000 m^3 of RH and CH TRU. Operating costs throughout the facility life-cycle would be higher for this option because the entire facility would come on-line and require maintenance and operation costs for the entire processing operations duration. This is unlike the option for multiple smaller storage facilities, which would require a smaller staff for maintenance; and once the small storage facility were filled to capacity, operations would be eliminated, with exception to scheduled surveillance of the stored materials.

Storage after processing could be eliminated if CH and RH TRU were shipped directly to final disposal. If this were possible, a 90-day storage area, with comparatively small storage area requirements, would be required for storage prior to shipping to final disposal.

Option two for processing assumes a completely segregated process line for RH and CH TRU in the same facility. This process logic would require a slower start-up process rate and would peak at approximately 4000 m^3 in the year 2013. This is a 15% increase in process capacity compared to the commingled process facility. Storage prior to processing is approximately 16,500 m^3 for a segregated facility, which is 18% less than a commingled process facility. The post-treatment storage requirements are the same for both options. Storage options for both processing scenarios would hold true, with the exception that storage facility sizes for pre-processing may differ.

Strontium and cesium capsules, unirradiated uranium, miscellaneous sources, and HLW canisters will also require storage prior to off-site disposal. These waste streams are assumed to be stored on-site until the year 2028. Exhibit 6.6.1-4 provides the dimensions, characteristics, and storage requirements for each of the waste stream containers.

Required storage space for pre-and post-processing storage in any given year is a function of the waste generations and processing rates for the present and prior years. The maximum volume of waste to be stored occurs in the year 2023 with storage continuing through the year 2028. All GTC-3 waste will require storage at this time. Total volume to be stored is 89,200 m^3. Of this, 43,600 m^3 is RH and 47,700 m^3 is CH.

The storage space can be calculated, in square feet, from the waste volumes if the container types are known. For this summary, all CH wastes were assumed to be in 200 liter drums, and all RH wastes were assumed to be in 1.5 m x 1.5 m x 2.7 m metal boxes. Drums are stacked three high, and metal boxes are stacked two high, with a 3-ft. aisle between rows, as required by WAC 173-303. The calculated storage areas are then 50,641 m^2 for CH wastes, and 19,700 m^2 for RH wastes. The CWC Phases I through V provide 26,022 m^2 of CH waste storage space, thus reducing the new construction CH storage space requirements to 24,618 m^2. All RH storage space must be provided by new construction.

Construction costs for storage space are approximately $70 per sq. ft. for CH and RH wastes, respectively. Adding in the costs for design, construction management, and project management, the average total project costs are approximately $207 per sq. ft. for CH waste storage, and $1,283 per sq. ft. for RH waste storage. Total new construction costs for future CWC expansion are projected to be $55 million for CH storage, and $272 million for

RH storage. The costs for CWC Phase V, $26 Million, should be added to these totals. Table 6.6.1-7 shows the estimated costs for CH and RH storage facilities.

6.6.1.4.1.1 RH TRU Storage. The TRU waste will be processed at either T Plant or the MASF under Alternative 3. Some TRU waste will require storage prior to processing at the selected facility, as well as storage prior to off-site disposal for the processed CH/RH TRU, and TRU waste. To minimize overall storage costs, all TRU storage would be consolidated into two facilities or storage complexes: one for RH TRU, and one for CH TRU. Storage of RH TRU requires shielded cells or storage areas and remote-handling equipment and monitoring systems. Additionally, storage areas must be clean (free of radioactive contamination) to allow shipment out of storage without having to decontaminate the containers. No existing facility meets all criteria for storage of the projected volumes of RH TRU.

6.6.1.4.1.2 RH LLMW Storage. There were three options were considered viable for processing RH LLMW and large containers of CH LLMW under Alternative 3. The T Plant, MASF, and Grout Vaults could be modified to perform these operations at the required throughput. If T Plant or MASF were used for LLMW processing, then some surge storage capacity would be necessary because of the limited throughput of these facilities. It may be possible to achieve sufficient throughput at the Grout Vaults to preclude the need for surge storage capacity. Preparation of detailed Time Motion Studies for each facility processing option to accurately predict the maximum possible throughputs was considered outside this scope of this study. It does seem possible that with fewer processing steps required under the Grout Vault option, the LLCE items could be disposed of as they are generated. Because the LLCE items comprise the large majority of the LLMW waste stream, it may be possible to eliminate the need for pre-processing storage, at least for RH LLMW, by using the Grout Vaults for LLMW processing. Because of the large volume of RH LLMW (12,000 m^3) waste requiring storage prior to processing, there is not enough floor space available in any one existing facility to provide storage for RH LLMW. This report does, however, provide a discussion of the RH LLMW storage issue and the available storage space in the FMEF. No other radiologically-clean facilities have adequate secondary containment, shielded cells, and remote-handling capabilities to store RH LLMW.

6.6.1.4.1.3 CH TRU and LLMW Storage. A detailed study of storage options for CH LLMW have been performed (Evaluation of Existing Hanford Buildings for the Storage of Solid Wastes, WHC-EP-0636). The conclusions from this study are that storage of RCRA waste in compliance with the Washington State Dangerous Waste Regulations (173-303 WAC), cannot be done in a cost-effective manner by converting any existing facility to such use. Based on this study, it was not considered worthwhile to pursue storage of CH TRU, LLMW, and Greater Than Category 3 LLW in any existing facility. This report does, however, consider storage of RH TRU and LLMW in existing facilities (the FMEF). To the extent that the requirements for storage of CH waste are less restrictive than for RH waste, any facility capable of storing RH could also be used for CH storage as well.

6.6.1.4.1.4 Strontium and Cesium Capsule Storage. This report evaluates various options for interim storage of all capsules (1,577 Cs and 640 Sr) prior to final disposal. On-site processing of the capsules through a vitrification process is currently being evaluated as part of the TWRS and is

not addressed herein. Actual capsule storage space allocations depends on the method (dry storage in casks at a new facility, dry storage in existing storage tubes at the FMEF, or wet storage at WESF) chosen for storage (see Exhibit 6.6.1-5).

Studies provided for the compilation of this report indicate that dry storage is a viable option for long-term storage. Detailed computations for the option described in Section 6.6.2.8 (FMEF) would be required for further evaluating the safe operating parameters anticipated. Information provided by WESF was used to develop heat load requirements, monitoring equipment and inspection criteria. This report suggests a further detailed analysis of the FMEF Dry Storage option.

6.6.1.4.1.5 High-Level Waste Canister Storage. Interim storage of the HLW canisters was considered in this study. Storage of the waste canisters produced but the LLVP was considered out of scope.

The estimate of 6,802 canisters is based on a volume of 8,569 m^3, as developed in the TPA M-33 Milestone inventory volume (revised date February 17, 1995). Generation of HLW in canisters is to begin in 2010 and proceed for 19 years at a rate of 451 m^3 per year (358 canisters). Heat dissipation is an important consideration for HLW canister storage. All approaches considered for interim storage require forced-circulation dry cooling (see Exhibit 6.6.1-6).

The 1990 ICF Kaiser Hanford Company study evaluated storage options for 2,000 smaller canisters, which were projected at that time. This study indicated that the storage facilities must meet Safety Class 2 requirements. The storage concept for 221-U and the PUREX involved forced-air cooling, with the canisters stored in racks of nine. The racks had a floor surface area of approximately 2.44 m x 2.44 m (5.95 m^2) or 8 feet x 8 feet (64 sq. ft.). The bottom of the racks were approximately 1 m off the floor to allow for cooling air circulation. The suggested storage area for the larger canisters is approximately 2.74 m x 2.74 m (7.51 m^2) or 9 feet x 9 feet (81 sq. ft.). The storage racks would have a height of at least 5.2 m (approximately 17 to 18 ft.). By taking the estimated number of canisters and dividing it by the number of canisters per rack, a special requirement for storage of 5,691 m^2 is calculated. This area is then multiplied by the height of the canisters, 1.6 m^2, and added to the estimated area required for handling to calculate the total area required for HLWC storage.

6.6.1.4.1.6 Storage of Unirradiated Uranium. Interim storage of unirradiated uranium (UU) was also considered under Alternative 3. The volumes and container types for the UU are provided in Section 6.6.2.9. The UU inventory is currently for sale and storage area requirements depend on the amount, if any, of VV that is delivered offsite. Section 6.6.2.9.1 discusses the requirements for storage with and without the pending sale going through.

6.6.1.4.1.8 Storage of Miscellaneous Sources. Section 6.6.1.1.8.3 provides a detailed discussion of the types and quantities of miscellaneous sources that will require continued storage. This information is summarized in Section 6.6.1.1.8.3, and Table 6.6.1-2 lists the seven different types of waste included within the miscellaneous sources category, amounts in volumes and/or masses, and current storage locations, mainly storage cells in Buildings 324, 325 and 327. The total volume of the waste is estimated to be 60 m^3. This is

a relatively small amount; however, some items are highly radioactive (up to 100,000 R/hr) and the present storage locations are not considered suitable for long-term storage.

The storage requirements for the miscellaneous sources will be as demanding as those for RH TRU some of the miscellaneous sources volume. Actual storage volume required for the 15 m^3 is expected to be 60 m^3, assuming a factor of 4 increase in volume due to shielding and packaging requirements for storage. The only existing facility that satisfies all of the expected technical criteria would be the FMEF.

6.6.1.4.2 Facilities Considered for Storage Operations Under Alternative 3.

6.6.1.4.2.1 Storage of RH TRU and RH LLMW. There are no existing facilities that can be modified to contain the projected maximum storage quantities of RH TRU and RH LLMW. The only existing, radiologically clean facility, with RH capability and shielded cells, that could meeting Hazard Category 2 requirements, is the FMEF. For this reason, the FMEF was evaluated for the interim storage of the RH TRU and LLMW streams, and was found to have inadequate storage volume available. Interim storage of RH TRU and RH LLMW, prior to processing, require 20,000 m^3, and 12,000 m^3 of storage space, respectively. Adding the required storage volumes prior to final disposal or processing at WRAP-1 and WRAP-2A. The total required RH storage volumes would be somewhat higher. If one or both of these variables were altered, reducing the maximum storage required to less than 3,300 m^3, it would be possible to modify the FMEF for RH storage.

6.6.1.4.2.2 Storage of CH TRU and CH LLMW. There are no existing facilities that can be modified to contain the projected maximum storage quantities of CH TRU and CH LLMW. The FMEF and the 2101-M warehouse were evaluated in much the same manner as the evaluation for storage of RH TRU and RH LLMW. The FMEF was found to have inadequate space and the compartmental configuration of the facility would require extensive modifications for the storage of large volumes of waste. The WHC report, Evaluation of Existing Hanford Buildings for the Storage of Solid Waste, concluded that modifications to bring 2101-M into regulatory compliance would cost $108/sq. ft., compared to $58/sq. ft., for a new facility specifically designed to store these waste streams. The conclusion of the Alternative 3 Evaluation is that construction of a new storage facility (i.e., Phase V of the Central Waste Complex) is more cost-effective and poses less risk than converting any existing facility to store large volumes of CH TRU or LLMW.

6.6.1.4.2.3 Storage of Greater than Category 3 Waste. There are no existing facilities that can be modified to store the projected maximum storage quantities of 89,200 m^3 for GTC 3 waste. The same evaluation criteria and conclusions derived for CH TRU and CH LLMW were used for this waste stream. The construction of a new facility is the most cost effective and logistically feasible alternative for the large volumes of this waste stream.

6.6.1.4.2.4 Storage of Sr and Cs Capsules. Dry storage of the Sr and Cs is the preferred option as outlined in the HDW-EIS (DOE 1987) and the Hanford Waste Management Plan (DOE-RL 1987) reports. The WHC-EP-0616 report, Cesium and Strontium Capsule Disposal, further identifies options for ultimate disposal of the capsules. The two primary considerations in this report are

the blending of the capsule contents, SrF_2 and CsCl, into the high level waste vitrification waste stream or, overpackaging and transfer to dry storage. The dry storage option is a technically feasible and is contained in this report. Processing of the capsules as part of the high level waste vitrification waste stream was not within the scope of the M-33 Study.

Use of the FMEF for the dry storage of the Sr and Cs capsules appears to be a viable option. The FMEF was constructed as a safety class one nuclear facility and could be modified for the dry storage of Cs and Sr capsules. The Fuel Assembly Area (FAA) currently contains a below grade storage vault with 301 storage locations which were specifically designed for the storage of high exposure Pu fuel assemblies. This option could be executed at a lower cost than upgrading WESF or constructing a new facility (see Cost Data Section 6.6.3, Alternative 3 and 6.8.3 of Alternative 5).

6.6.1.4.2.5 Storage of HLW Canisters. Modular Vault Dry Storage (MVDS) for high-level waste canisters was proposed in an engineering study by ICF Kaiser Hanford Company in 1990. The proposed facility is an approved storage method for remote handled materials on U.S. Department of Energy Sites. Other options that have been evaluated for storage are the conversion of canyon facilities such as U Plant, B Plant and PUREX, and modification of the large cells in the FMEF (see Section 6.6.1.4.1.6). The current projected waste stream of 6,802 waste canisters will not fit in FMEF. The use of canyon facilities would require conversion of three canyon facilities (U Plant, B Plant and PUREX) to provide adequate storage. This option is discussed in Section 6.6.2.10. Projected costs for a MVDS is approximately $100 million and is discussed further in Section 6.8 for Alternative 5.

If the canyon decks were to be used for storage of the 6,802 HLW canisters, the available deck area from one canyon (approximately 2,400 m^2) is not sufficient for storage of all HLW canisters. The usable floor area should be capable of storing approximately 150 to 200 storage racks, with nine canisters per rack. The required storage area is approximately 5,700 m^2 plus space for handling. Therefore, three canyon facilities would be required to store all of the projected HLW canisters. The upgrades to the canyon facilities for shielding and heat removal are significant factors in the cost estimates for this option.

6.6.1.4.2.6 Storage of Unirradiated Uranium and Miscellaneous Sources. Unirradiated uranium and miscellaneous sources are currently located at a number of facilities. The routine maintenance and surveillance costs associated with storage of these materials at different locations was thought to be high in comparison to the costs involved in consolidated storage at one facility. For this reason consolidation and storage at one facility was considered under Alternative 3. The FMEF was specifically considered because of the safeguards and security systems already provided for the facility. However, there are likely many other facilities on the Hanford Site, which could also perform this function. A thorough evaluation of all possible siting locations for consolidated storage was not performed in this study. The overall conclusion to be drawn from the evaluation done for the FMEF is that consolidated storage of these materials is a cost-effective option that could be executed with very little in the way of facility modifications. This same conclusion could also be reached for other facilities with adequate floor-loading limits, physical confinement, and safeguards and security protection.

6.6.2 FACILITY OPTIONS FOR ALTERNATIVE 3

This section of the report discusses each individual facility considered for the waste processing and storage functions for Alternative 3. Sections 6.6.2.1 and 6.6.2.2 discuss the facility options considered for TRU processing. Sections 6.6.2.3 through 6.6.2.5 discuss the facility options considered for RH LLMW and Large Container CH LLMW processing. Sections 6.6.2.6 through 6.6.2.10 describe the various storage options considered.

6.6.2.1 TRU Waste (RH and Large Container CH) Processing at T-Plant Canyon.

6.6.2.1.1 Introduction. The T Plant Facility is being considered for processing and packaging of RH TRU and CH TRU in Large Containers. Figure 6.6.2-1 provides a layout of the T Plant Facility and the TRU processing activities. The TRU processing approach at T Plant is provided herein. Process flow and logic are included in Figures 6.6.2-2 and 6.6.2-3.

6.6.2.1.2 Processing Approach.

6.6.2.1.2.1 Receiving/Shipping. All waste entering the 221-T Canyon will be received in the tunnel on rail cars. Preparatory work will be performed outside of the tunnel to loosen the package tiedowns and prepare the rail car for unloading in the tunnel. Waste packages will be unloaded from the rail car for processing or for temporary storage prior to processing. The RH TRU packages may be temporarily staged in the Head End until processing. The Head End is a shielded facility, with the potential space necessary for temporarily staging up to 150 m^3 of TRU, prior to processing. A 10-ton telescoping boom crane, with an 24.3-m span, would be located in the Head End and would be able to transport packages from the rail car to the Head End.

Packages that will be processed immediately will be retrieved from the rail car using the modified 45-ton crane, and will be moved directly into the Size-Reduction Area.

6.6.2.1.2.2 Unloading and Size-Reduction Area. The Size-Reduction Area will be located adjacent to the west edge of the tunnel in portions of Sections 3, 4, and 5. The Size-Reduction Area and associated equipment will be situated adjacent to the Pressurized-Water Reactor (PWR) Fuel Pool, located in Cell 2R.

The RH TRU waste should be received in a container overpacked in a cask/overpack. The containers will be removed from the cask/overpack using the 45-ton crane and will be set down in the unloading area. The cask/overpack will be returned to the rail car using the 40.8-tonne crane and will be shipped to the 2706-T Facility for decontamination and eventual reuse.

The container will be unloaded using Pick-and-Place Robots, which will either transfer the waste to the Size-Reduction Area or load it directly into buckets on the conveyor lines. Those items with dimensions larger than 1 m will be transferred to one of the size-reduction modules, items smaller than 1 m will by-pass size-reduction and will be placed into buckets at the first loading station of the conveyor system.

Once the container is unloaded, the container and any shielding will be size-reduced and packaged as LLW; an assumption was made that no lead shielding will be used for the manufacturing of these containers. The

container and shielding will be cut into pieces and placed into the container shredder by a Pick-and-Place Robot, assuming a shredder is needed to fit the pieces into the boxes. The TRU or hazardous/mixed waste will not be placed into the shredder to minimize the potential for cross-contamination. The shredded materials will be placed into buckets on the conveyor and sent to the survey area.

Size-reduction will be performed in one of two enclosed modules. A Pick-and-Place Robot will retrieve the item and perform the cutting, depending upon the type of materials and dimensions.

A conveyor system with a bar code scanning system will be used for transporting the waste through the Processing Area. The bar code scanning system will allow for the buckets to be directed into the individual process modules and will aid in tracking the waste and accounting for the facility throughput. Two conveyors will be used for the loaded buckets, which will span the length of the Processing Area. These conveyors will be stacked such that the two lower levels will carry the waste through the process modules and the two upper levels of the conveyor system will be the return system, transporting the unloaded/empty buckets back to the Unloading and Size-Reduction Area. The conveyor will be 1 m wide and will be located approximately 4.5 m from the south wall of the Canyon Facility, to allow for a corridor which can be accessed by a 1.8-tonne mobile manipulator/forklift to provide access to the conveyor for maintenance purposes and to remove the conveyor buckets in case of a failure in the conveyor system.

6.6.2.1.2.3 Assay/Survey. All buckets will enter one of two on-line bucket assay machines. The conveyor directs the buckets into the assay modules. The buckets and waste will be weighed and assayed simultaneously to calculate the Pu-239 specific activity for the bucket waste. Routine empty bucket assays will be performed. Each bucket of waste will leave the assay module with either TRU or LLW designators assigned to them by the bar code system.

After the assay is performed, the buckets will pass through a dose rate survey machine to determine whether the waste is CH or RH (both the TRU and LLW). The CH TRU originally in Large Containers and LLW buckets will by-pass the stabilization process modules and will enter the Packaging Area directly (i.e., CH TRU is size-reduced and repackaged only).

6.6.2.1.2.4 Stabilization. The RH TRU buckets will enter a sorting module prior to stabilization. The buckets will be emptied onto a sorting table and the waste will be sorted by a Pick-and-Place Robot for the type of stabilization, Polyethylene Extrusion or Vibragrout. The waste will then be reloaded into buckets and directed into the appropriate module, loaded into drums, and be stabilized. After the stabilization process, the drums will be transported to the Packaging/Staging Area using the manipulator/forklift.

6.6.2.1.2.5 Packaging. The waste will be received in the Packaging/Staging Area with CH TRU in drums, LLW in boxes, and RH TRU in drums/containers. There will be designated areas for packaging each of the waste streams, staging of empty containers and overpacks, and staging of packaged containers. The containers will be surveyed and smeared in this area immediately prior to transport to the tunnel rail car by the manipulator/forklift or the 45-ton crane.

6.6.2.1.2.6 Throughput Analysis. Throughput for CH TRU in large containers was prepared with an estimated time motion analysis of a 1,500-cu.-ft. (43 m^3) batch (Figure 6.6.2-4). The limiting steps were determined to be shipping and receiving. Once a batch is received, the contents of the container are processed sequentially on a conveyor fed multi-task line. The evaluated processes include: removal of waste from containers, size-reduction, assay and weigh, load into SWBs, survey and smear SWBs, and transport the loaded SWBs to the railcar. Since all of these operations occur simultaneously, it appears that the sequential operations of shipping and receiving will limit throughput.

Figure 6.6.2.4 shows that T Plant can process a 1,500-cu.-ft. (43-m^3) batch in one, 8-hr shift. At this rate, T Plant could process all the CH TRU in large containers, a total of 31,514 m^3, in a period of approximately 4 yr on the proposed remotely operated process line. As discussed previously, shipping and receiving will be the limiting operations. The RH TRU will be received in similar batch sizes, but it will go through more processing steps such as sorting, polyethylene extrusion, and grouting. These extra processing steps will be conducted simultaneously and should not drastically slow the production rate. If the production rate of RH TRU is only 20% of the CH TRU production rate, then it would take approximately 4 yr to process 3,000 m^3. At this low assumed rate, T Plant could process 50,000 m^3 of RH TRU in approximately 17 yr. The total time to process CH and RH TRU at T Plant is calculated at approximately 21.5 yr. This is the amount of process time that is available between a startup date of 2001 and a shutdown date on 2023, assuming a ramped startup rate of 25% the first year, 50% the second year, 75% the third year, and 100% the fourth year and each year thereafter.

Therefore this throughput analysis concludes that if T Plant was configured as proposed, it could process all of the existing and forecasted RH and CH TRU in large containers by the year 2023, assuming one shift per work day, five work days per week, and 35 work weeks per year.

6.6.2.1.3 Facility Description.

6.6.2.1.3.1 Existing Facility Layout. The T Plant Complex, located in the 200 West Area, consists of various support facilities, including the 221-T Canyon, 2706-T Low Level Decontamination Facility, 271-T Office Facility, 211-T Chemical Storage Facility, and mobile offices and change rooms.

The T Plant was constructed in 1942 to provide chemical separations of special nuclear materials. 221-T's main processing room, the canyon, is approximately 800 feet (243.9 m) long, 35 feet (10.6 m) wide and 40 feet (12.1 m) (Reference WHC-SD-CP-SAR-007, Rev. 1C: Section 5.2.1.1, Figure 5-5). The operating, electrical, and piping galleries run the length of, and are immediately adjacent to, the canyon.

All material shipments into and out of the canyon occur through the T Plant Railroad Tunnel. This tunnel extends approximately 30.4 m from T Plant with access to the canyon through a process cell (approximately 6.1 m below the canyon deck).

The north end of the canyon, referred to as the Head End, is separated from the tunnel and the remainder of the canyon by a corrugated metal wall. The Head End is an area approximately 12.2 m x 12.2 m wide and the depth of

the canyon facility. The Head End was converted in the 1960s to provide various laboratory support functions, but is currently inactive. The Sodium Test Vessel is located below the deck level and various support equipment is scattered around the deck and levels.

The canyon deck consists of 20 Sections which contain process cells. The cells are covered with cover blocks which have 1-m high lifting bales. A crane bridge runs the length of the canyon. A 68-tonne crane is mounted on the bridge, which was down-rated to 40.1-tonne due to structural and mechanical deficiencies. A 10-ton crane is welded in place on the bridge, which is not currently operable.

The 271-T Facility is currently being utilized for offices. It is located adjacent and attached to the canyon galleries.

The 2706-T Facility is currently providing decontamination services for large transportable equipment with low levels of radiological and hazardous contamination.

6.6.2.1.3.2 Upgrades/Modifications. A 1994 study evaluated the viability of the 221-T Canyon in supporting the Hanford Site decontamination mission, Long-Term Decontamination Engineering Study (LTDES) (Parsons 1994). The study discussed a scenario for providing a fully remotely handled operation with a projected waste stream that included LLCE LLMW and TRU processing at T Plant. The key safety and environmental compliance upgrades were identified to support this mission.

T Plant Facility upgrades were identified in the LTDES for providing processing services for the waste stream projected at the time of the study. The need for the individual upgrades required for the waste streams and processed considered in this scenario were evaluated separately. Where similar upgrades were considered in the LTDES, the detailed plant modifications and associated costs were excerpted from the LTDES. Each of the required upgrades are described below. More detailed information on most of these upgrades is included in the LTDES.

6.6.2.1.3.2.1 Zone Reduction and Canyon Cleanup. Limited zone reduction activities will be performed, since all operations in the Canyon will be remotely handled. The 221-T galleries will be cleared and depending upon the existing conditions, the walls and floors will be sandblasted, painted, and coated with a sealant to eliminate radiological zones in the galleries to the extent possible. Zone reduction in the Canyon will include removing the significant quantity of waste materials and contaminated equipment stored on the deck, to provide adequate processing space in the canyon. Equipment currently stored in the processing cells will not be removed. Removal of the stored contaminated equipment on the deck will require size-reduction, decontamination and hazardous waste treatment, and packaging. A limited painting and coating of those areas potentially containing "clean" packages will be performed, such as the Size-Reduction Area and Packaging Area.

The PWR Pool (Shippingport fuel) is stored in Cell 2R of Section 2 of the Canyon. The operations associated with this proposed scenario would be constructed around this cell in order to provide future access to this cell.

The cell cover blocks have 1-m-high lifting bales that limit the

placement of process equipment and may restrict movement of contaminated equipment through a process line. The proposed process modules will be elevated on 1-m platforms over the canyon deck and lifting bales. Removal of the lifting bales is not feasible since removal of these cover blocks in the future may be required.

Several of the operations identified in this scenario will be performed in process modules, including separate modules for size-reduction (2 areas), sorting for processing, polyethylene extrusion, and grout (2 systems). These process modules will be stainless steel with individual ventilation systems.

6.6.2.1.3.2.2 Crane Upgrades. The 40.8-tonne crane (originally rated at 68-tonne) is shielded with lead plate, this shielding should be removed to improve the operating life of the crane. The crane must be equipped with remote handling capabilities and optics.

The 9.1-tonne crane, welded in place on the crane bridge, is not currently operable. This crane would be repaired and returned to service to provide added flexibility to operations within the canyon.

6.6.2.1.3.2.3 Head End Modifications. The Head End could be modified in order to provide a temporary staging area for waste to be treated or transported following treatment.

A corrugated metal wall separates the Head End from the tunnel in the canyon which may be removed to provide a staging area for temporary storage of the RH TRU which is awaiting processing in the facility. This area is shielded by the same configuration as the canyon wall and could be ideal for storing limited quantities of RH waste prior to processing.

A sodium test vessel is located in the Head End which would be removed. The Head End could be cleared of all the equipment and materials stored in the area. A 10-ton boom crane with an 24.4-m span would be placed in the Head End to retrieve the packages from the rail car for temporary storage in the Head End.

6.6.2.1.3.2.4 Concrete/Roof Repairs. The concrete walls of the canyon facility show visible signs of degradation, such as cracks and rust, indicating deterioration of the structure and the reinforcing steel. The cracks should be filled with a grout or mortar and the exterior of the walls coated with a weatherproofing sealant to prevent further deterioration. The existing roof gravel and asphalt, which has not been replaced since construction, will be removed and a new roofing system reapplied.

6.6.2.1.3.2.5 Electrical. Project C-157 was scheduled to provide upgrades to the 480 volt motor control centers and provide the plant with a primary 240V/480V electrical system. This upgrade is necessary for safe operation of the facility. The process would require a viable standby power system and uninterruptible power supply system to support process, monitoring, and controls in case of extended power outages. New diesel-generator sets consisting of two units with 100% redundancy would be sufficient to satisfy standby requirements. A detailed description of the proposed electrical work under this project can be found in the Project C-157, T Plant Electrical Upgrade - Functional Design Criteria.

6.6.2.1.3.2.6 Lighting. Limited lighting upgrades will be needed at the facility. The Canyon lighting is adequate for the proposed remote operations. Additional 120V receptacles will be added to allow the use of temporary lighting near the Canyon deck as necessary for performing maintenance tasks on the facility and equipment. Fluorescent type light fixtures will be used in each of the galleries. Lighting in the tunnel is adequate for remote operations and upgrades are not necessary.

6.6.2.1.3.2.7 Heating System. The current steam distribution system at the facility would require extensive upgrades with a large cost. Disconnecting the existing steam system and installing heat pumps for the galleries and canyon could provide an efficient, cost effective heating/cooling system.

6.6.2.1.3.2.8 Fire Suppression. An automatic fire suppression system should be installed in the T Plant Galleries to include sprinkler system, piping system, and connection to the Fire Department.

An automatic fire suppression system would not be effective in the canyon due to the ceiling height. In addition, a large quantity of contaminated waste water could be created. An early warning fire detection system with interlocks to shut-down the HVAC system from the fire alarm control panel will be implemented.

6.6.2.1.3.2.9 Remote Control Room. All operations in the 221-T Canyon will be remotely operated. Project C-159 includes the construction of a centralized control room to consolidate the surveillance information and records for equipment and operations being monitored. Project C-159 also includes upgrades to the instrumentation and controls that will be implemented for this process.

6.6.2.1.3.2.10 Office Facility. The 271-T Office Facility will not be used due to the need to upgrade the HVAC, hot water, chilled water, and fire suppression systems. A mobile office structure (e.g., 3.04-m-wide office trailer) may be used for office facilities.

6.6.2.1.3.2.11 Operator Certification, Procedures, Readiness Review. Operator training, procedure writing, and a formal readiness review must be completed prior to implementation of any processing at the 221-T Canyon.

6.6.2.1.4 References. A study was performed in 1994 which evaluated the viability of the 221-T Canyon in supporting the Hanford Site decontamination mission, Long-Term Decontamination Engineering Study (LTDES) (Parsons 1994). The study discussed a scenario for providing a fully remote operation with a projected waste stream which included LLCE LLMW and TRU processing at T Plant. The key safety and environmental compliance upgrades were identified to support this mission. This study was used as a basis for the identifying the necessary upgrades, modifications, and process layout. Detailed cost estimates were included in the LTDES, and were used as a basis for estimating this scenario.

6.6.2.1.5 Assumptions. General assumptions were identified for the TRU processing. Specific assumptions for processing TRU at T Plant include:

1. The facility does not need to be seismically qualified to Hazardous Category 2. Structural upgrades are not necessary for complying with

this category.

2. An initial package assay of the Suspect waste will be performed in the field, to further segregate and define the waste stream. Only those packages which are identified as TRU (> 100 nCi/g) will be shipped to the 221-T Canyon for processing.

3. Lead shielding will not be used for the manufacturing of containers.

4. The NESHAPs stack monitoring and iso-kinetic sampling for radionuclides will be performed at the 291-T Stack. It is assumed monitoring will be required due to a much higher source term expected with a full service mission.

5. Size-reduction equipment will include band saws, plasma arc cutter, acetylene torches, and hydraulic cutters.

6.6.2.1.6 Uncertainties. The T Plant complex is currently permitted on an interim basis under the RCRA for treatment and storage of LLW and LLMW. A Part-B permit application is currently being prepared and is expected to be submitted to the State Department of Ecology, early in 1996. If T Plant is selected to process the TRU waste stream, the Part-B permit application must be modified. A modification of this nature, changing waste streams, may require a period for public review and comments. Therefore, the T Plant Part-B permit could be delayed. However, this probably will not significantly increase the cost of the permit application, currently being prepared by external consulting firms and budgeted for $200,000.

6.6.2.2 TRU Waste (RH and Large Container CH) Processing at the MASF.

6.6.2.2.1 Introduction. The MASF is being considered for processing and packaging of RH TRU and Large Container CH TRU. Figure 6.6.2-5 provides a layout of the MASF facility and the TRU processing activities. The TRU processing approach at MASF is provided herein the process flow and logic are included in 6.6.2-6 and 6.6.2-7.

6.6.2.2.2 Processing Approach.

6.6.2.2.2.1 Receiving/Shipping. The waste will be received by rail car at the north end of the facility in the high-bay area. The package tiedowns on the rail car will loosened manually prior to entering the facility. Up to three rail cars may be backed into the facility for unloading.

The packages will be removed from the rail car using the 181.4-tonne crane and will be transported for processing or for temporary storage. Portions of the processing line will be covered under a 0.6-m-thick wall and ceiling. Ceiling bays will be constructed in order to move packages between the rail, the Decontamination Area #2, and the Size-Reduction Area. Packages may be temporarily staged on top of the ceiling near the Size-Reduction Area until processing. Packages may be transported to the Size-Reduction Area at the time of processing using the 181.4-tonne crane.

6.6.2.2.2.2 Unloading and Size-Reduction Area. The crane will retrieve the waste packages from the rail car and transfer them to the Size-Reduction Area for unpacking. RH TRU waste may be received in a container overpacked in a

cask/overpack. The containers will be removed from the cask/overpack using the crane and will be set down in the Unloading Area. The cask/overpack will be decontaminated in the Decontamination Area #2 for reuse/repackaging of the TRU waste.

The container will be unloaded using a Pick-and-Place Robot, which will either transfer the waste to a size-reduction module or load it directly into buckets on the conveyor lines. Those items with dimensions larger than 1 m will be transferred to the size-reduction module, items smaller than 1 m will by-pass size-reduction and will be placed into buckets at the first loading station of the conveyor system (Figure 6.6.2-5).

Once the container is unloaded, the container and any shielding will be shredded and packaged as LLW; an assumption was made that no lead shielding will be used for the manufacturing of these containers. The container and shielding will be cut into pieces and placed into the container shredder. The TRU or hazardous/mixed waste will not be placed in the shredder to minimize the potential for cross-contamination. The shredded materials will be placed into buckets on the conveyor and will be directed to the survey area. A Pick-and-Place Robot will retrieve the item and perform the cutting, depending upon the type of materials and dimensions.

A conveyor system with a bar code scanning system will be used for transporting the waste through the Processing Area. The bar code scanning system will allow for the buckets to be directed into the individual process modules and will aid in tracking the waste and accounting for the facility throughput. Two conveyors will be used for the loaded buckets, which will span the length of the Processing Area. These conveyors will be stacked such that the two lower levels will carry the waste through the process modules and the two upper levels of the conveyor system will be the return system, transporting the unloaded/empty buckets back to the Unloading and Size-Reduction Area. A 1.8-tonne mobile manipulator/forklift will access the conveyor for maintenance purposes and to remove the conveyor buckets in case of a failure in the conveyor system.

6.6.2.2.2.3 Assay/Survey. All buckets will enter one of two on-line bucket assay machines. The conveyor directs the buckets into the assay modules. The buckets and waste will be weighed and assayed simultaneously to calculate the Pu-239 specific activity for the bucket waste. Routine empty bucket assays will be performed. Each bucket of waste will leave the assay modules with either TRU or LLW designators assigned to them by the bar code system.

After the assay is performed, the buckets will pass through a dose rate survey machine to determine whether the waste is CH or RH (both the TRU and LLW). The CH TRU originally in Large Containers and LLW buckets will by-pass the stabilization process modules and will enter the Packaging Area directly. The CH TRU is size-reduced and repackaged, only.

6.6.2.2.2.4 Stabilization. The TRU buckets will enter a sorting module prior to stabilization. The buckets will be emptied onto a sorting table and the waste will be sorted by a Pick-and-Place Robot for the type of stabilization, Polyethylene Extrusion or Vibragrout. The waste will then be reloaded into buckets and directed into the appropriate module, loaded into drums, and be stabilized. After the stabilization process, the drums will be transported to the Packaging/Staging Area using the manipulator/forklift.

6.6.2.2.2.5 Packaging. The waste will be received in the Packaging/Staging Area in buckets or drums as one of three possible waste streams: RH and CH TRUM, RH and CH TRU, and CH LLW.

There will be designated areas assigned for packaging each of the waste streams, staging of empty containers and overpacks, and staging of packaged containers. The containers will be surveyed and smeared in this area immediately prior to transport to the rail car by the crane.

6.6.2.2.2.6 Througnput Analysis. See Section 6.6.2.1.2.6. It is assumed that throughput at MASF will be slightly higher than at T Plant. Because the limiting operation at T Plant was shipping and receiving based on one railcar at a time, and the proposed MASF system will be able to ship and receive waste three railcars at a time.

6.6.2.2.3 Facility Description.

6.6.2.2.3.1 Existing Facility Layout. The MASF Complex is located in the 400 Area approximately 152 m north of the FFTF. MASF is an existing facility which is used as a multipurpose facility for testing, storage, decontamination, and repair.

The MASF Complex consists of a main building and a two-story service wing (Figure 6.6.2-8). The main building is 88.4 m long by 28.9 m wide and is divided into a low-bay (14.9 m height) and high-bay (32.01 m height) area.

The high-bay area includes a Cask Decontamination and Maintenance Facility (CDMF) which is currently used to clean and reconfigure T-3 Shipping Casks. A 181.4-tonne overhead crane and a 22.7-tonne auxiliary hoist services the high-bay area.

The high-bay area is used for storage and contains a shielded enclosure for low level decontamination of tools and miscellaneous equipment. The Contaminated Equipment Repair Shop (CERS) for repair of IEM Cell components after decontamination is located in the high-bay area. A 60-ton overhead bridge crane with a 9.1-tonne auxiliary hoist services both the low and high-bay areas.

Materials are shipped into the MASF on a rail spur, which runs the length of the facility through both the low and high bays and ends at the north end of the building (high bay).

A two-story service wing is separated from the main building by a concrete block structural wall. The process control room, process equipment room, offices, and support rooms are located in this area. The separating wall serves as a fire wall and shield wall from the low and high-bay areas.

Loadout facility is located west of the service wing and is used for transfer of radioactive liquid waste from two, 18,925-liter, stainless-steel radioactive waste storage tanks located in concrete-shielded enclosure to tank cars on a second rail spur.

6.6.2.2.3.2 Upgrades/Modifications. The Maintenance and Storage Facility (MASF) Safety Analysis Report (WHC-SD-FF-SAR-005) provides an assessment of the facility environmental, operational, and protective safety features. A

detailed assessment of the MASF facility should be performed to determine the necessary upgrades and modifications for processing TRU waste. The following is a description of potential upgrades needed at the facility.

6.6.2.2.3.2.1 Zone Reduction. The main building in the MASF facility is not contaminated. In order to mitigate decontamination costs, a 0.6-m-thick concrete wall and roof will be constructed around the process line to contain the activities. The top of the ceiling will be used for segregated storage areas for packages prior to processing, overpacks prior to decontamination, decontaminated overpacks, empty containers, and packaged waste containers prior to shipment.

Ceiling bay doors will be located in the ceiling of the concrete structure over the Rail, Unloading Area, and Decontamination Area #2. A crane will be used for accessing each of these areas and for transporting the packages. The surfaces of the concrete structure should be painted prior to use to reduce future Decontamination and Decommissioning costs.

6.6.2.2.3.2.2 Structural. The MASF Facility is designed to the UBC standards. A structural analysis will be performed to determine any upgrades or modifications necessary to meet the Hazard Category 3 classification for processing waste at the facility. The column anchor bolts for the facility were not originally installed as designed. These may need to be modified or replaced.

6.6.2.2.3.2.3 Electrical. It is assumed that limited electrical upgrades may be necessary for the MASF facility.

6.6.2.2.3.2.4 Ventilation. Separate ventilation will be necessary for the activities performed inside the concrete structure.

6.6.2.2.3.2.5 Rail Road. The Rail Road spur runs the length of the facility, but terminates outside of the north end of the facility. Approximately 60.9 m of rail spur will need to be constructed and connected to the main rail line on the east side of the facility.

6.6.2.2.3.2.6 Remote Control Room. Viewing windows; operator interfaces with joy stick; and closed-circuit televisions.

6.6.2.2.3.2.7 Operator Certification, Procedures, Readiness Review. Operator training, procedure writing, and a formal readiness review must be completed prior to implementation of any processing at MASF.

6.6.2.2.4 References. The Maintenance and Storage Facility (MASF) Safety Analysis Report (WHC-SD-FF-SAR-005) provides an assessment of the facility environmental, operational, and protective safety features. This study was used as a basis for defining the process layout.

6.6.2.2.5 Assumptions. General assumptions were identified for TRU processing. Specific assumptions for processing TRU at MASF include:

1. An initial package assay of the Suspect waste will be performed in the field, to further segregate and define the waste stream. Only those packages which are identified as TRU (> 100 nCi/g) will be shipped to MASF for processing.

2. Lead shielding will not be used for the manufacturing of these containers.

3. Size-reduction equipment will include band saws, plasma arc cutter, acetylene torches, and hydraulic cutters.

6.6.2.2.6 **Uncertainties**. A detailed assessment of MASF should be performed to determine the extent of necessary upgrades.

6.6.2.3 RH and Large Container CH LLMW Processing at Grout Vault Facilities.

6.6.2.3.1 **Introduction**. The grout vault facilities are being considered for the processing of RH and CH Large Container LLMW, and final disposal of RH LLMW. Treatment required for the waste streams includes size-reduction, segregation, thermal treatment (devolitization) of organic and other volatile materials from the RH stream, macro encapsulation of the RH stream, and repackaging of the CH LLMW. The majority of the RH LLMW stream is LLCE that is currently either stored in the canyon facilities or will be removed from the SSTs or DSTs in the Tank Farms.

6.6.2.3.2 **Process Approach**. It is estimated that 111,000 m^3 of RH and large-container CH LLMW will be processed. Of this, approximately 87,000 m^3 will be LLCE. The remaining volumes are CH LLMW and will be repackaged and shipped to WRAP-2A.

For the purpose of this study, approximately 10% of the LLCE waste stream (221 LLCE items) was evaluated to determine volumes for final disposal. These volumes included shipping container, void space, and envelope volumes. The envelope volume was determined by taking the maximum outside dimension of the specific LLCE and multiplying by its maximum length. The void space volume is the inner volume of the shipping container minus the envelope volume. This was derived from outside dimensions and maximum equipment sizes provided in the Titzler report.

Although the PNL waste stream model assumed a volume of 87,000 m^3 for the LLCE, exact calculations produced an estimate of 102,000 m^3 for the aggregate volumes of all containers for the LLCE. The calculations are shown in Exhibit 6.6.1-2. Of this, approximately 86% is either the shipping container or void space. Evaluation of the total volumes in relation to the void volumes produced an estimate of 15,000 m^3 LLCE envelope volume. The envelope volume would be further decreased during the size-reduction process, thus reducing the final disposal volume. This report did not further evaluate potential volume reductions because this would require extensive equipment drawing reviews to determine a more precise disposal volume.

Using the total disposal volume of 18,000 m^3 for size-reduced RH LLMW, the grout vaults are a viable option for RH LLMW stream macro-encapsulation. This would require modifications to three of the vaults, and construction of a size-reduction facility.

6.6.2.3.3 **Facility Description**. There are four unused grout vaults near the 200 East area. These vaults measure 37.6 m long, 15.4 m wide and 10.3 m deep, and were constructed to meet Safety Class 2 criteria. The vaults were constructed for the disposal of liquid tank waste mixed with a grout slurry, and are composed of structural backfill, high-density polyethylene

(HDPE), concrete, and various geotextiles to assure containment. Leak detection and sump collection systems were installed and would be used for the new application of LLCE macro-encapsulation.

6.6.2.3.3.1 Facility Modifications, Scenario 1. The preferred scenario would require that an above-ground structure be constructed adjacent to the grout vaults to facilitate offloading, unpacking, size-reduction, and transfer of waste to the vaults (see Figure 6.6.2-9). This shielded structure would contain equipment for size-reduction, thermal devolitization, and manipulation for the LLCE. A building extension would be constructed, connecting the size-reduction facility to the vaults. This extension would allow the shielded transfer LLCEs from the size-reduction facility to the storage vaults (Figure 6.6.2-10).

A minimum of three overhead cranes would be required for the entire process--an off-load crane, housed in the main size-reduction facility; a transfer crane installed in the transfer extension to move the size-reduced LLCE from the main facility to the vaults; and a placement crane, which would move the LLCE from the access port in the vault to the final disposal location (see Figure 6.6.2-11). Closed-circuit television and lighting would be installed for remote surveillance of each crane.

6.6.2.3.3.1.1 Grout Pour Operation. The first layer of LLCE will be placed directly on the vault floor and stacked to approximately 2.4 m. Grout will then be pumped through existing access ports to macro-encapsulate the first layer of LLCE. After the layer is poured, a bond-breaking agent will be applied to reduce the bonding effect between layers of grout, allowing for future retrieval. Each layer of grout will be succeeded by another layer of LLCE, macro-encapsulation grout, and a bond breaking agent until the vault is filled to within 1.8 m of the top. The bond breaking agent will assist in separating the grout layers in the eventuality that the LLCE would need to be retrieved.

Scenario No. 1 would require the use of 85% of each of the three vaults to accommodate the storage of the 15,000 m^3 LLCE waste stream.

6.6.2.3.3.1.2 Waste Retrieval. Inside of each vault, specialized retrieval provisions would be installed. Diamond cable cutting is a viable technology that is capable of cutting through steel and grout. A network of conduit will be installed in the eventuality that retrieval of the waste would be required. If retrieval were required, a specially constructed diamond cutting cable would be threaded through the conduit and cycled through similar to a bandsaw machine.

The bond-breaking agent that was installed during placement would help to prevent the layers of grout from sticking together. Provisions for the picking of each block of retrieved grout would need to be further evaluated as well as the need for shielding the blocks during retrieval.

6.6.2.3.3.2 Facility Modifications Scenario 2. Scenario 2 follows much of the same logic used in Scenario 1. The major difference is that the disposal vaults tops would be removed and a building would be constructed directly over each existing vault to contain size-reduction thermal treatment activities and LLCE placement. One of the vaults would be used as the processing facility and the remaining three would be used for macro-encapsulation. The processing

functions would be performed inside the processing vault, using existing cranes and would provide natural shielding from the surrounding earth.

The top of each vault would be removed entirely and replaced with a support structure. The additional support structure is required because the roof is a structural member of the complete vault system, providing lateral support for pressure exerted by the structurally backfilled soil. Over this support structure, a new facility would be constructed allowing direct overhead access to the vault for direct placement of the size-reduced LLCE pieces.

Transfer of LLCE from the size reduction area to the disposal area would be performed by conveyor systems in above-ground buildings that connect the processing vault to the disposal vaults (see Figures 6.6.2-12, 6.6.2-13, 6.6.2-14, 6.6.2-15, 6.6.2-16, and 6.6.2-17).

6.6.2.3.3.2.1 Grout Pour Operation. Vault filling will be accomplished the same as in Section 6.6.2.3.3.1.1, with the exception that the vault can be filled to within 0.3 m to 0.6 m of the inner roof structure elevation surface. With the additional fill space, three vaults will be required to store the 15,000-m^3 LLCE; two filled to maximum capacity and one filled to 35%. It is feasible the third grout vault would not be required if size-reduction activities could lower the waste stream volume to approximately 11,300 m^3.

6.6.2.3.3.2.2 Waste Retrieval. Provisions could also be made for retrieval of the waste by including placement of an array of conduit or piping for diamond wire cutting and using bond-breaking material between grout layers. The details of this proposed retrieval method are in Section 6.6.2.3.3.1.2.

6.6.2.4 LLMW (RH and Large Container CH) Processing at the MASF

6.6.2.4.1 Introduction. The MASF is being considered for processing and packaging of RH LLMW and CH LLMW in Large Containers. Figure 6.6.2-18 provides a layout of the MASF Facility and the LLMW processing activities. The LLMW processing approach at MASF is provided below. The process flow and logic are included in 6.6.2-19 and 6.6.2-20.

6.6.2.4.2 Processing Approach.

6.6.2.4.2.1 Receiving/Shipping. The waste will be received by rail car at the north end of the facility in the high-bay area. The package tiedowns on the rail car will be loosened manually prior to entering the facility. Up to three rail cars may be backed into the facility for unloading.

The packages will be removed from the rail car using the 200-ton crane and will be transported for processing or for temporary storage. Portions of the processing line will be covered under a 0.6-m-thick concrete wall and ceiling enclosure. Ceiling bays will be constructed in order to move packages between the rail, Decontamination Area No. 2, Vertical Cells, and the Size-Reduction Area. The packages may be temporarily staged on top of the ceiling near the Size-Reduction Area until processing.

The LLCE will be picked up by the 181.4-tonne crane, lifted over the concrete enclosure, and set down in the Vertical Cells in the high-bay area. The LLCE will be removed from the casks/overpacks while in the Vertical Cells

at the time of processing. While the LLCE are being lifted out of the cells, they will be supported and cut into lengths of less than 6 ft., and moved to the Size-Reduction Area for final size-reduction.

Non-LLCE packages received on the rail will be transported to the Size-Reduction Area from the temporary staging on top of the concrete enclosure at the time of processing using the 181.4-tonne crane. A Pick-and-Place Robot will retrieve the item and perform the cutting, depending upon the type of materials and dimensions.

A conveyor system with a bar code scanning system will be used for transporting the waste through the Processing Area. The bar code scanning system will allow for the buckets to be directed into the individual process modules and will aid in tracking the waste and accounting for the facility throughput. Two conveyors will be used for the loaded buckets, which will span the length of the Processing Area. These conveyors will be stacked such that the two lower levels will carry the waste through the process modules and the two upper levels of the conveyor system will be the return system, transporting the unloaded/empty buckets back to the Unloading and Size-Reduction Area. A 1.8-tonne mobile manipulator/forklift will access the conveyor for maintenance purposes and to remove the conveyor buckets in case of a failure in the conveyor system.

6.6.2.4.2.3 Examination/X-Ray (Optional). An Examination/X-Ray Area could be included to identify the hazardous waste portions of the LLMW buckets. This would consist of a visual examination machine which would x-ray the bucket to identify items which contribute to categorizing the waste as RMW, such as batteries, light bulbs, etc. This machine would allow a portion of the waste stream to be designated as LLW for shipping to the LLW Burial Grounds. The buckets would then be sorted as LLMW and LLW in the sorting module. This examination process was not specified in the PNL Process Logic Model, and is therefore, not included in the cost estimate for this option.

6.6.2.4.2.2 Unloading and Size-Reduction Area. The LLCE will be transferred to the Size-Reduction Area for final cutting into lengths less than 1 m and 181 kg.

The crane will retrieve the non-LLCE waste packages from the rail car and transfer them to the Size-Reduction Area for unpacking. RH LLMW waste should be received in a container overpacked in a cask/overpack. The containers will be removed from the cask/overpack using the crane and will be set down in the Unloading Area. The cask/overpack will be decontaminated in the Decontamination Area #2 for reuse/repackaging of the LLMW.

The container will be unloaded using a Pick-and-Place Robot that will either transfer the waste to a size-reduction module or load it directly into buckets on the conveyor lines. Those items with dimensions larger than 1 m will be transferred to the size-reduction module, items smaller than 1 m, will by-pass size-reduction and will be placed into buckets at the first loading station of the conveyor system.

Once the container is unloaded, the container and any shielding will be shredded and packaged as LLW; an assumption was made that no lead shielding will be used for the manufacturing of these containers. The container and shielding will be cut into pieces and placed into the container shredder. No

hazardous/mixed waste will be placed in the shredder to minimize the potential for cross-contamination. The shredded materials will be placed into buckets on the conveyor and will be directed to the survey area.

6.6.2.4.2.4 Thermal Treatment and Stabilization. The LLMW buckets will enter a sorting module prior to stabilization. The buckets will be emptied onto a sorting table and the waste will be sorted by a Pick-and-Place Robot for Thermal Treatment or stabilization. The waste will then be reloaded into buckets, sent through a dose rate survey machine to determine whether the waste is CH or RH, and directed into the appropriate treatment module. The CH LLW buckets will by-pass the treatment modules and will be sent directly to the packaging area.

The thermal treatment module will consist of a devolatilization process for small piece combustibles. The bucket contents will be emptied onto a rack which enters the devolatizer that vaporizes off the organic compounds, then is placed into another bucket.

The remaining LLMW will enter one of the stabilization modules, be placed in drums, and be stabilized in a Vibragrout machine. After the stabilization process, the drums will be transported to the Packaging/Staging Area using the manipulator/forklift.

6.6.2.4.2.5 Packaging. The waste will be received in the Packaging/Staging Area in buckets or drums as one of three possible waste streams: RH and CH LLMW and CH LLW. Designated areas will be assigned for packaging each of the waste streams, staging of empty containers and overpacks, and staging of packaged containers. The containers will be surveyed and smear-tested in this area immediately prior to transport to the rail car by the crane.

6.6.2.4.3 Facility Description.

6.6.2.4.3.1 Existing Facility Layout. The MASF Complex is located in the 400 Area, approximately 152 m north of the FFTF. The MASF is an existing facility that is used as a multipurpose facility for testing, storage, decontamination, and repair.

The MASF Complex consists of a main building and a two-story service wing (Figure 6.6.2-8). The main building is 88 m long x 28.9 m wide and is divided into a low-bay (14.9 m high) and high-bay (32 m high) area.

The high-bay area includes a Cask Decontamination and Maintenance Facility (CDMF), which is currently used to clean and reconfigure T-3 Shipping Casks. A 181.4-tonne overhead crane and a 22.7-tonne auxiliary hoist services the high-bay area.

The low-bay area is used for storage and contains a shielded enclosure for low level decontamination of tools and miscellaneous equipment. The Contaminated Equipment Repair Shop (CERS) for repair of IEM Cell components after decontamination is located in the high-bay area. A 54.4-tonne overhead bridge crane with a 9.1-tonne auxiliary hoist services both the low- and high-bay areas.

Materials are shipped into the MASF on a rail spur, which runs the length of the facility through both the low and high bays and ends at the

north end of the building (high bay).

A two-story service wing is separated from the main building by a concrete block structural wall. The process control room, process equipment room, offices, and support rooms are located in this area. The separating wall serves as a fire wall and shield wall from the low and high-bay areas.

The loadout facility is located west of the service wing and is used for transfer of radioactive liquid waste from two, 18,925 liter, stainless-steel radioactive waste storage tanks located in concrete-shielded enclosure to tank cars on a second rail spur.

6.6.2.4.3.2 Upgrades/Modifications. The Maintenance and Storage Facility (MASF) Safety Analysis Report (WHC-SD-FF-SAR-005) provides an assessment of the facility environmental, operational, and protective safety features. A detailed assessment of the MASF facility should be performed to determine the necessary upgrades and modifications for processing LLMW waste. The following is a potential list of upgrades needed at the facility:

(a) Zone-Reduction
(b) Structural
(c) Electrical
(d) Ventilation
(e) Rail Road
(f) Remote Control Room
(g) Operator Certification, Procedures, Readiness Review

6.6.2.4.3.2.1 Zone-Reduction. The main building in the MASF facility is not contaminated. To mitigate decontamination costs, a 0.6-m-thick concrete wall and roof will be constructed around the process line to contain the activities. The top of the ceiling will be used for segregated storage areas for packages prior to processing, overpacks prior to decontamination, decontaminated overpacks, empty containers, and packaged waste containers prior to shipment.

Ceiling bay doors will be located in the ceiling of the concrete structure over the Rail, Size-Reduction Area, Decontamination Area #2, and Vertical Cells. A crane will be used for accessing each of these areas and for transporting the packages. The surfaces of the concrete structure should be painted prior to use to reduce future Decontamination and Decommissioning costs.

6.6.2.4.3.2.2 Structural. The MASF Facility is designed to the UBC standards. A structural analysis will be performed to determine any upgrades or modifications necessary to meet the Hazard Category 3 classification for processing waste at the facility. The column anchor bolts for the facility were not originally installed as designed. These may need to be modified or replaced.

6.6.2.4.3.2.3 Electrical. It is assumed that limited electrical upgrades may be necessary for the MASF facility.

6.6.2.4.3.2.4 Ventilation. Separate ventilation will be necessary for the activities performed inside the concrete structure.

6.6.2.4.3.2.5 Rail Road. The Rail Road spur runs the length of the facility, but terminates outside of the north end of the facility. Approximately 60.9 m of rail spur will need to be constructed and connected to the main rail line on the east side of the facility.

6.6.2.4.3.2.6 Remote Control Room.

(a) Viewing windows;
(b) Operator interfaces with joy stick; and
(c) Closed-circuit televisions.

6.6.2.4.3.2.7 Operator Certification, Procedures, Readiness Review. Operator training, procedure writing, and a formal readiness review must be completed prior to implementation of any processing at MASF.

6.6.2.4.4 References. The Maintenance and Storage Facility (MASF) Safety Analysis Report (WHC-SD-FF-SAR-005) is an assessment of the facility environmental, operational, and protective safety features. The study was used as a basis for defining the process layout.

6.6.2.4.5 Assumptions. General assumptions were identified for TRU processing. Specific assumptions for processing TRU at MASF include:

1. An initial package assay of the Suspect waste will be performed in the field, to further segregate and define the waste stream. Only those packages which are identified as TRU (> 100 nCi/g) will be shipped to MASF for processing.

2. Lead shielding will not be used for the manufacturing of containers.

3. Size-reduction equipment will include band saws, plasma arc cutter, acetylene torches, and hydraulic cutters.

6.6.2.4.6 Uncertainties.

1. A detailed assessment of MASF should be performed to determine the extent of necessary upgrades.

6.6.2.5 LLMW (RH and Large Container CH) Processing at T Plant Canyon.

6.6.2.5.1 Introduction. T Plant Facility is being considered for processing and packaging of RH LLMW and CH LLMW in Large Containers. Figure 6.6.2-21 is a T Plant Facility layout and the LLMW processing activities. The LLMW processing approach at T Plant is provided below. Process flow and logic are included in Figures 6.6.2-22 and 6.6.2-23.

6.6.2.5.2 Processing Approach.

6.6.2.5.2.1 Receiving/Shipping. Waste entering T Plant will be received in the tunnel on rail cars. Packaged tiedowns will be loosened outside the tunnel to prepare the rail car for unloading in the tunnel.

The LLCE will be brought into the tunnel on rail cars, butted up against a LLCE staging rail car. This car will be used for removing LLCE from its cask/overpack, horizontally, and performing an initial size-reduction to

reduce maximum dimension to 1.8 m and 1.8-tonne, to transport the waste into the Canyon with the existing entrance port. The LLCE will be cut using a system such as hydraulic cutters mounted on a retractable monorail (I-Beam) boom. The size-reduced pieces will be lifted from the rail car.

The non-LLCE waste packages will be unloaded from the rail car for processing or for temporary storage prior to processing. RH LLMW packages may be temporarily staged in the Head End until processing. The Head End is a shielded facility and would have the potential space necessary for temporarily staging up to 150 m^3 of LLMW prior to processing. A 9.07-tonne Telescoping Boom Crane would be located in the Head End which would have an 24.4-m span and would be able to transport the packages from the rail car to the Head End. The CH LLMW packages may be temporarily staged on an existing asphalt staging pad located west of the 2706-T Facility.

Packages that will be processed immediately will be retrieved from the rail car using the modified 40.8-tonne crane. These packages will be moved directly into the Size-Reduction Area.

6.6.2.5.2.2 Unloading and Size-Reduction Area. The Size-Reduction Area will be located adjacent to the west edge of the tunnel in portions of Sections 3, 4, and 5 of the building. The Size-Reduction Area and associated equipment will be situated adjacent to the PWR Fuel Pool, located in Cell 2R.

The LLCE pieces will be transferred to one of the Size-Reduction Modules for final size-reduction of lengths of 1 m and 181.8 kg. The RH LLMW should be received in a container overpacked in a cask/overpack. The containers will be removed from the cask/overpack using the 40.8-tonne crane and will be set down in the Unloading Area. The cask/overpack will be returned to the rail car using the 40.8-tonne crane and will be shipped to the 2706-T Facility for decontamination and eventual reuse.

The container will be unloaded using Pick-and-Place Robots which will either transfer the waste to the Size-Reduction Area or load it directly into buckets on the conveyor lines. Those items with dimensions larger than 1 m will be transferred to one of the Size-Reduction Modules, items smaller than 1 m will by-pass size-reduction and will be placed into buckets at the first loading station of the conveyor system.

Once the container is unloaded, the container and any shielding will be shredded and packaged as LLW; an assumption was made that no lead shielding will be used for the manufacturing of these containers. The container and shielding will be cut into pieces and placed into the container shredder by a Pick-and-Place Robot. No hazardous/mixed waste will be placed in the shredder to minimize the potential for cross-contamination. The shredded materials will be placed into buckets on the conveyor and sent to the survey area.

Size-reduction will be performed in one of two enclosed modules. A Pick-and-Place Robot will retrieve the item and perform the cutting, depending upon the type of materials and dimensions.

A conveyor system with a bar code scanning system will be used for transporting the waste through the Processing Area. The bar code scanning system will allow for the buckets to be directed into the individual process modules and will aid in tracking the waste and accounting for the facility

throughput. Two conveyors will be used for the loaded buckets, which will span the length of the Processing Area. These conveyors will be stacked such that the two lower levels will carry the waste through the process modules and the two upper levels of the conveyor system will be the return system, transporting the unloaded/empty buckets back to the Unloading and Size-Reduction Area. The conveyor will be 1 m wide and will be located approximately 4.5 m from the south wall of the Canyon Facility, to allow for a corridor which can be accessed by a 1.8-tonne mobile manipulator/forklift to provide access to the conveyor for maintenance purposes and to remove the conveyor buckets in case of a failure in the conveyor system.

6.6.2.5.2.3 Examination/X-Ray (Optional). An Examination/X-Ray Area could be included to identify the hazardous waste portions of the LLMW buckets. This would consist of a visual examination machine which would x-ray the bucket to identify items which contribute to categorizing the waste as RMW, such as batteries, light bulbs, etc. This machine would allow a portion of the waste stream to be designated as LLW for shipping to the LLW Burial Grounds. The buckets would then be sorted as LLMW and LLW in the sorting module. This examination process was not specified in the PNL Process Logic Model, and is therefore, not included in the cost estimate for this option.

6.6.2.5.2.4 Thermal Treatment and Stabilization. The LLMW buckets will enter a sorting module prior to stabilization. The buckets will be emptied onto a sorting table and the waste will be sorted by a Pick-and-Place Robot for thermal treatment or stabilization. The waste will then be reloaded into buckets, sent through a dose rate survey machine to determine whether the waste is CH or RH, and directed into the appropriate treatment module. The LLW buckets will by-pass the treatment modules and will be sent directly to the packaging area.

The Thermal Treatment module will consist of a devolatilization process for small pieces. The bucket contents will be emptied onto a rack which enters the devolatizer that volatilizes the organic compounds. The pieces are placed into another bucket.

The remaining LLMW will enter one of the stabilization modules, be placed in drums, and stabilized in a Vibragrout machine. After the stabilization process, the drums will be transported to the Packaging/Staging Area using the manipulator/forklift.

6.6.2.5.2.5 Packaging. The waste will be received in the Packaging/Staging Area in buckets or drums as one of three possible waste streams: RH and CH LLMW and CH LLW.

Designated areas for packaging each of the waste streams, staging of empty containers and overpacks, and staging of packaged containers.

The containers will be surveyed and smear-tested in this area immediately prior to transport to the tunnel rail car by the manipulator/forklift or the 40.8-tonne crane.

6.6.2.5.2.6 Throughput Analysis. See Section 6.6.2. It is assumed that throughput at MASF will be slightly higher than at T Plant, because the limiting operation at T Plant was shipping and receiving based on one railcar at a time, and the proposed MASF system will be able to ship and receive waste

three railcars at a time.

6.6.2.5.3 Facility Description.

6.6.2.5.3.1 Existing Facility Layout. The T Plant Complex, located in the 200 West Area, consists of various support facilities, including the 221-T Canyon, 2706-T Low Level Decontamination Facility, 271-T Office Facility, 211-T Chemical Storage Facility, and mobile offices and change rooms.

The 221-T Canyon was constructed in 1942 to provide chemical separations of special nuclear materials. 221-T's main processing room, the canyon, is approximately 800 feet (243.9 m) long, 35 feet (10.6 m) wide and 40 feet (12.1 m) (Reference WHC-SD-CP-SAR-007, Rev. 1C: Section 5.2.1.1, Figure 5-5).The operating, electrical, and piping galleries run the length of, and are immediately adjacent to, the canyon.

All material shipments into and out of the canyon occur through the 221-T Canyon Railroad Tunnel. This tunnel extends approximately 30.5 m from T Plant with access to the canyon through a process cell (approximately 6.1 m below the canyon deck).

The north end of the canyon, referred to as the Head End, is separated from the tunnel and the remainder of the canyon by a corrugated metal wall. The Head End is an area approximately 12.2 m long x 12.2 m wide and the depth of the canyon facility. The Head End was converted in the 1960s to provide various laboratory support functions, but is currently inactive. A Sodium Test Vessel is located below the deck level and various support equipment is scattered around the deck and levels.

The canyon deck consists of 20 Sections with process cells below the deck. The cells are covered with cover blocks which have 1-m-high lifting bales. A crane bridge runs the length of the canyon. A 68-tonne crane is mounted on the bridge which was down-rated to 40.8-tonne due to structural and mechanical deficiencies. A 9.1-tonne crane is welded in place on the bridge which is not currently operable.

The 271-T Facility is currently being used for offices. It is located adjacent and attached to the canyon galleries.

The 2706-T Facility is currently providing decontamination services for large transportable equipment with low levels of radiological and hazardous contamination.

6.6.2.5.3.2 Upgrades/Modifications. A study was performed in 1994 which evaluated the viability of the 221-T Canyon in supporting the Hanford Site decontamination mission, Long-Term Decontamination Engineering Study (LTDES) (Parsons 1994). The study discussed a scenario for providing a fully remotely handled operation with a projected waste stream that included LLCE LLMW and TRU processing at T Plant. The key safety and environmental compliance upgrades were identified to support this mission.

T Plant Facility upgrades were identified in the LTDES for providing processing services for the waste stream projected at the time of the study. The need for the individual upgrades required for the waste streams and processed considered in this scenario were evaluated separately. Where

similar upgrades were considered in the LTDES, the detailed plant modifications and associated costs were excerpted from the LTDES. The following upgrades and modifications were identified for the proposed T Plant LLMW mission:

(a) Zone Reduction and Canyon Cleanup;
(b) Crane Upgrades;
(c) Head End Modifications;
(d) Concrete/Roof Repairs;
(e) Electrical;
(f) Lighting;
(g) Heating System;
(h) Fire Suppression;
(i) Remote Control Room;
(j) Office Facility; and
(k) Operator Certification, Procedures, Readiness Review.

Each of the required upgrades are described below. More detailed information on most of these upgrades is included in the LTDES.

6.6.2.5.3.2.1 Zone Reduction and Canyon Cleanup. Limited zone reduction activities will be performed, since all operations in the Canyon will be remotely handled. The 221-T galleries will be cleared and depending upon the existing conditions, the walls and floors will be sandblasted, painted, and coated with a sealant to eliminate radiological zones in the galleries to the extent possible. Zone reduction in the Canyon will include removing the significant quantity of waste materials and contaminated equipment stored on the deck, to provide adequate processing space in the canyon. Equipment currently stored in the processing cells will not be removed. Removal of the stored contaminated equipment on the deck will require size-reduction, decontamination and hazardous waste treatment, and packaging. A limited painting and coating of those areas potentially containing "clean" packages will be performed, such as the Size-Reduction Area and Packaging Area.

The PWR Pool (shipping port fuel) is stored in Cell 2R of Section 2 of the Canyon. The operations associated with this proposed scenario would be constructed around this cell in order to provide future access to this cell.

The cell cover blocks have 1-m high lifting bales which limit the placement of process equipment and may restrict movement of contaminated equipment through a process line. The proposed process modules will be elevated on 1-m platforms over the canyon deck and lifting bales. Removal of the lifting bales is not feasible since removal of these cover blocks in the future may be required.

Several of the operations identified in this scenario will be performed in process modules, including separate modules for size-reduction (2 areas), sorting for processing, polyethylene extrusion, and grout (2 systems). These process modules will be stainless steel with individual ventilation systems.

6.6.2.5.3.2.2 Crane Upgrades. The 40.8-tonne crane (originally rated at 68-tonne) is shielded with a lead plate, this shielding should be removed to improve the operating life of the crane. The crane must be equipped with remote handling capabilities and optics.

The 10-ton crane, welded in place on the crane bridge, is not currently operable. This crane would be repaired and returned to service to provide added flexibility to operations within the canyon.

6.6.2.5.3.2.3 Head End Modifications. The Head End could be modified in order to provide a temporary staging area for waste to be treated or transported following treatment.

A corrugated metal wall separates the Head End from the tunnel in the canyon which may be removed to provide a staging area for temporary storage of the RH LLMW which is awaiting processing in the facility. This area is shielded by the same configuration as the canyon wall and could be ideal for storing limited quantities of RH waste prior to processing.

A sodium test vessel is located in the Head End which would be removed. The Head End could be cleared of all the equipment and materials stored in the area. A 10-ton boom crane with an 24.4-m span would be placed in the Head End to retrieve the packages from the rail car for temporary storage in the Head End.

6.6.2.5.3.2.4 Concrete/Roof Repairs. The concrete walls of the canyon facility show visible signs of degradation, such as cracks and rust, indicating deterioration of the structure and the reinforcing steel. The cracks should be filled with a grout or mortar and the exterior of the walls coated with a weatherproofing sealant to prevent further deterioration. The existing roof gravel and asphalt, which has not been replaced since construction, will be removed and a new roofing system reapplied.

6.6.2.5.3.2.5 Electrical. Project C-157 was scheduled to provide upgrades to the 480 volt motor control centers and provide the plant with a primary 240V/480V electrical system. This upgrade is necessary for safe operation of the facility. The process would require a viable standby power system and Uninterruptable power supply system to support process, monitoring, and controls in case of extended power outages. New diesel-generator sets consisting of two units with 100% redundancy would be sufficient to satisfy standby requirements. A detailed description of the proposed electrical work under this project can be found in the Project C-157, T Plant Electrical Upgrade - Functional Design Criteria.

6.6.2.5.3.2.6 Lighting. Limited lighting upgrades will be needed at the facility. The Canyon lighting is adequate for the proposed remote operations. Additional 120V receptacles will be added to allow the use of temporary lighting near the Canyon deck as necessary for performing maintenance tasks on the facility and equipment. Fluorescent type light fixtures will be used in each of the galleries. Lighting in the tunnel is adequate for remote operations and upgrades are not necessary.

6.6.2.5.3.2.7 Heating System. The current steam distribution system at the facility would require extensive upgrades with a large cost. Disconnecting the existing steam system and installing heat pumps for the galleries and canyon could provide an efficient, cost effective heating/cooling system.

6.6.2.5.3.2.8 Fire Suppression. An automatic fire suppression system should be installed in the 221-T Canyon Galleries to include sprinkler system, piping system, and connection to the Fire Department.

An automatic fire suppression system would not be effective in the canyon due to the ceiling height. In addition, a large quantity of contaminated waste water could be created. An early warning fire detection system with interlocks to shut-down the HVAC system from the fire alarm control panel will be implemented.

6.6.2.5.3.2.9 Remote Control Room. All operations in the 221-T Canyon will be remotely operated. Project C-159 includes the construction of a centralized control room to consolidate the surveillance information and records for equipment and operations being monitored.

Project C-159 also includes upgrades to the instrumentation and controls which will be implemented for this process.

6.6.2.5.3.2.10 Office Facility. The 271-T Office Facility will not be used due to the need to upgrade the HVAC, hot water, chilled water, and fire suppression systems. A mobile office structure (e.g., 3-m wide office trailer) may be used for office facilities.

6.6.2.5.3.2.11 Operator Certification, Procedures, Readiness Review. Operator training, procedure writing, and a formal readiness review must be completed prior to implementation of any processing at the 221-T Canyon.

6.6.2.5.4 References. A study performed in 1994 evaluated the viability of the 221-T Canyon in supporting the Hanford Site decontamination mission, Long-Term Decontamination Engineering Study (LTDES) (Parsons 1994). The study discussed a scenario for providing a fully remotely handled operation with a projected waste stream which included LLCE LLMW and TRU processing at T Plant. The key safety and environmental compliance upgrades were identified to support this mission. This study was used as a basis for the identifying the necessary upgrades, modifications, and process layout. Detailed cost estimates were included in the LTDES, and were used as a basis for estimating this scenario.

6.6.2.5.5 Assumptions. General assumptions were identified for the LLMW processing. Specific assumptions for processing LLMW at T Plant include:

1. The facility does not need to be seismically qualified to Hazardous Category 2. Structural upgrades are not necessary for complying with this category.

2. Lead shielding will not be used for the manufacturing of containers).

3. The ESHAPs stack monitoring and iso-kinetic sampling for radionuclides will be performed at the 291-T Stack. It is assumed monitoring will be required due to a much higher source term expected with a full service mission.

4. Size-reduction equipment will include band saws, plasma arc cutter, acetylene torches, and hydraulic cutters.

6.6.2.5.6 Uncertainties. The T Plant is currently permitted under the Resource Conservation and Recovery Act (RCRA) for treatment and storage. Other permitting may be needed, including the Revision of the Part B permit and NEPA C2 Analysis and Environmental Assessment to determine impacts due to

the major systems used in this scenario.

6.6.2.6 Storage of RH-TRU Waste at the FMEF

6.6.2.6.1 **Introduction.** The FMEF is a Safety Class 1 nuclear facility constructed in the 400 Area with no current mission. The FMEF is the only existing facility that has remote-handling capability, is free of radioactive contamination, and contains heavily shielded cells that could be modified to accommodate storage of RH TRU. Interim storage of the RH TRU would be required prior to processing and prior to final disposal (WIPP).

6.6.2.6.2 **Storage Approach.** The maximum RH TRU storage volume prior to processing is projected to be 16,300 m^3. The maximum volume to be stored prior to disposal is projected to be 36,166 m^3 in the year 2023. This represents the maximum storage volume required. The three cells in FMEF that meet the shielding requirements for RH TRU could accommodate up to 3,300 m^3 of waste. The total storage capacity would only meet 9% of the RH TRU storage space needed. Use of FMEF as a storage facility would only be a partial solution due to the limited amount of storage space available.

6.6.2.6.3 **Facility Description.** The RH TRU waste would be transported to FMEF via truck. The RH TRU transport containers would be unloaded in Truck Bay 300. An overhead crane would be installed on the existing crane rails to transport the containers to the receiving port of the 325 or 351 Storage Cells. The receiving ports were originally designed to transport 1-ft-dia. irradiated fuel assemblies. Larger receiving ports would be installed to accommodate the larger containers. A new conveyor system would transfer the containers to the third storage location, Room 141.

Storage Cells 325 and 351 were designed to support overhead cranes for product handling. The lower cell, Room 141 would require a support structure and overhead rail crane installed. The new cranes would provide the mechanism to move the RH TRU between the transfer ports and the storage locations.

Each storage cell would be fitted with custom storage racks that could be remotely assembled and moved in the cells. The racks would be designed to allow for the retrieval of any storage container for processing or repair. The facility was originally equipped for CCTV monitoring. This system would be used to perform monitoring and surveillance of the cells.

6.6.2.6.4 **References.** Facility drawings (H-4-104241,300819,104285), tours, meetings with FMEF Engineering Staff.

6.6.2.6.5 **Facility Specific Assumptions.** No modifications would be required to the FMEF ventilation system to support this process. See Exhibit 6.6.1.4 for assumptions made regarding RH TRU storage in WIPP canisters.

6.6.2.6.6 **Uncertainties.** The type of container used to transport and store the waste prior to processing is not known. The projected maximum volume prior to processing does not include lost space due to handling equipment.

6.6.2.6.7 **Cost.** The cost to modify FMEF for the storage of RH TRU is estimated at $8 Million. Operating costs are estimated to be $2 Million per year based on the current operations and maintenance budget.

6.6.2.6.8 **Schedule**. All required modifications could be completed to support initial storage in the year 2001.

6.6.2.7 Storage of RH-LLMW at the FMEF.

6.6.2.7.1 **Introduction**. The FMEF could be modified to support interim storage of RH LLMW if it is not used for RH TRU storage, as discussed in Section 6.6.2.6. FMEF is the only existing facility that has remote-handling capability, is free of radioactive contamination, and contains heavily shielded cells. Interim storage of RH LLMW at FMEF would be required prior to processing and prior to final disposal (Mixed-Waste Disposal Trench).

6.6.2.7.2 **Storage Approach**. The maximum RH LLMW storage volume prior to processing is projected to be 20,125 m^3. The maximum volume to be stored prior to disposal is projected to be 40,363 m^3. The three cells in FMEF that meet the shielding requirements for RH LLMW could accommodate up to 3,300 m^3 of waste. The total storage capacity would only meet 8% of the RH LLMW storage space needed. Use of FMEF as an interim storage facility would only be a partial solution due to the limited amount of available storage space, as was the case for interim storage of RH TRU.

6.6.2.7.3 **References**. Facility drawings (H-4-104241,300819,104285), tours, and meetings with FMEF Engineering Staff.

6.6.2.7.4 **Facility Specific Assumptions**. No modifications would be required to the FMEF ventilation system to support the process. See Exhibit 6.6.1-4 for assumptions made regarding RH LLMW containers.

6.6.2.7.5 **Schedule**. All modifications could be completed to support storage in the year 2001.

6.6.2.8 Interim Storage of Cs and Sr Capsules.

6.6.2.8.1 **Introduction.** The existing baseline documentation for long term storage and processing (overpacking) of the capsules for disposal in a off-site repository, describes a number of options but does not provide a clear path forward. The options which have been described in various documents include storage and processing at WESF, the Canister Storage Building, and a new Cs/Sr overpack facility. All of these options are discussed below.

The current capsule inventory is as follows:

1. 1,577 Cs-137 capsules were fabricated at WESF (Figure 6.6.2-24); and

2. 640 Sr capsules were fabricated at the WESF. Currently, 601 Sr capsules (23.23 mCi, decayed to October 15, 1994) are stored in the WESF pool cells; four Sr capsules (0.32 mCi) are located off-site (Nevada), and 5 Sr capsules (2.36 mCi) have been cut or destroyed (Figure 6.6.2-25).

The capsules are currently stored in pools of demineralized water in the WESF, except those that are in commercial use or stored elsewhere.

The inner portion of the Sr-90 source capsules are constructed of hastelloy C, while the outer portion is 316L stainless-steel (UT) with gas

tungsten arc welded. The projected Sr-90 loading of each capsule is 90 KCi. Both the inner and outer portions of the Cs-137 source capsule are constructed of 316L stainless-steel (UT) and gas tungsten arc welded. The projected Cs-137 loading of each capsule is 70 KCi. The inner container was filled to approximately 80% of volume with the molten CsCl or compacted granules of SrF_2 and sealed with a welded cap. After passing leak checks and other inspections, the container was decontaminated by electropolishing and placed into an outer container. The inner container was then sealed in the outer container by welding a cap onto the open end of the outer container.

The process to be used in overpacking the capsules consists of several steps. First, the capsules will be removed from the water pools in the WESF and are loaded into an overpack container suitable for disposal at the off-site repository. The overpack container is then placed into a cask for shipment.

The general requirements for a capsule overpack facility include:

1. A receiving area for the capsules which arrive by truck in shielded casks;

2. A shielded receiving cell where the capsules are remotely unloaded from the shielded casks and placed on a transfer mechanism;

3. A shielded packing and welding hot cell where the capsules are placed into stainless steel canisters, and the canisters seal welded;

4. A load-out area where the sealed canisters are placed into a shipment casks; and

5. A storage area/pad for the casks awaiting shipment to the off-site Repository.

Several facility options are available for the capsule overpacking operations. The WESF could be modified to add a hot cell for overpacking the capsules. Other options being considered include shipment to the Canister Storage Building (CSB). The CSB could then be used for interim storage of the capsules and for the overpacking operations.

6.6.2.8.2 Storage Approach.

FMEF. The FMEF FAA would be modified to accommodate the storage of the 2,217 capsules originally manufactured at WESF (Figure 6.6.2-26). Truck transport of the capsules from WESF to FMEF starting in 2009 would allow time for the required modifications to be performed. Initial cooling would be provided blowing air through the storage pit. After natural radionuclide decay, the heat generation rate of the capsules would decrease and natural convection cooling would be acceptable. The convection cooling concept is inherently a low maintenance operation and would minimize operational and maintenance costs.

WESF. Modifications required to continue wet storage of the Cs and Sr capsules at WESF are currently being developed by WESF operations. The FY 1997 activity data sheet outlines the summary level activities that will be required to meet current regulations. The upgrades include electrical,

ventilation, crane and compressor upgrades. Additional equipment for re-encapsulation and additional seismic upgrades will need to be installed. This option requires the capsules to be cooled in water which does not conform to the preferred dry storage option outlined in WHC-EP-0616, Rev. 0, "Cesium and Strontium Capsule Disposal."

An additional handling and repackaging facility will require construction in conjunction with continued wet storage at WESF. This facility will contain the capabilities for weld inspections of the capsules as well as overpacking operations. This ability will be required for any alternative.

6.6.2.8.3 Facility Description.

FMEF. The existing FAA is an excess annex to the FMEF main complex. It has a stand-alone HVAC system with two primary and two separate back up power sources. The area is serviced by a 4.5-tonne overhead rail crane. There is approximately 434 m^2 (4,675 ft^2) of available space in the FAA which could contain operations for the transfer, loading and remote manipulation of the capsules (Figure 6.6.2-27).

Preliminary calculations were performed that were intended to provide rough estimates of the heat generation rate and cooling requirements. The calculations are included in Exhibit 6 6.1-5.

Preliminary calculations show that forced-air cooling will provide adequate storage conditions to maintain the capsules at satisfactory temperatures. However, the results of the preliminary computations show that there is a strong possibility that natural convection cooling could be used alternately in the FAA. Regardless of the need for forced air, there is ample space and flexibility in the FAA to provide storage for the Cs and Sr capsules with the following modifications.

Cs and Sr capsules would be transported via truck transport to FMEF truck bay 111. The existing 111 bay crane would be upgraded to 18.1 tonne to accommodate unloading of the Beneficial Uses Shipping System (BUSS) transport cask. A raised loadout dock would be constructed to provide access to a new 12.2-m-long conveyor system leading to the BUSS unload area in room 101. Use of the FAA as a remote-handling area would require shielding walls to be constructed to maintain a less-than-detectable radiation reading outside the facility. In the BUSS loadout area, newly installed remote manipulators would transfer Cs and Sr capsules from the BUSS to new storage racks or casings. Storage racks would then be transported by the existing overhead rail crane in the FAA, to an underground port in the existing storage pit.

Excess remote manipulators and lead shielded viewing windows are currently being stored at FMEF pending a new use. These units could be used in the facility but should be considered for use at any facility ultimately chosen for storage.

WESF. The primary mission of the WESF was conversion of the liquid Sr and Cesium in B Plant to stable solid forms (strontium fluoride in the form of a compact powder and Cesium chloride as cast metal); encapsulation of the resulting solidified materials; and storage of the strontium and Cs capsules. The Cs salts and Sr salts were a result of a separation process for purifying these isotopes from aqueous tank waste.

The WESF consists of the cells, support facilities, and water basins used to store the Cs and Sr capsules. The adjacent B Plant provides WESF with the capabilities for liquid radioactive aqueous transfer, liquid effluent treatment and disposal, solid waste handling, and lag storage for the processed capsule contents. The G Cell at WESF is a key facility in handling the Cs and Sr capsules as they are inspected or loaded into casks for shipment from the facility.

Raw water provides once-through cooling for the WESF pool cells and the hot cell heat exchanger system (inactive). Currently, the cooling water effluent is routed to B Pond for disposal. A closed-loop cooling system for the WESF pool cell and hot cell areas is currently being installed. The new closed-loop cooling system will eliminate the current cooling water waste effluent stream.

The WESF has 11 pool cell areas, five of which contain Cs and Sr capsules. Shielding is provided by 4.3 m of water and a media of heat exchange for the capsules. The present plan is for the Cs and Sr capsules to be stored in the WESF pool system for the short term until a decision is made on longer term on-site storage and over packing. Off-site capsules will be returned and will remain in storage in the pool cell facility for 10 to 15 years.

The WESF depends on the adjacent B Plant for liquid radioactive waste transfer and liquid effluent treatment and disposal. As long as the Cs and Sr capsules are stored underwater at the WESF, waste-handling facilities in B Plant must be kept in a standby mode. The B Plant/WESF are currently operating under "interim status" RCRA standards. Three projects are underway (WO24, Compliance Upgrades; WO10, Ventilation; and WO07, Process Condensate Treatment) as steps to achieve compliance. The B Plant Complex is being modified to comply with environmental and safety regulations, codes, and standards to support the continued storage of the Cs and Sr capsules.

Cs/Sr Overpack Facility. Several options are available for capsule overpack. WESF can be modified to add hot cell handling capabilities for overpacking operations. The disassembly and processing represents a mission change for WESF and may require significant upgrades to meet regulatory requirements. Another option is to construct a new facility near WESF to provide overpacking operations.

The capsule overpack facility would require a transfer mechanism from the cooling cells to the overpack process area. This area would be a shielded hot cell to pack the capsules into welded steel canisters. The overpacks would be transferred to a loadout area specifically designed for placement into a transport vehicle. The entire process would require an offgas system and provisions for airborne contamination that would be generated.

Canister Storage Building (CSB). Some baseline documents state that commercially available modular vaults or the Canister Storage building will be used for Cs/Sr capsule storage. The *Multipurpose Storage Complex Description* indicates that the capsules will be stored initially in the Canister Storage Building. The CSB was originally designed for HLW canisters but is now planned to be used for storage of the Spent Nuclear Fuel. The CSB design would have to be modified to provide either wet or dry storage of the Cs/Sr capsules.

6.6.2.8.4 References.

WHC Internal Memo #16800-94-KPB-007, Cs Capsule Return Program to E.D. Robbins, Date 10/20/94, *"Quarterly Report - Location of WESF Cs Capsules"*

WHC Internal Memo #16610-94-JFB-051, B Plant Environmental Engineering to P.C. Sato, Date 07/26/94, *"Revision of Project W-252 Heat Load Requirements"*

WHC-EP-0616, Rev. 0, *Tank Waste Technical Options Report*, Appendix I, Section III.0

Fax to J. Kasper, from J. Sabin, dated 03/07/95

WHC-SD-HWV-ES-044, Rev. OE, *"Engineering Study for the Transfer and Storage of Cs and Sr Capsules,"* Predecisional Draft.

Telephone conversation, March 13, 1995, H. A. Heidkamp - Parsons Engineering Science, Inc. to W. J. Guether - Westinghouse Hanford Corporation.

6.6.2.8.5 Facility Specific Assumptions.

FMEF. Criteria has been provided that outlines that the capsules will be overpacked prior to interim storage. To assist in the cooling required to keep the capsules below their required storage temperature, an overpack consisting of a metallic pipe casing into which the capsules will fit snugly is suggested. Good contact between the outer casing surfaces and the overpack will facilitate conduction from the capsules; and in turn, convection cooling from the outer casing surfaces will adequately cool the capsules inside.

WESF. The WESF would continue to store the Cs and Sr capsules until a decision is made for longer term on-site storage and overpacking.

6.6.2.8.6 Uncertainties.

FMEF. Cooling requirements used for calculations in this report are approximations. Detailed analysis of convection cooling will be required. It is possible for the NEPA documentation to be prepared under an existing Environmental Assessment (EA). Other environmental assessments have been completed and the NEPA documentation could be incorporated with little potential impact.

WESF. Modifications are needed for both the WESF and the B Plant to meet the present environmental and safety regulations. The cost estimates for these modifications range form $30 million to over $100 million. Technical uncertainties associated with dry storage of the Cs/Sr capsules have not been resolved.

6.6.2.9 Storage of Unirradiated Uranium and Miscellaneous Sources at FMEF.

6.6.2.9.1 **Introduction.** The storage of UU currently occupies 2.620 m^2 of storage space at various locations in the 200 West, 300 and 400 Areas. The FMEF was evaluated for consolidated storage of the UU, using the current storage configurations. The space available in the FMEF is not adequate to

store the entire Hanford Site inventory; however, there are 1,778 tons (1,617 mtu) of UU currently for sale to off-site users. This represents 42% (by stored volume) of the current inventory at the Hanford Site and takes up 1,115 m^3 of the 2,620 m^3 of storage space. If this uranium is sold, the FMEF would have adequate storage space for the remaining (1,505 m^3 of storage space) 58% of the inventory of UU.

The FMEF is a Safety Class 1 nuclear facility located in the 400 Area. The facility has no current mission and could be modified to store UU and miscellaneous source waste streams identified in the M-33 waste inventory outline.

The FMEF was evaluated for use as a central storage facility for all miscellaneous materials (UU, miscellaneous sources and strontium and cesium copper) because it exceeded all criteria for storage such as safeguards and security, remote handling capability, shielded areas and safety classification. A central storage for all of these materials would result in a lower overall management and operating cost. The option of using FMEF as a central facility may not be cost effective for UU alone, particularly if only construction costs are considered. Existing storage warehouse facilities may be more practical.

6.6.2.9.2 **Storage Approach.** The FMEF contains 20 rooms that could store 1,505 m^3 of UU. There are additional rooms that could be modified to store the miscellaneous sources. The heavy UU storage containers (greater than 2,445 kg/m^2) could be stored on the 10.6-m level, which is a mat foundation floor. The remaining inventory will be stored in various locations above the 10.6-m level. An existing, 7.3-tonne freight elevator would allow for the transport of the materials into the storage locations. The storage areas to be used are accessible by hallways, which can accommodate the electric pallet jacks or forklifts.

6.6.2.9.3 **Facility Description.** A portion of the Miscellaneous Sources waste stream must be transferred into shielded containers prior to shipment to FMEF for storage. The rooms that would store these shielded containers must be equipped with appropriate surveillance and monitoring equipment. There are shielded rooms in the FMEF that would be modified for this use. This Miscellaneous Source waste stream volume is very small and would require minimal cost for conversion of the FMEF for storage of this material.

The UU and the Miscellaneous Sources would be transported to FMEF via truck and trailer transport to truck bay 300. Forklift unloading and transporting of the materials to the storage locations is possible through the existing corridors which were designed for forklift operation. The 21-ft, 3-in. level would require the removal of five non-load bearing walls to maximize storage area and provide additional forklift accessibility. No additional modifications need be performed such as HVAC or electrical upgrades. Remote closed circuit television is available for use with some minor modifications.

6.6.2.9.4 **References.**

Floor Loading, Drawing H-4-104285, Westinghouse Hanford Company.

Floor Loading, Drawing H-4-104241, Westinghouse Hanford Company.

Options Analysis for Uranium Consolidation," WHC-SD-CP-ES-163, Westinghouse Hanford Company.

6.6.2.9.5 **Facility Specific Assumptions**. Floor loading for storage of the UU has been examined (see Figure 6.6.2-28) and the facility load limits would not be exceeded. Removal of the walls at the 21-ft, 3-in. level is expected to be necessary, but should not affect the structural integrity of the facility. It has been assumed that only 58% of the existing total stored volume of UU will require interim storage. The remaining 42% is assumed to have been sold to commercial buyers.

6.6.2.9.6 **Uncertainties**. Estimated costs are preliminary and should be reevaluated for accuracy. Exact storage locations in each room must be evaluated because of the point-loading allowances provided in the design.

6.6.2.10 Storage of HLW Canisters In Canyon Facilities.

6.6.2.10.1 **Introduction**. Six potential storage options for the HLW Canisters to be generated by high level vitrification were originally evaluated in the Engineering Study, ER 0665, June 1990. The study was tasked to evaluate the use of modified existing facilities, construct a new facility, or increase the scope of an approved project baseline. The report was generated using smaller canister sizes and fewer quantities than are now estimated.

The preferred alternative of this study for storage of the HLW canisters is the Modular Vault Dry Storage facility and is discussed in Section 6.8.2.1. The following information is derived from evaluating the original option study and is not the suggested option.

6.6.2.10.2 **Storage Approach**. The PUREX facility was determined to be the most cost effective alternative for interim storage of the canisters. The area needed to store the entire projected waste stream would require the modification of PUREX, U Plant and B Plant.

6.6.2.10.3 **Facility Description**. There is approximately 2,400 m^2 available deck area in U Plant which is not enough to store the 6,802 canisters requiring of 5,700 m^2 of floor space. The use of multiple canyon facilities such as PUREX, 221-B and 221-U would provide a total area of about 7200 m^2. This would allow for the possibility of additional storage as well as designated inspection and repackaging cells. New HVAC, electrical, and fire suppression systems would be required at a minimum.

6.6.2.10.4 **References**. Engineering Study - "Hanford Waste Vitrification Plant Project Interim Storage Facility for Hanford Waste Vitrification Plant Canisters Evaluation of Alternatives", Work Order ER 0665, June 1990.

6.6.2.10.5 **Facility Specific Assumptions**. The use of the three canyon facilities outlined above is dependant on permitting requirements and cost. It is assumed that the costs for the decontamination and modifications would all be comparable to the estimate provided for B Plant.

6.6.2.10.6 **Uncertainties**. The modifications to the facilities have a high likelihood to be more intensive than identified because of the many

variables that exist in each canyon.

6.6.3 ALTERNATIVE 3 COST SUMMARY

The cost estimates for Alternative 3 were compiled using the Construction Specifications Institute format to facilitate ease of tracking and grouping. The categories used on this project are listed as follows:

01 General Requirements
02 Site Work
03 Concrete
04 Masonry
05 Metals
06 Wood and Plastics
07 Thermal and Moisture Protection
08 Doors and Windows
09 Finishes
11 Equipment
13 Special Construction
14 Conveying Systems
15 Mechanical
16 Electrical

Parametric cost estimates were prepared utilizing information from previous estimates (Long-Term Decontamination Engineering Study, December 1994), established estimating manuals (R.S. Means, Richardson, etc.) Waste Management Facilities Cost Information Reports (EGG-WM-10701, EGG-WM-10962 and EGG-WM 11274) and engineering judgement. Information taken from estimating manuals was adjusted to reflect the labor and equipment rates that exist in the Hanford Site area. Construction and equipment items that significantly affect cost were addressed in greater detail than those items which have a smaller impact on cost.

Construction management and Title I, II and III engineering costs were estimated as percentages of the construction costs, as is standard practice. A contingency factor of 35% was identified and applied to account for the fact that the design is in a "pre-conceptual" stage and information is not available to identify all potential cost elements. All costs are escalated to the assumed midpoint of the construction phase. Establishment of the construction midpoint of the appropriate activity phase. Establishment of the midpoints was based on the assumed operational start date of January 2001, and reflects minor modification to the procurement requirements of DOE 4700.1.

A concerted effort was made to maintain the same level of detail and accuracy for all of the estimates to permit meaningful, cost based evaluation. General steps in the estimating procedure are listed as follows:

1. Identification of potential facilities;
2. Waste stream projections;
3. Process flow diagram development;
4. Establishment of assumed facility configurations;
5. Identification of necessary facility modifications;
6. Identification of process equipment;
7. Quantity take-off;

8. Estimate construction costs using historical data, estimating manuals and engineering judgment;
9. Assume percentages for engineering, construction management, contingency and escalation;
10. Estimate decontamination and decommissioning costs;
11. Estimate start-up, operation and maintenance costs; and
12. Perform life cycle cost analysis.

For the life-cycle cost analysis the following assumptions were made:

- Operational life is 2001 through 2023 for processing facilities and 2001 through 2028 for storage facilities;
- Design period is three years;
- Construction period is two years; and
- D&D period is one year and returns existing facilities to their current condition.

Tables 6.6.3-1 and 6.6.3-2 provide the estimate basis and contingency analysis while Tables 6.6.3-3 and 6.6.3-4 are a cost estimate summary and a comparison of storage facility costs.

6.6.3.1 T Plant for TRU Processing. The facility and process configuration for processing transuranic waste in the T Plant facility is described in Section 6.6.2.1.

Inasmuch as the T Plant canyon is contaminated, work performed there must be done with personal protective equipment in place. The effect on labor productivity is reflected in the estimated cost. In addition, equipment usage is increased by decreased labor productivity (equipment is on the job longer if productivity rates decrease). This cost is also reflected in the estimated cost.

6.6.3.2 MASF for TRU Processing. The facility and process configuration for processing transuranic waste in the MASF is described in Section 6.6.2.2. The MASF Building is not contaminated; therefore, work performed there does not require the use of personal protective equipment. The enclosed structure will allow work to proceed without weather delays, etc.

6.6.3.3 Grout Vaults for LLMW Processing. The facility and process configuration for processing low level mixed waste in the existing grout vaults is described in Section 6.6.2.3.

6.6.3.4 MASF for LLMW Processing. The facility and process configuration for processing low level mixed waste in the MASF is described in Section 6.6.2.4. The MASF is not contaminated; therefore, work performed there does not require the use of personal protective equipment. The enclosed structure will allow work to proceed without weather delays, etc.

6.6.3.5 T Plant for LLMW Processing. The facility and process configuration for processing low level mixed waste in the T Plant facility is described in Section 6.6.2.5.

Inasmuch as the T Plant canyon is contaminated, work performed there must be done with personal protective equipment in place. The effect on labor productivity is reflected in the estimated cost. In addition, equipment usage

is increased by decreased labor productivity (equipment is on the job longer if productivity rates decrease). This cost is also reflected in the estimated cost.

6.6.3.6 FMEF for Storage. The facility modifications required to permit storage of RH TRU, RH LLMW, Sr and Cs capsules, UU and miscellaneous sources in the FMEF is described in Sections 6.6.2.6, 6.6.2.7, 6.6.2.8, and 6.6.2.9. The FMEF is not contaminated and does not require the use of personal protective equipment in the performance of work within the facility.

6.6.4 SCHEDULE FOR ALTERNATIVE 3

The DOE Order 4700.1 provides a guidance and tentative schedule for completing candidate design and construction projects at DOE sites. The schedule identified in this order was evaluated and compared to individual schedules identified for facilities proposed under Alternative 3. The tentative schedule for completing construction projects under DOE Order 4700.1 provides a funding appropriation period of 33 months with an allowance of approximately three months prior to the beginning of Title I and II Design activities. It assumes a design phase of six months and a construction phase of 24 months. The preliminary assumption of DOE 4700.1 is that selection of a desired alternative would be accomplished in time to permit submittal of a candidate project list at the beginning of calendar year 1996.

The DOE 4700.1 allows approximately 33 months for tentative approval, conceptual design preparation, review, budget validations, and allotment of funds. To maximize operational time, and reduce the required annual throughput for the facilities prior to the defined completion date of 2023, pre-construction activities were analyzed to identify functions that could possibly be accelerated. This initial funding appropriation phase could be reasonably reduced from 33 months to 24 months. With diligent planning, delays between allotment of funds and beginning of Title I and II design could be eliminated.

It was assumed Title I and II design phase would require 12 months if separate design teams were assigned to each facility. This assumption is conservative compared to budget cycle assumptions in DOE 4700.1, which allow only six months for definitive design completion.

It is reasonable to assume that construction and modification of the facilities can be completed in 24 months, as indicated in DOE 4700.1. This assumption is predicated on the fact that construction at each facility can be accomplished concurrently.

Figure 6.6.4-1 provides the DOE 4700.1 tentative schedule for completing construction projects. It also identifies the proposed schedule for completion of the funding appropriation, design, construction, and operational activities proposed under this alternative.

6.6.4.1 TRU Waste (RH and Large Container CH) Processing at T-Plant Canyon. Processing of RH TRU and CH TRU in large containers would be required until the year 2023. The upgrades/modifications required for processing TRU in the T Plant Canyon are identified in Section 6.6.2.1.

Cleanup of the canyon facility is currently ongoing and is required prior to construction of the processing line identified in the processing description section for TRU waste in the T Plant Canyon . The remaining upgrades/modifications identified at the T Plant Canyon could be performed concurrently. Head End modifications are not immediately required and could be phased in during operation. Permitting efforts at T Plant are underway which would lessen the time necessary for permitting operations in the facility.

Based on the proposed construction schedule, which was developed from DOE 4700.1, an operational startup date of 2001 would be feasible for the T Plant Canyon. A preliminary throughput analysis was performed for the facility (Section 6.6.2.1) using a processing time frame from the year 2001 to 2023. It was determined that the T Plant facility would be capable of handling the required waste stream.

6.6.4.2 TRU Waste (RH and Large Container CH) Processing at MASF. The MASF processing option would require modifications to the existing facility for construction of processing equipment, a containment shell, and remote-handling operations as identified in Section 6.6.2.2.

The MASF facility is currently not contaminated in the proposed processing area. This will allow an expedited construction time, due to the lack of radiation protection needed. Most upgrades at MASF could be performed concurrently within the schedule proposed above.

The estimated schedule for startup of TRU processing activities at MASF under this alternative is the year 2001. A comparative throughput analysis between T Plant and MASF identified throughput at MASF would be slightly higher than that of T Plant; therefore the facility would be able to handle the necessary throughput.

6.6.4.3 LLMW (RH and Large Container CH) Processing at Grout Facilities. The LLMW is expected to be processed until the year 2023. Upgrades necessary for processing LLMW at the Grout Facilities are described in Section 6.6.2.3.

Construction modifications to the Grout Facilities could be implemented and the facility capable of receiving LLMW by the year 2001. A preliminary throughput analysis of the facility shows that the facility would be able to handle the expected waste stream quantities.

6.6.4.4 LLMW (RH and Large Container CH) Processing at MASF. The upgrades/modifications required for processing LLMW at the MASF facility are similar to those required for processing TRU. The upgrades are identified in Section 6.6.2.4. Operational startup of MASF for processing LLMW is proposed for the year 2001.

6.6.4.5 LLMW (RH and Large Container CH) Processing at T Plant Canyon. Upgrades/modifications required for processing LLMW at T Plant Canyon are similar to those required for processing TRU. Upgrades are identified in Section 6.6.2.5. The facility could begin handling the LLMW in the year 2001, and would be capable of handling the estimated throughput through the year 2023.

6.6.4.6 Storage of RH TRU Waste at FMEF. Storage of RH TRU would be required

until the year 2023. The FMEF was identified for storage of RH TRU. It was determined that the facility could store approximately 9% of the expected RH TRU waste stream. Upgrades required for storage of this waste are not extensive. It is assumed that the FMEF would be able to begin handling waste by the year 1997.

6.6.4.7 Storage of RH LLMW at FMEF. Storage of RH LLMW is required by the year 2001. The FMEF would be capable of handling approximately 8% of the total RH LLMW waste stream if not used for storage of RH TRU waste. A new facility must be identified for storage of the remaining portion of the waste. The FMEF facility could begin storing RH LLMW by the year 1997.

6.6.4.8 Interim Storage of Cs and Sr Capsules at FMEF. Interim storage of the Cs and Sr capsules is required through the year 2028. The FMEF facility would be capable of handling the total expected waste stream with the modifications identified in Section 6.6.2.8.

Storage required for Cs and Sr Capsules at FMEF would require an upgrade to the facilities existing Fuel Assembly Area. Construction of the dry storage modifications could be completed at FMEF well in advance of the required interim storage date of 2009.

6.6.4.9 Storage of UU and Miscellaneous Sources at FMEF. Storage of UU and Miscellaneous Sources is required until the year 2028. It's assumed modifications necessary in FMEF could be ready by the year 2001.

6.6.4.10 Storage of HLW Canisters in Canyon Facilities. Storage of HLW Canisters would be required between the years 2010 and 2028.

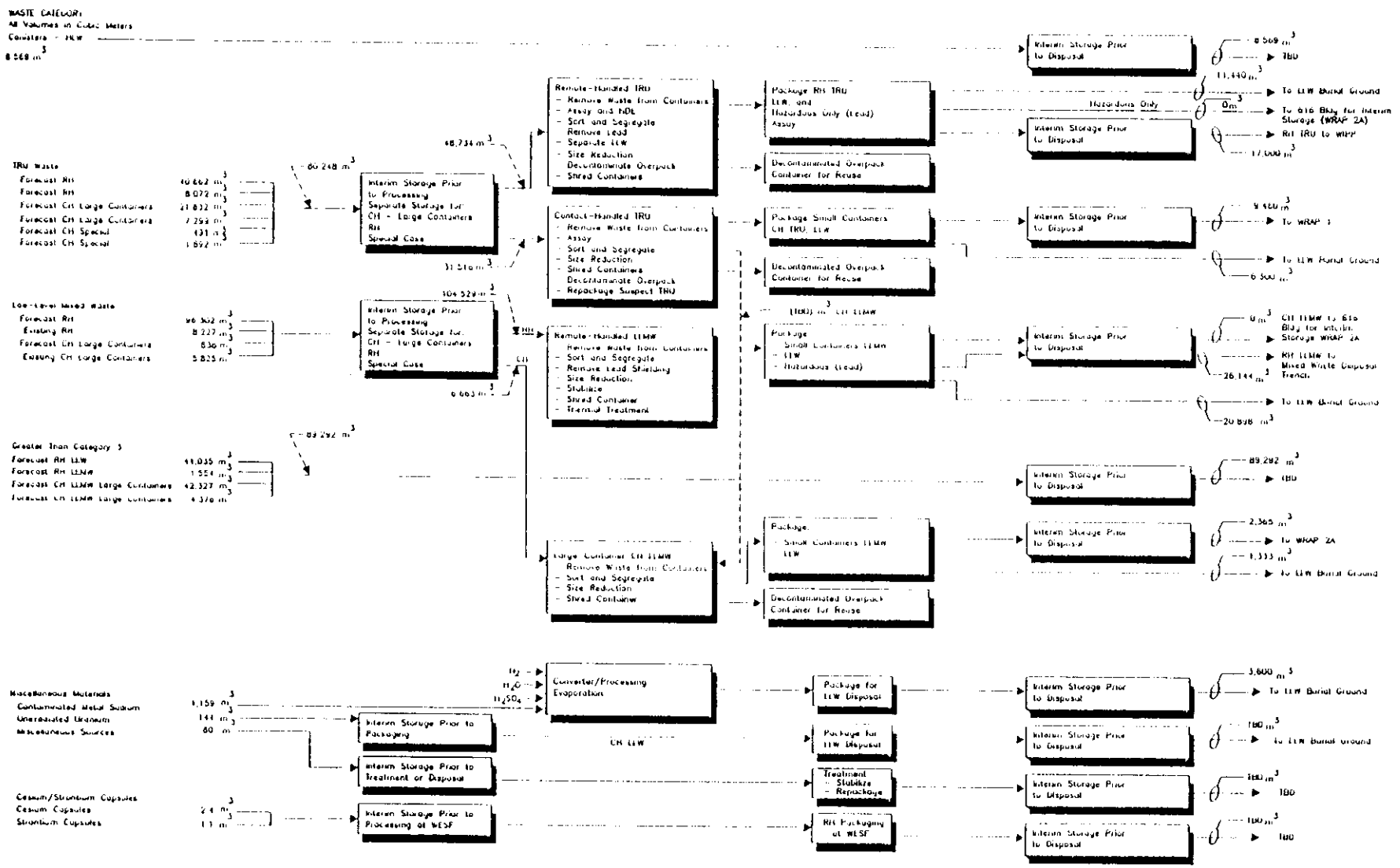
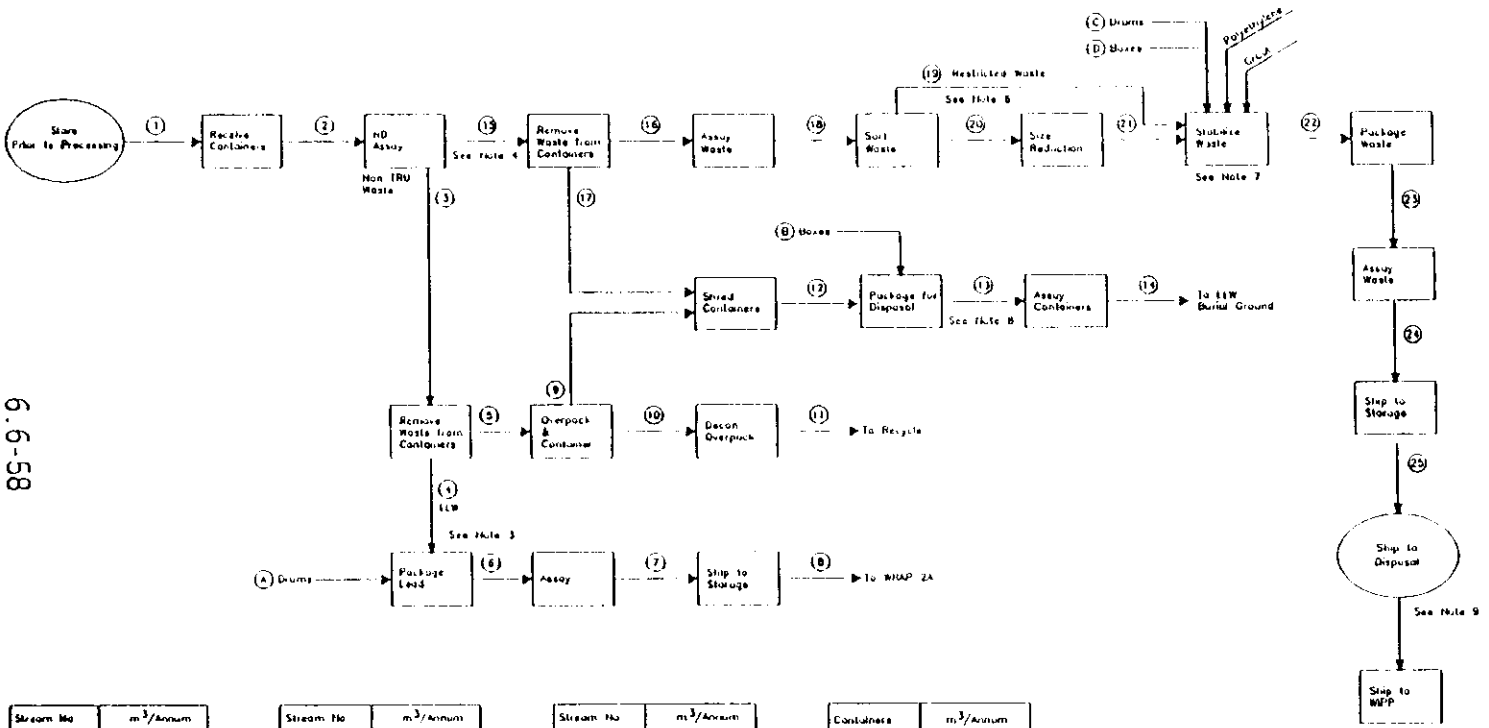


Figure 6.6.1.1. Alternative 3 Flow Schematic.

Figure 6.6.1-2. RH TRU Process Flow Diagram.



Stream No	m³/Annum
1	2267
2	2267
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0

Stream No	m³/Annum
11	0
12	453
13	532
14	532
15	2267
16	680
17	453
18	680
19	68
20	612

Stream No	m³/Annum
21	612
22	800
23	800
24	800
25	800

Containers	m³/Annum
A - Drums	200 L - TBD
B - Boxes	SWB - TBD
C - Drums	200 L - 100
D - Boxes	SWB - 100
E -	

TBD - To Be Determined

NOTES

1. Some NIS TRU will be received in overpacks. The overpacks will be decontaminated and reused.
2. Some stream (3) could diverted to the Rt LLWM facility. This stream is considered to be non LLWM for the analysis.
3. Stream (4) is included at a value of zero (0) but feed is not current PNL model.
4. See process logic for volume analysis. Values adjusted for void space. Overall volume reduction of 70% is expected.
5. Some waste will be received in overpacks. Volume of overpacks is excluded from the analysis as the overpacks will be recycled.
6. Approximately 10% of stream (18) is considered restricted waste and bypasses size reduction.
7. All waste is assumed to be packaged in 200 L drums with some recovery of volume to maintain the drum at 85% full including the void space with the equipment.
8. Shredded containers in boxes have a volume increase by approximately 15%.
9. Storage volume based on 200 L drums only.

Figure 1
DESIGN DATA:

48 734 m³ total Volume
Annual Volume - 2,267 m³
21.5 Years

Figure 6.6.1-3. CH TRU Process Flow Diagram.

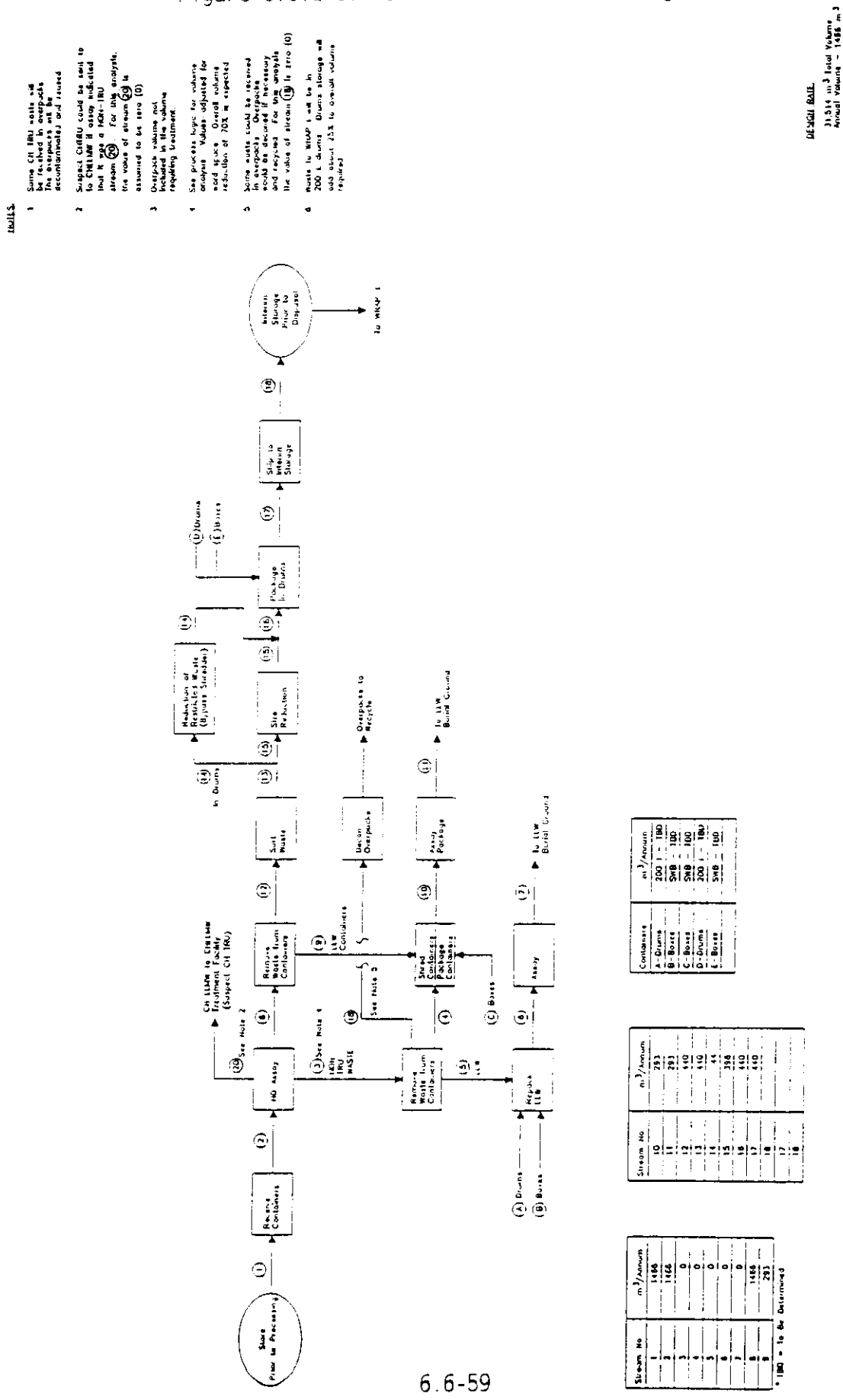


Figure 6.6.1-4. Proposed WIPP Canister Diagram.

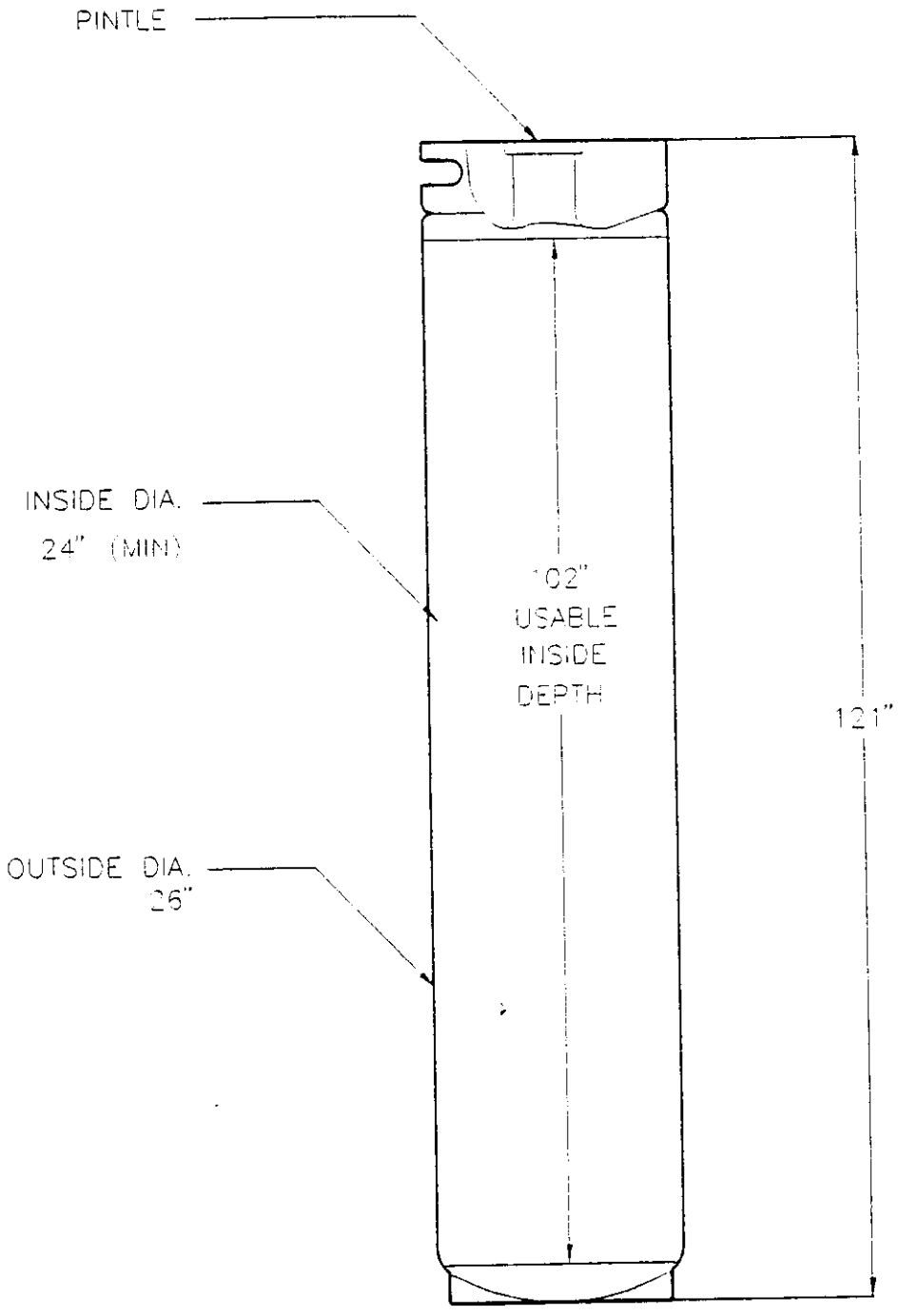
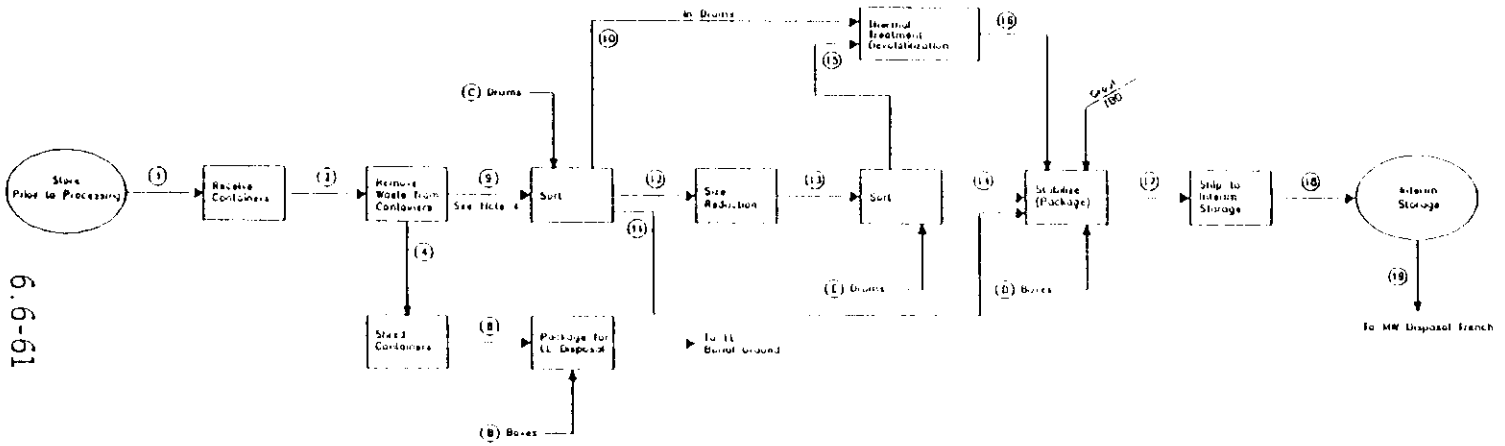


Figure 6.6.1-5. RH LLMW Process Flow Diagram.



Stream No	m³/Annum
1	4862
2	4862
3	-
4	972
5	-
6	-
7	-
8	972
9	1216
10	122

TBD = To Be Determined

Stream No	m³/Annum
11	61
12	1033
13	1033
14	878
15	155
16	277
17	1216
18	1216
19	1216

Containers	m³/Annum
A	
B-Boxes	TBD
C-Drums	TBD
D-Boxes	TBD
E-Drums	TBD

NOTES:

1. First sort step
   10% bypasses size reduction and is packaged in 200 l drums and sent to Thermal Treatment
   5% bypasses size reduction and proceeds to Stabilization
2. Second sort step:
   15% of stream is sent to Thermal Treatment
3. Thermal Treatment assumes a low temperature devolatilization without a volume reduction
4. See process Logic for Volume analysis. Values adjusted for void space. Overall volume reduction is expected to be approximately 75% for waste going to MW disposal trench. Volume reduction includes packaging in high integrity container.

Figure

DESIGN BASE:

104,229 m³ Total Volume
Annual Volume - 4,862 m³

Containers are not included in volume estimates
21.5 Years

Figure 6.6.1-6. CH LLMW Process Flow Diagram.

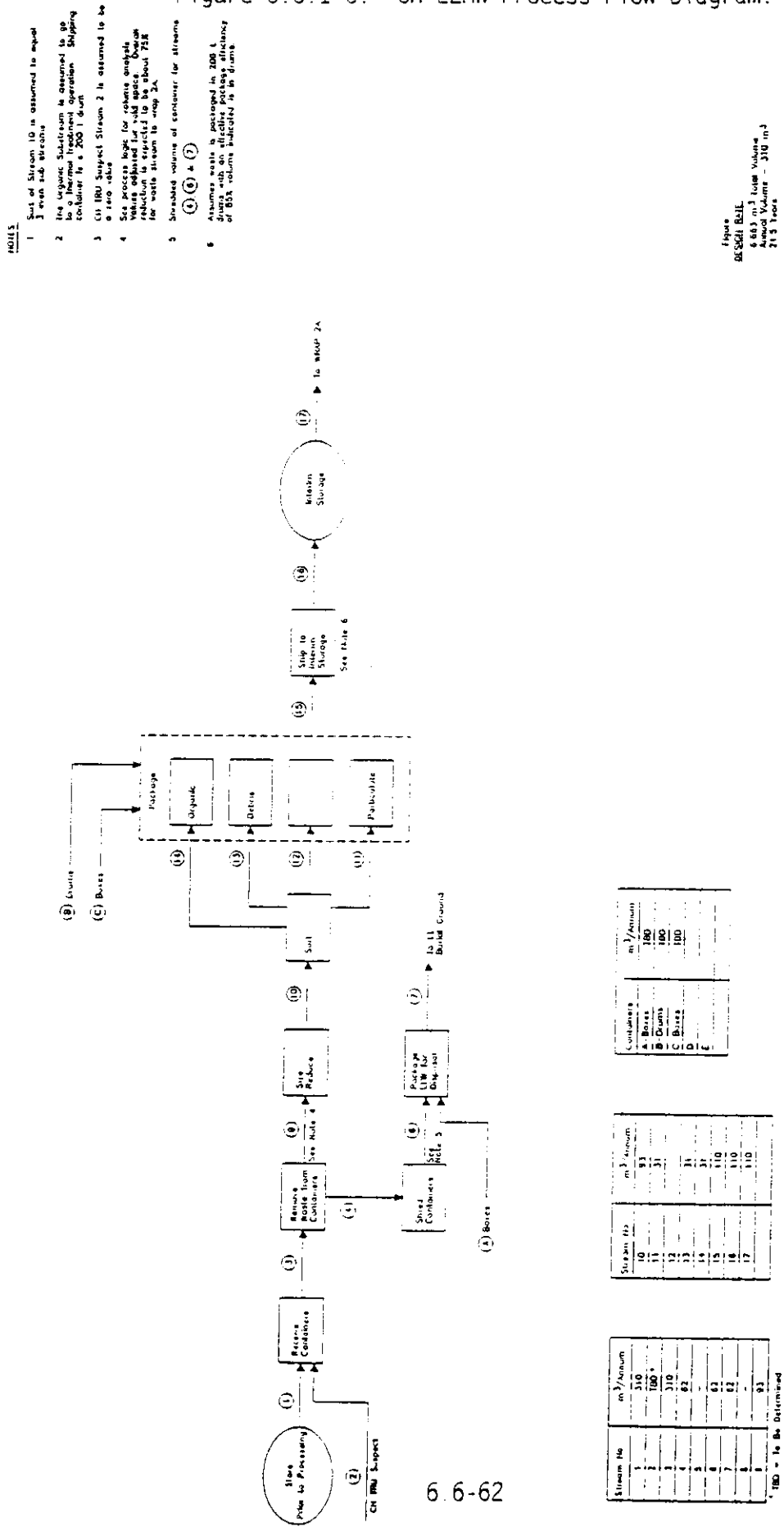
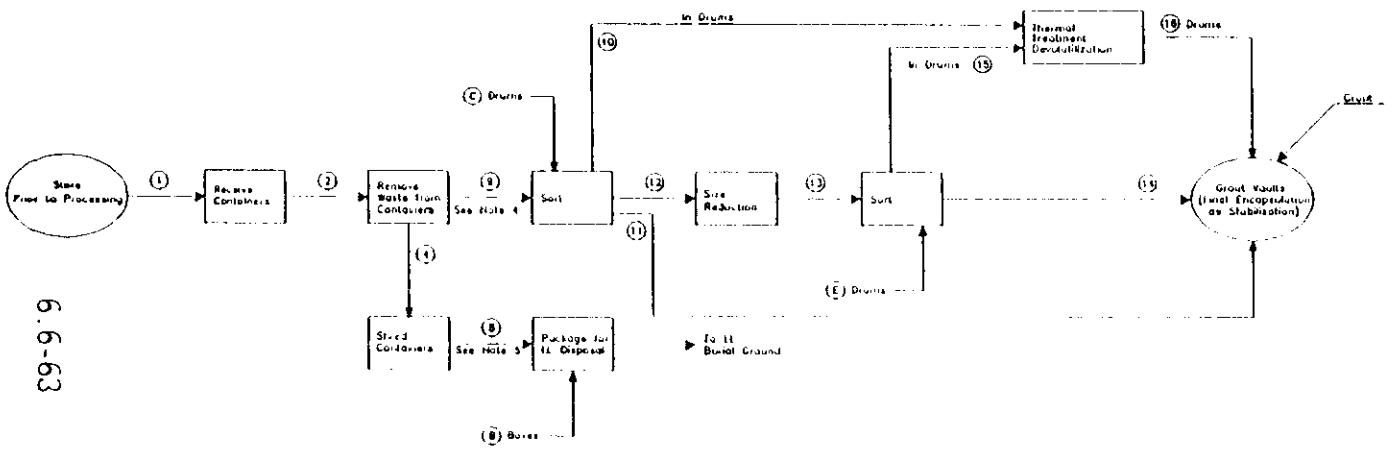


Figure 6.6.1-7. RH LLMW Process Flow Diagram - Grout.



Stream No	m³/Annum
1	4862
2	4862
3	-
4	972
5	-
6	-
7	-
8	972
9	1216
10	1216

* TBD - To Be Determined

Stream No	m³/Annum
11	81
12	1035
13	1035
14	878
15	155
16	277

Containers	m³/Annum
A-	
B-Boxes	180
C Drums	100
D-	
E-Drums	100

NOTES:

1. First sort step:
   10% bypasses size reduction and is packaged in 200 l drums and sent to Thermal Treatment.
   5% bypasses size reduction and proceeds to Stabilization
2. Second sort step:
   15% of stream is sent to Thermal Treatment
3. Thermal Treatment assumes a low temperature devolatilization without a volume reduction
4. See process logic for volume analysis
   Values adjusted for void space. Overall volume reduction is expected to be approximately 75% for waste, additional volume in the grout vault is anticipated as small containers are not used and the packing volume is expected to be more effective
5. Shredded volume of container for streams (1) & (8)

Figure

DESIGN BASE:

104,529 m³ Total Volume
Annual Volume - 4,862 m³
21.5 Years

Figure 6.6.1-8. Suggested Box/Container Configuration.

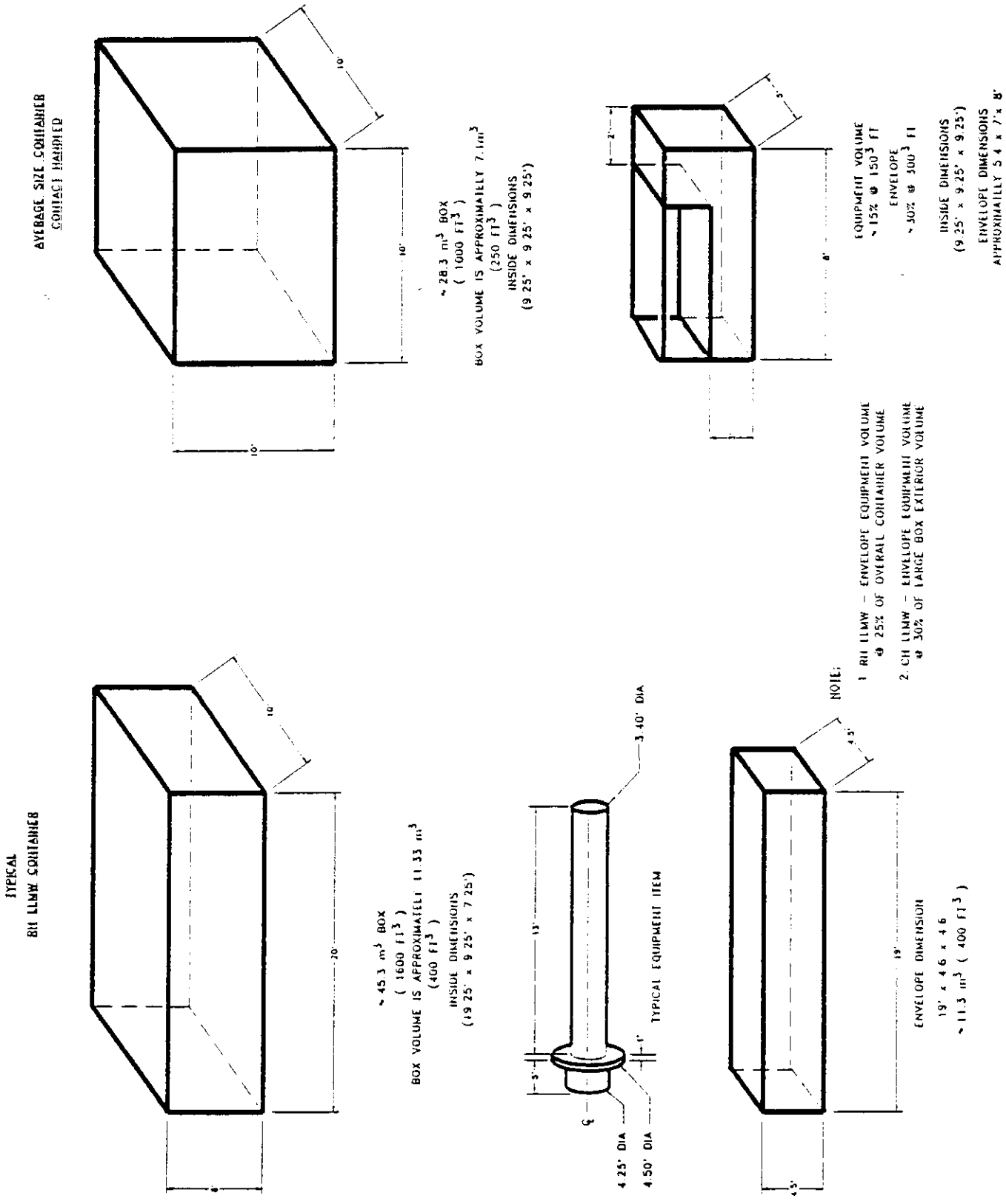
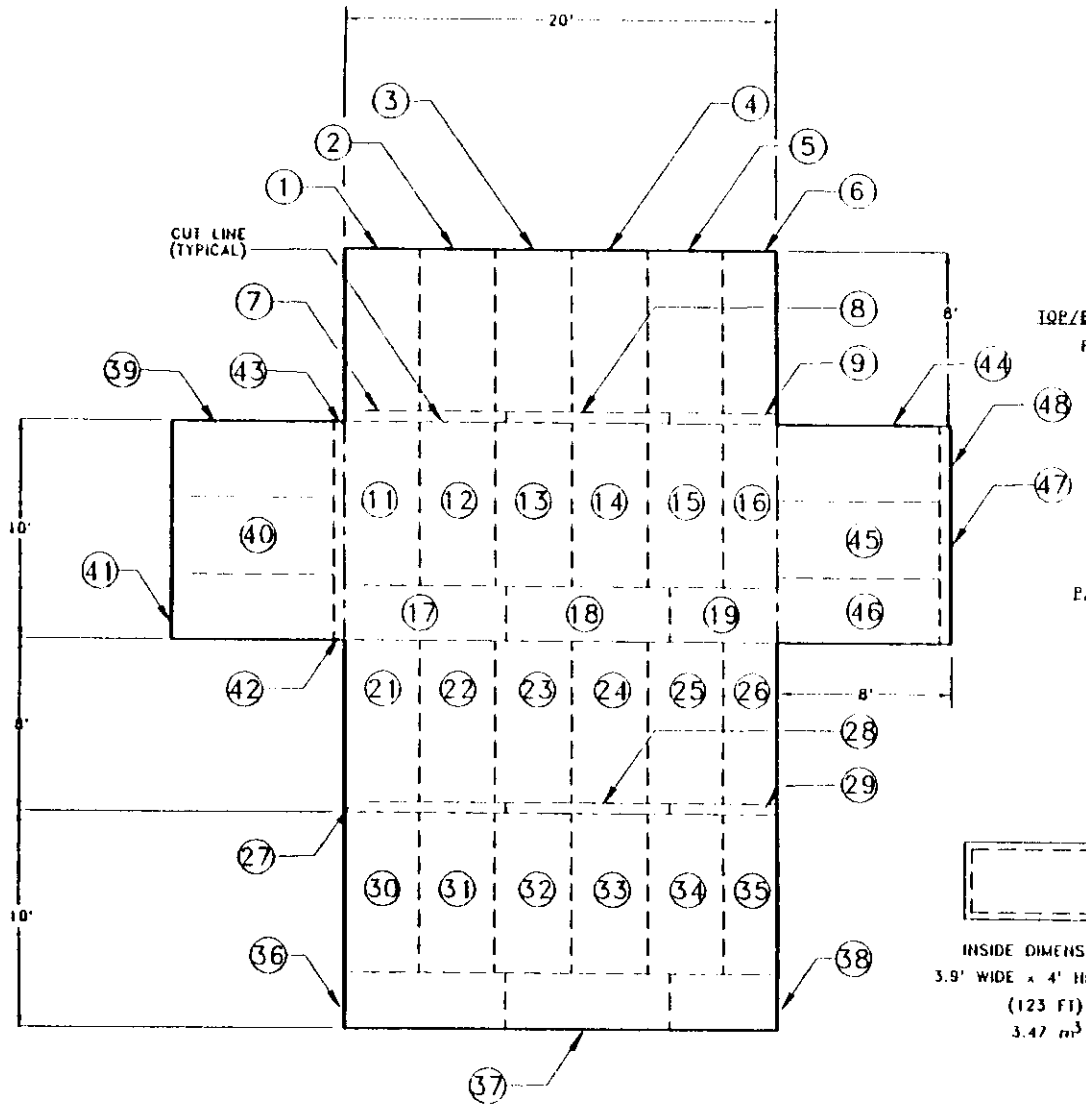


Figure 6.6.1-9. Box Size Reduction.Figure 6.6.2-1

LARGE CONTAINER EXTENDED SURFACE



NOTES:

1. BOX DIMENSIONS ARE OVERSTATED & DO NOT INCLUDE WALL THICKNESS OF 4.5 INCHES AT ENDS.
2. BOX PACKAGING DOES NOT INCLUDE A WEIGHT RESTRICTION
3. PIECE SIZES ARE INCLUDED BELOW ON PLANS OF BOX AS 38.

SIDES 2 AT 8 FT. BY 20 FT.	WIDTH	LENGTH	NO. OF PIECES
PIECES 1 TO 5 & 21 TO 25	3.5	7.5	10
7, 8, 27, & 28	0.5	7.5	4
6 & 26	2.5	7.5	2
9 & 29	0.5	5	2

TOP/BOTTOM 2 AT 10 FT. BY 20 FT.	WIDTH	LENGTH	NO. OF PIECES
PIECES 11 TO 15 & 30 TO 34	3.5	7.5	10
17, 18, 36, & 37	2.5	7.5	4
16 & 35	2.5	7.5	2
19 & 38	2.5	5	2

ENDS 2 AT 8 FT. BY 10 FT.	WIDTH	LENGTH	NO. OF PIECES
PIECES 39, 40, 44, & 45	3.5	7.5	4
41 & 46	3	7.5	2
42 & 47	0.5	7.5	2
43 & 48	0.5	7.5	2

PACKING -ASSUME PIECES ARE 0.375 FT. THICK AND 10 PIECES PER BOX

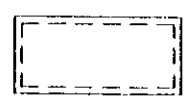
BOX 1 PIECES 1 TO 5 AND 11 TO 15	10
BOX 2 PIECES 21 TO 25 AND 30 TO 34	10
BOX 3 PIECES 39 TO 41 AND 44 TO 46	6

SMALL PIECES

6, 7, & 8	1
26, 27, & 28	1
17, 9, & 29	1
18, 42, & 47	1

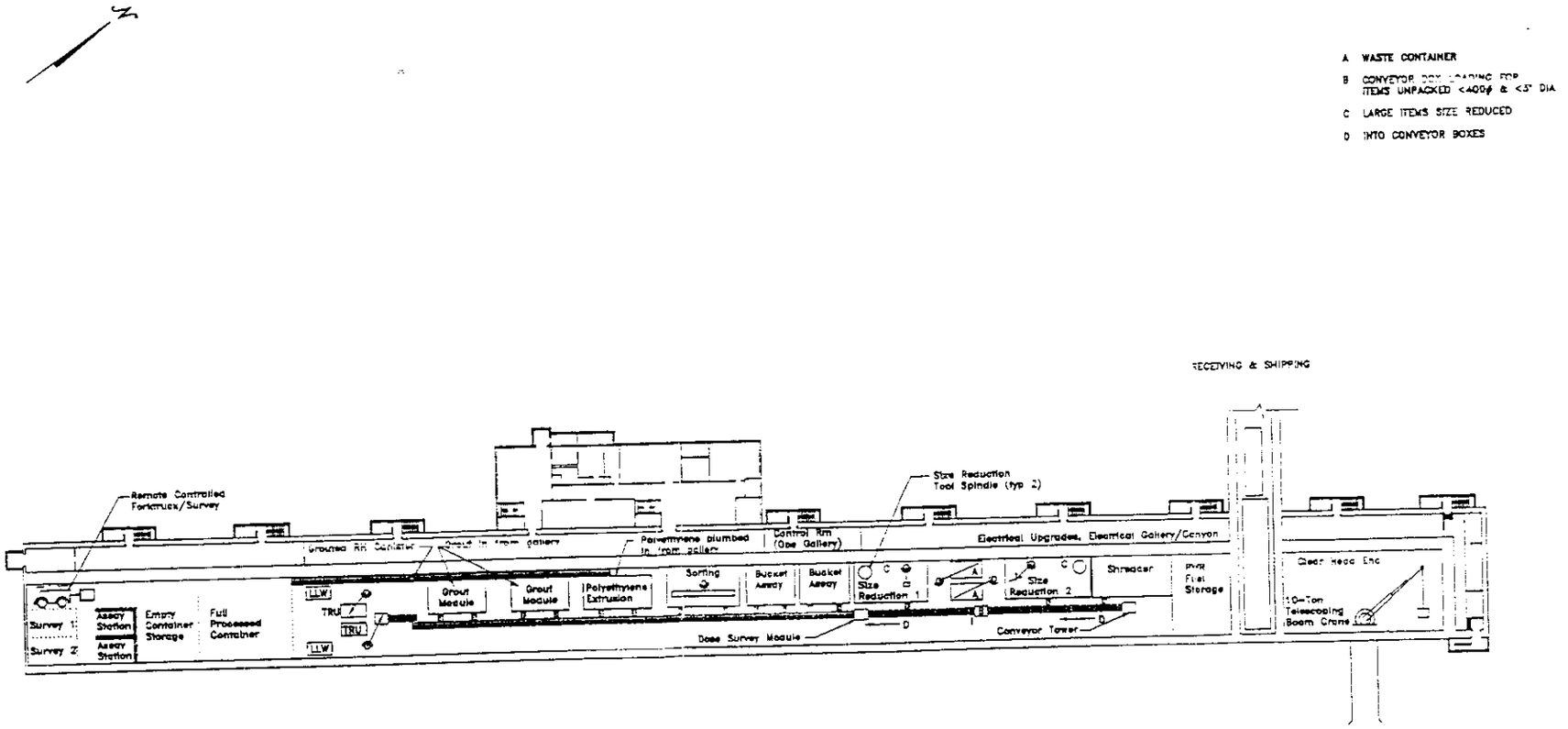
BOX 4 SMALL PIECES

16, 43, & 48	1
19	1
35	1
38	1
37	1



INSIDE DIMENSIONS:
3.9' WIDE x 4' HIGH x 8'
(123 FT)
3.47 m^3

Figure 6.6.2-1. Process Layout for TRU at T Plant.



RH TRU & CH TRU IN LARGE CONTAINERS AT T PLANT

Figure 6.6.2-2. Process Flow Diagram for TRU at T Plant.

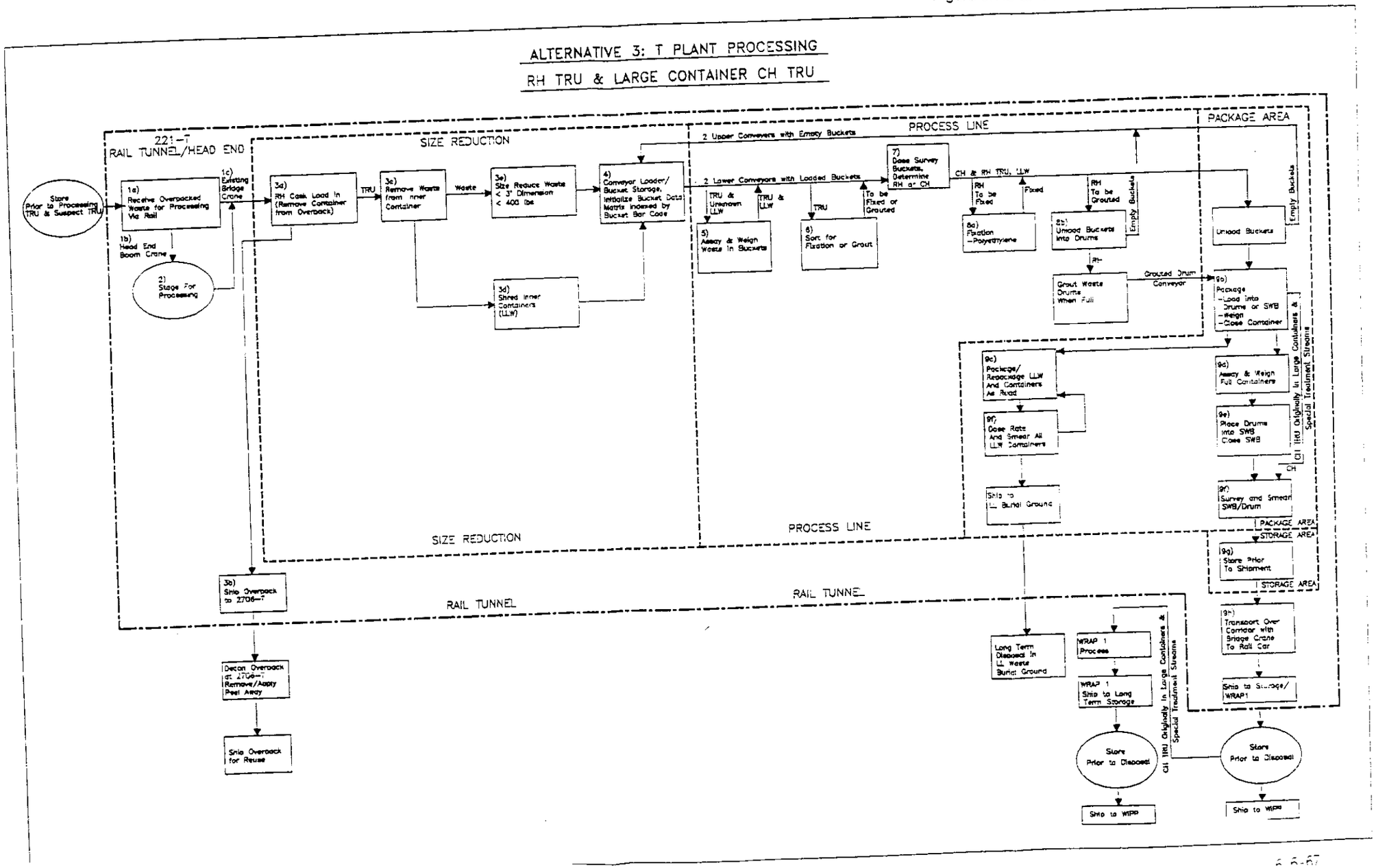


Figure 6.6.2-3

Process Flow Logic for Processing RH TRU and CH TRU in Large Containers in T Plant Canyon

1. Receiving/Shipping TRU in Tunnel
   a) TRU Waste Packages Received on Rail Car in Tunnel
   b) Packages Retrieved from Rail Car with Boom in Head End for RH Storage
   c) Packages Retrieved from Rail Car with Existing Canyon Crane for Processing/Size Reduction Area

2. Staging Area for TRU Prior to Processing
   a) Temporary Staging in Head End (Retrieve from Rail Car with 10 Ton Boom located in Head End)

3. Size Reduction Area
   a) Remove Container from Cask/Overpack
   b) Send Cask/Overpack to 2706-T by Rail Car for Decontamination and Reuse
   c) Remove Waste From Container
   d) Shred Containers/Shielding (Assumes No Lead Shielding)
   e) Size Reduction to Maximum Dimension of 3 ft and 400 lbs

4. Conveyor System
   a) 2 Conveyor Track Systems (Heavy/Light), 4 Stacked Layers (Lower 2 Levels are Loaded Buckets, Upper 2 Levels are Return System/Empty Buckets)
   b) Buckets with Bar Code Scanning System Directs Buckets to On-Line Process Modules and Tracks Waste

5. Assay Area
   a) Assay Buckets with Size Reduced Waste
   b) Determine if Waste in Bucket is TRU or LLW

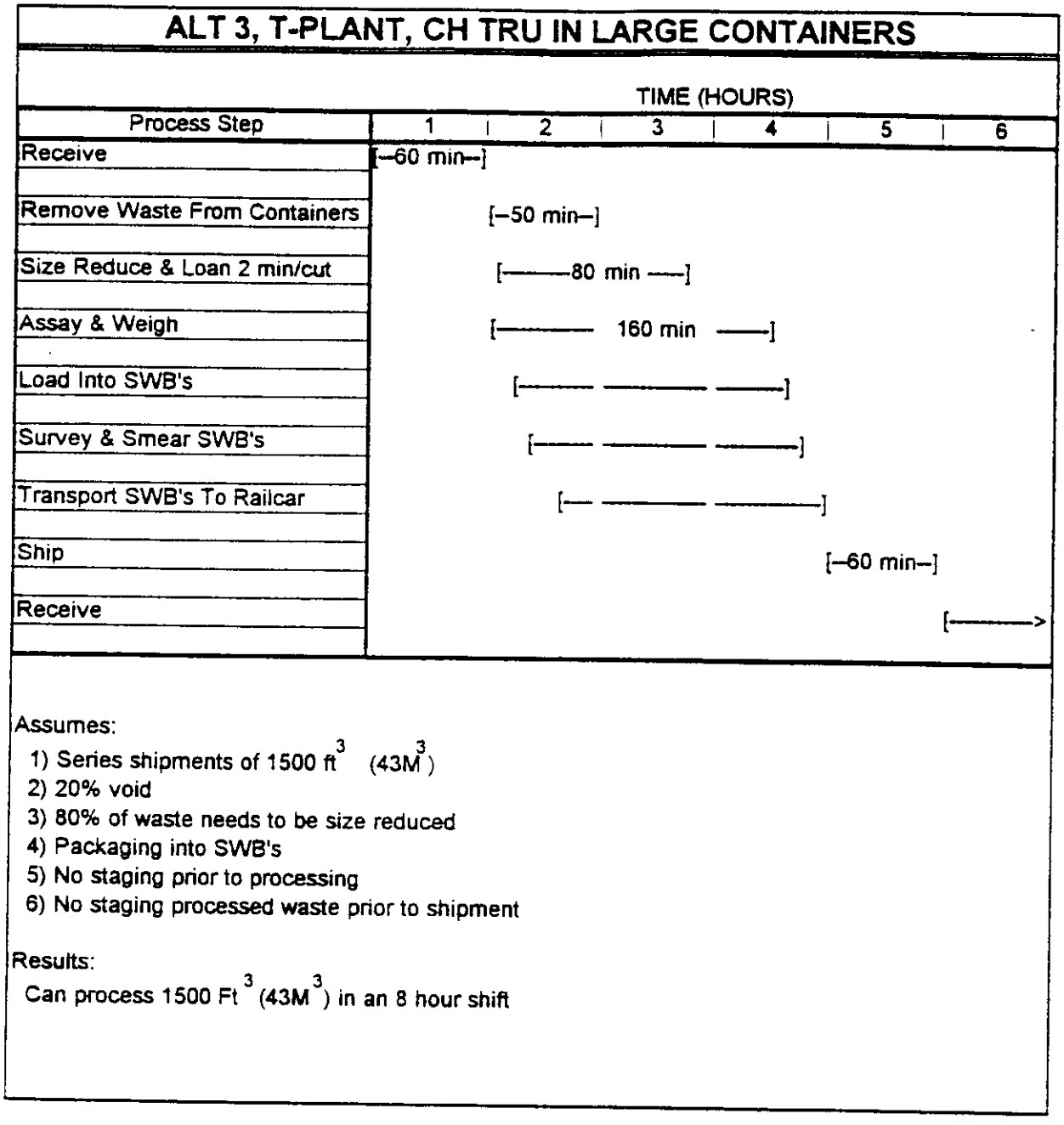
6. Sorting Area
   a) Sort for Polyextrusion or Grout

7. Survey/Dose Rate Buckets
   a) Survey Both LLW and TRU Buckets
   b) Determine CH and RH
   c) Send LLW Through To Packaging, By-Pass Processing

8. Stabilization
   a) Polyethylene Extrusion
   b) Vibragrout

9. Packaging/Staging Area
   a) Staging Area for Empty Containers/Overpacks
   b) Package TRU and TRUM (CH and RH)
   c) Package LLW (CH and RH)
   d) Assay Container
   e) Pack RH TRU Container in Overpack
   f) External Survey of Containers Prior to Shipment
   g) Staging Area for Filled Containers Prior to Shipment
   h) Transport by Crane to Rail Car Over Corridor

Figure 6.6.2-4. Throughput Analysis at T Plant.



Assumes:

1) Series shipments of 1500 ft^3 ($43M^3$)
2) 20% void
3) 80% of waste needs to be size reduced
4) Packaging into SWB's
5) No staging prior to processing
6) No staging processed waste prior to shipment

Results:

Can process 1500 Ft^3 ($43M^3$) in an 8 hour shift

Figure 6.6.2-5. Process Layout for TRU at MASF.

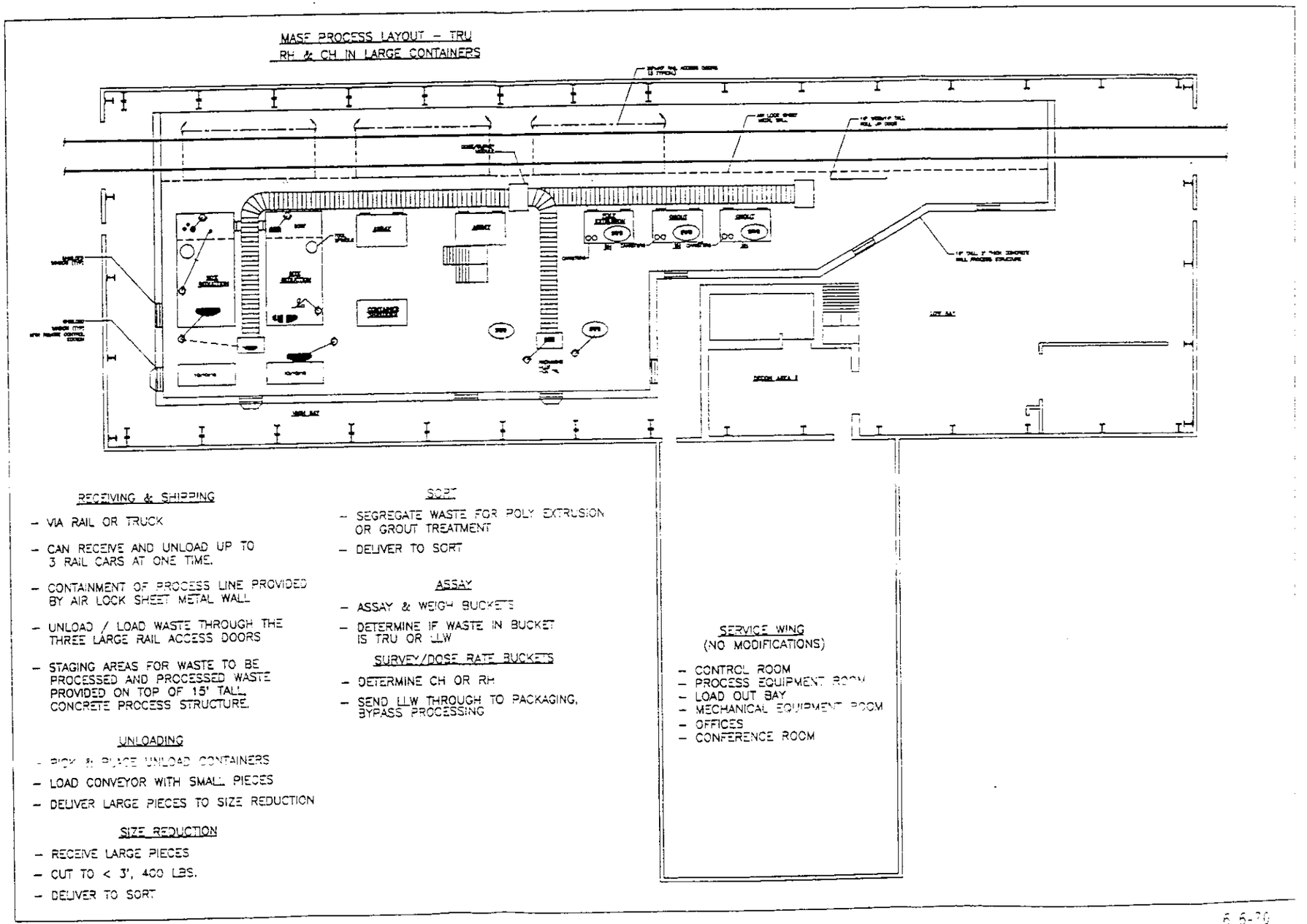


Figure 6.6.2-6. Process Flow Diagram for TRU at MASF.

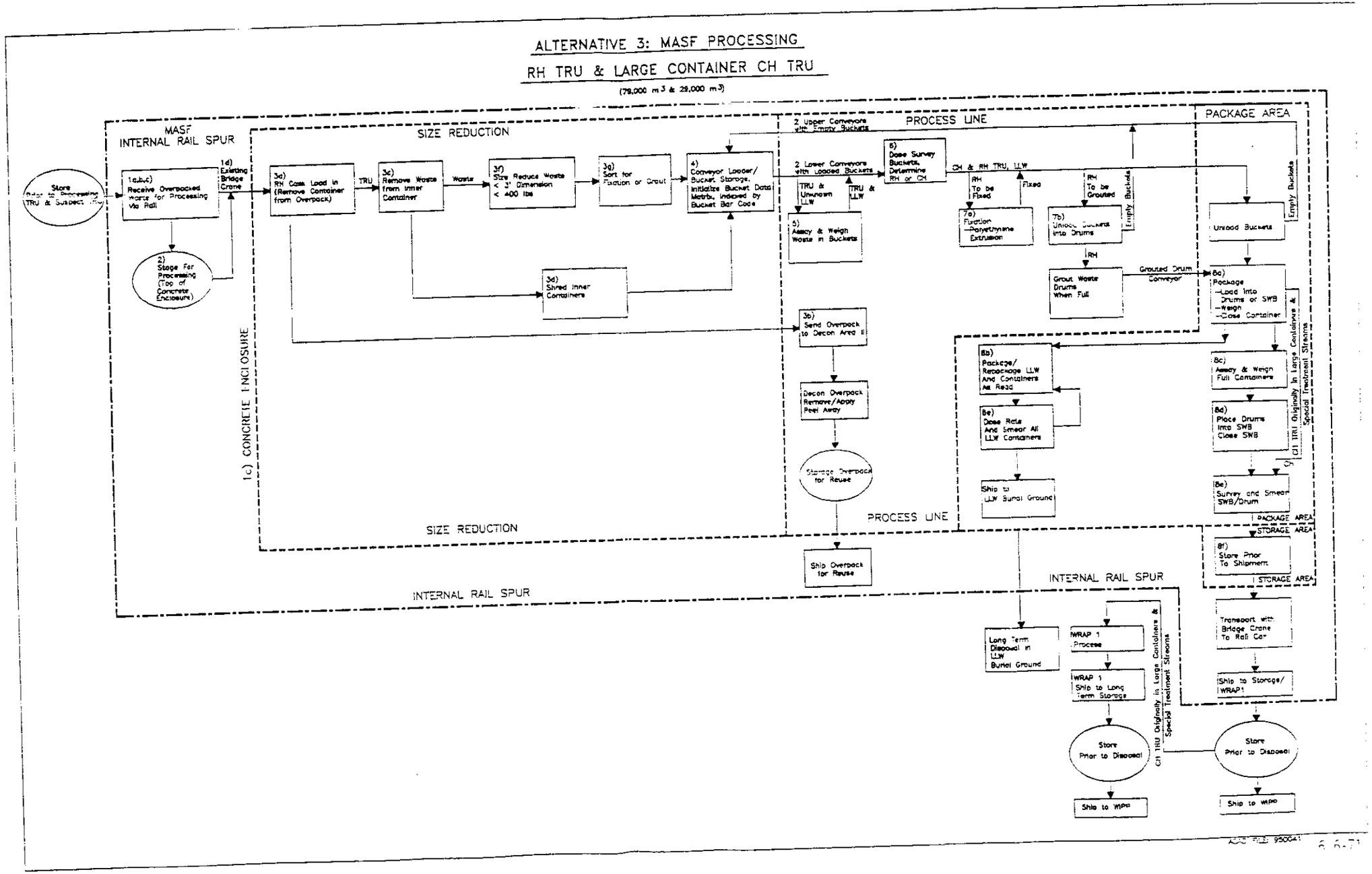


Figure 6.6.2-7

Process Flow Logic for Processing RH TRU and CH TRU in Large Containers in MASF

1. Receiving/Shipping TRU in High Bay Area
   a) TRU Waste Packages Received on Rail Car
   b) Up to Three Rail Cars Backed into Facility on Rail Spur at North End
   c) 2 ft Thick Concrete Enclosure Surrounding Process Area
   d) Packages Retrieved from Rail Car with 200 Ton Crane Through Ceiling Bay Doors Over Concrete Enclosure

2. Staging Area
   a) Staging on Roof of Concrete Structure
   b) Segregated Areas for Staging Waste Packages Prior to Packaging, Filled Containers Prior to Shipment, Empty Containers/Overpacks, and Overpacks Prior to Decontamination

3. Size Reduction Area
   a) Remove Container from Cask/Overpack
   b) Decontamination of Cask/Overpack in Decontamination Area #2
   c) Remove Waste From Container
   d) Shred Containers/Shielding (Assumes No Lead Shielding)
   e) Load Waste and Shredded Containers Into Conveyor Buckets
   f) Size Reduction to Maximum Dimension of 3 ft and 400 lbs
   g) Sort for Polyextrusion or Grout

4. Conveyor System
   a) 2 Conveyor Track Systems (Heavy/Light), 4 Stacked Layers (Lower 2 Levels are Loaded Buckets, Upper 2 Levels are Return System/Empty Buckets)
   b) Buckets with Bar Code Scanning System Directs Buckets to On-Line Process Modules and Tracks Waste

5. Assay Area
   a) Assay Buckets with Size Reduced Waste
   b) Determine if Waste in Bucket is TRU or LLW

6. Survey/Dose Rate Buckets
   a) Survey All Waste Buckets
   b) Determine CH and RH
   c) Send LLW Through To Packaging, By-Pass Processing

7. Stabilization
   a) Polyethylene Extrusion
   b) Vibragrout

8. Packaging Area
   a) Package TRU and TRUM (CH and RH)
   b) Package LLW (CH and RH)
   c) Assay Container
   d) Pack RH TRU Container in Overpack
   e) External Survey of Containers Prior to Shipment
   f) Transport by Crane to Rail Car for Shipment or Temporary Staging Above Enclosure
   g) Mobile Manipulator/Forklift to Access Conveyor

Figure 6.6.2-8. MASF - 30 Facility Cutaway.

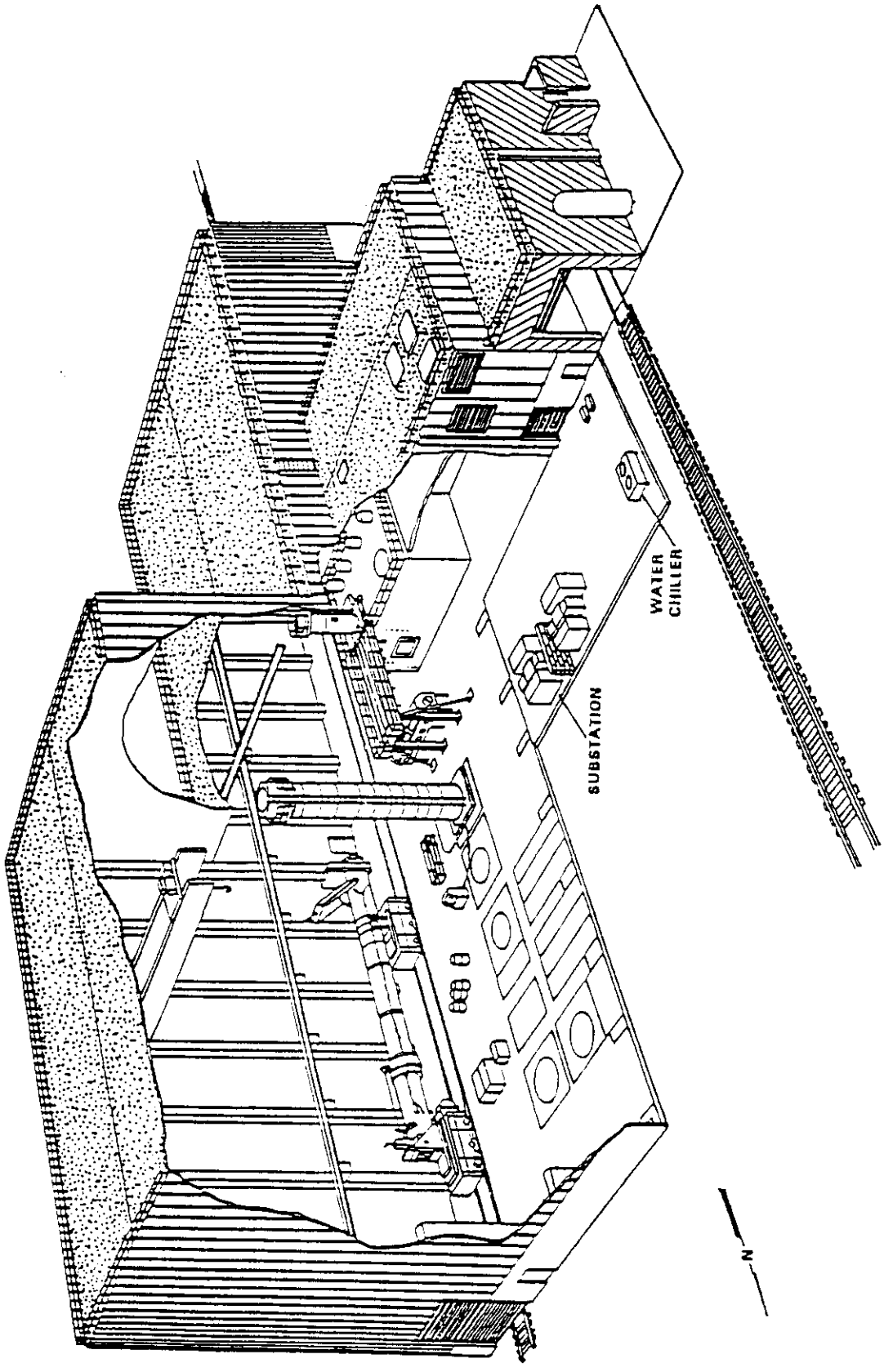


Figure 6.6.2-9. Process Flow Diagram, Scenario 1 at Grout Vaults.

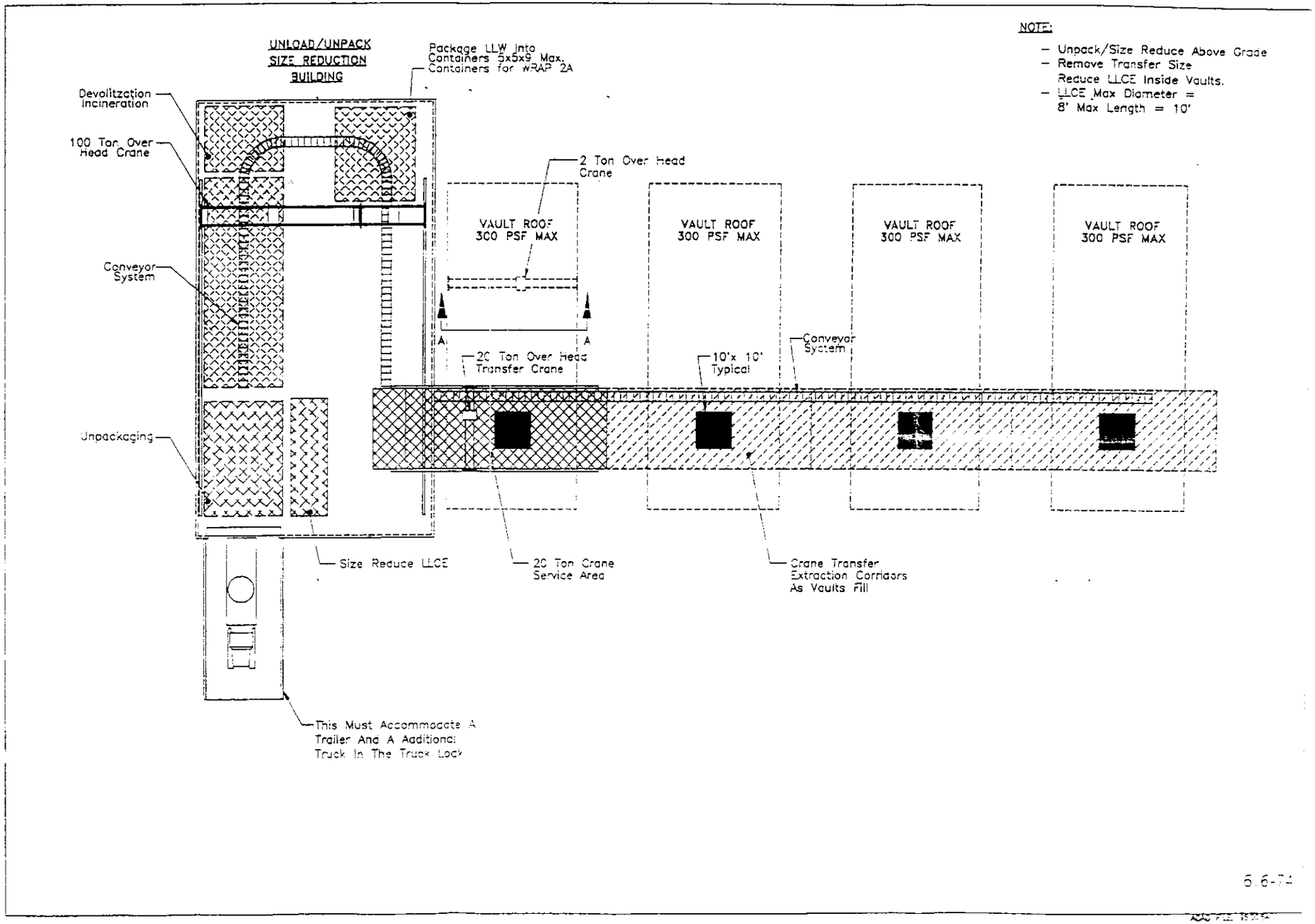
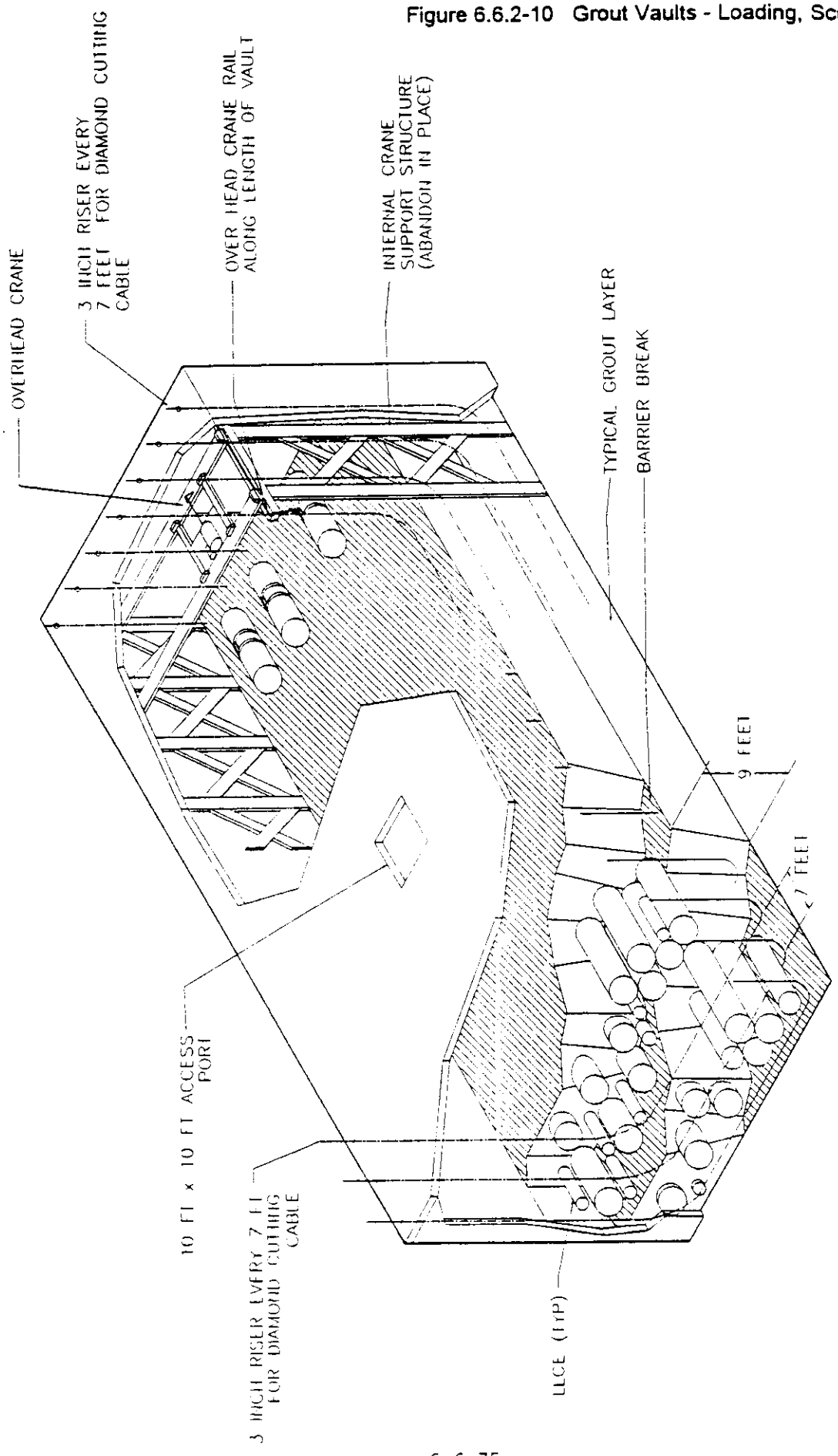


Figure 6.6.2-10 Grout Vaults - Loading, Scenario 1



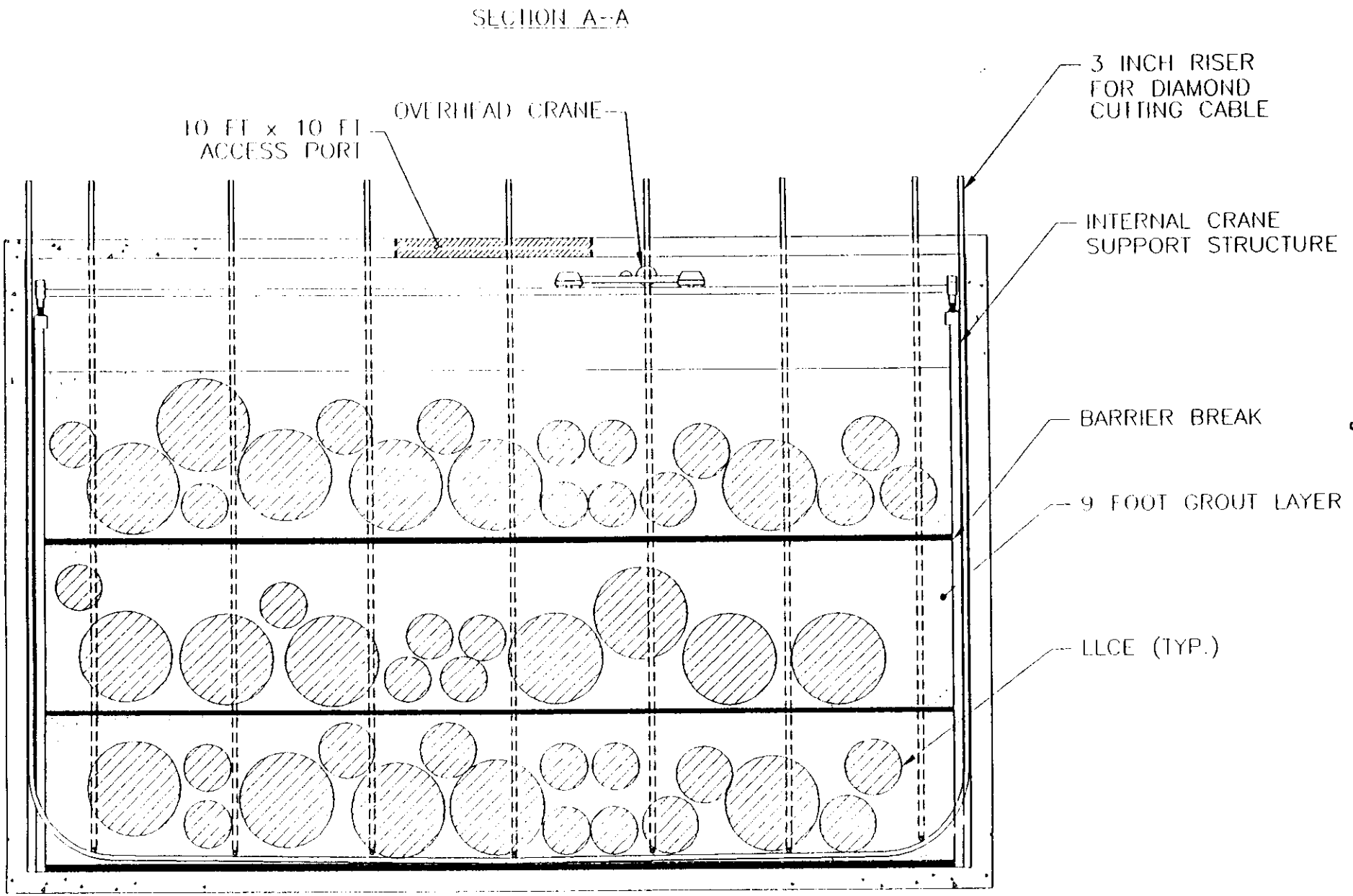


Figure 6.6.2-11 Grout Vaults - Cross Section, Scenario 1

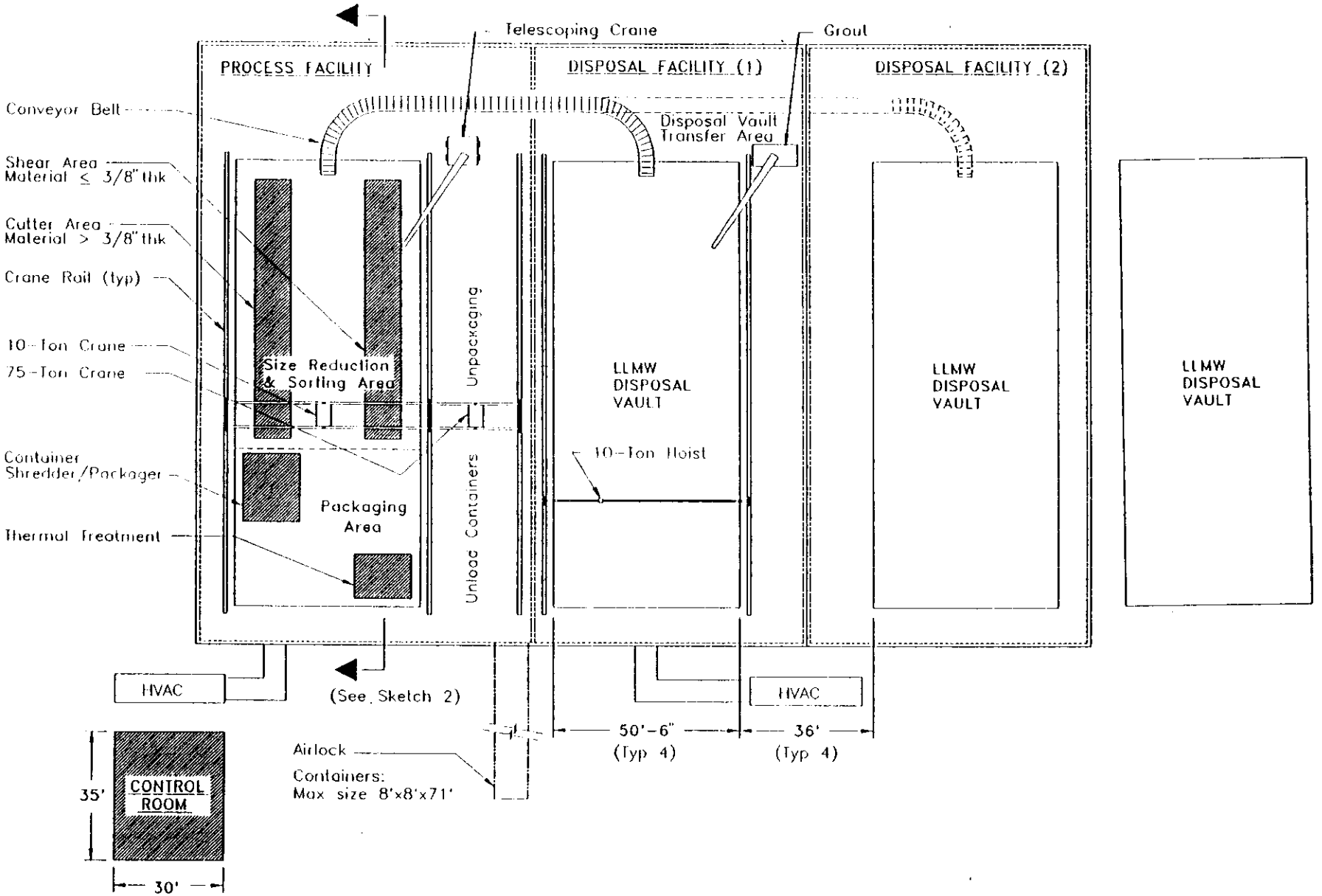
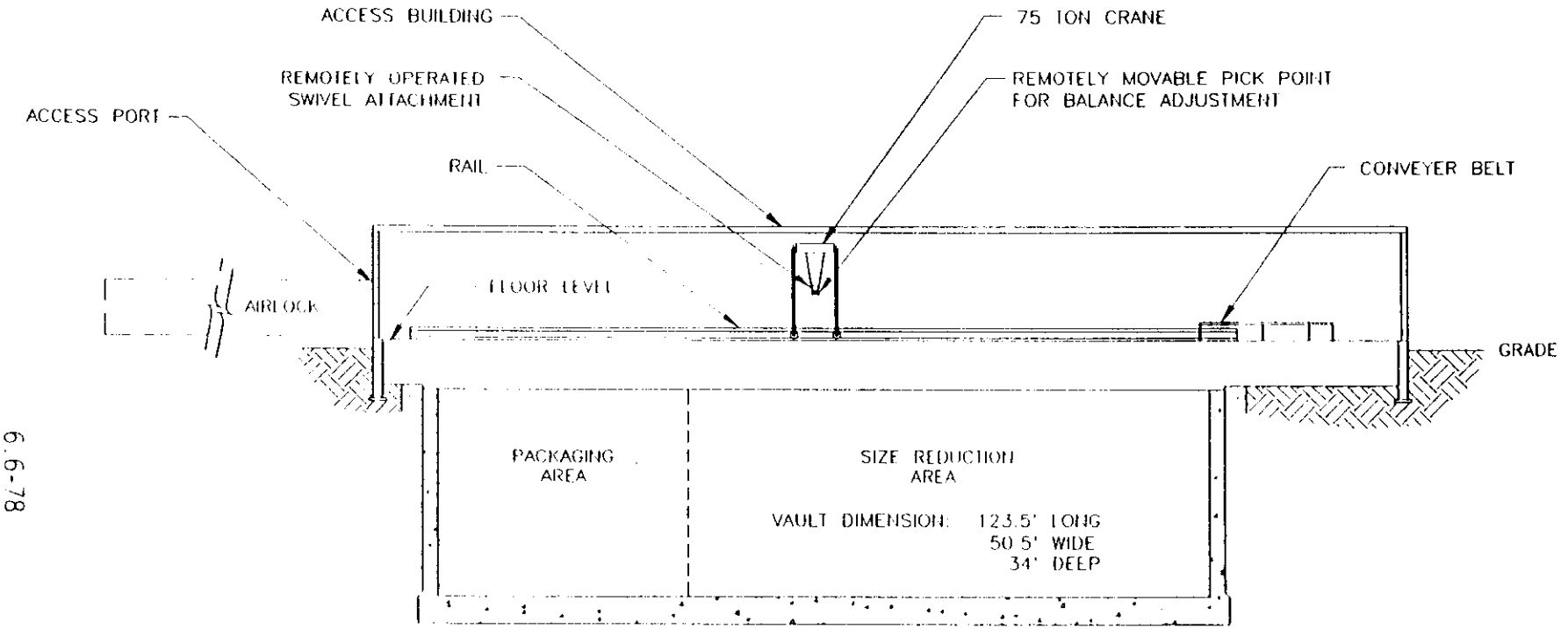


Figure 6.6.2-12 Grout Vaults - Modified Vault Plan, Scenario 2

Figure 6.6.2-13 Grout Vaults - Access for LLMW, Scenario 2



VAULT ACCESS FOR LLMW

Figure 6.6.2-14 Grout Vaults - Size Reduction Area, Scenario 2

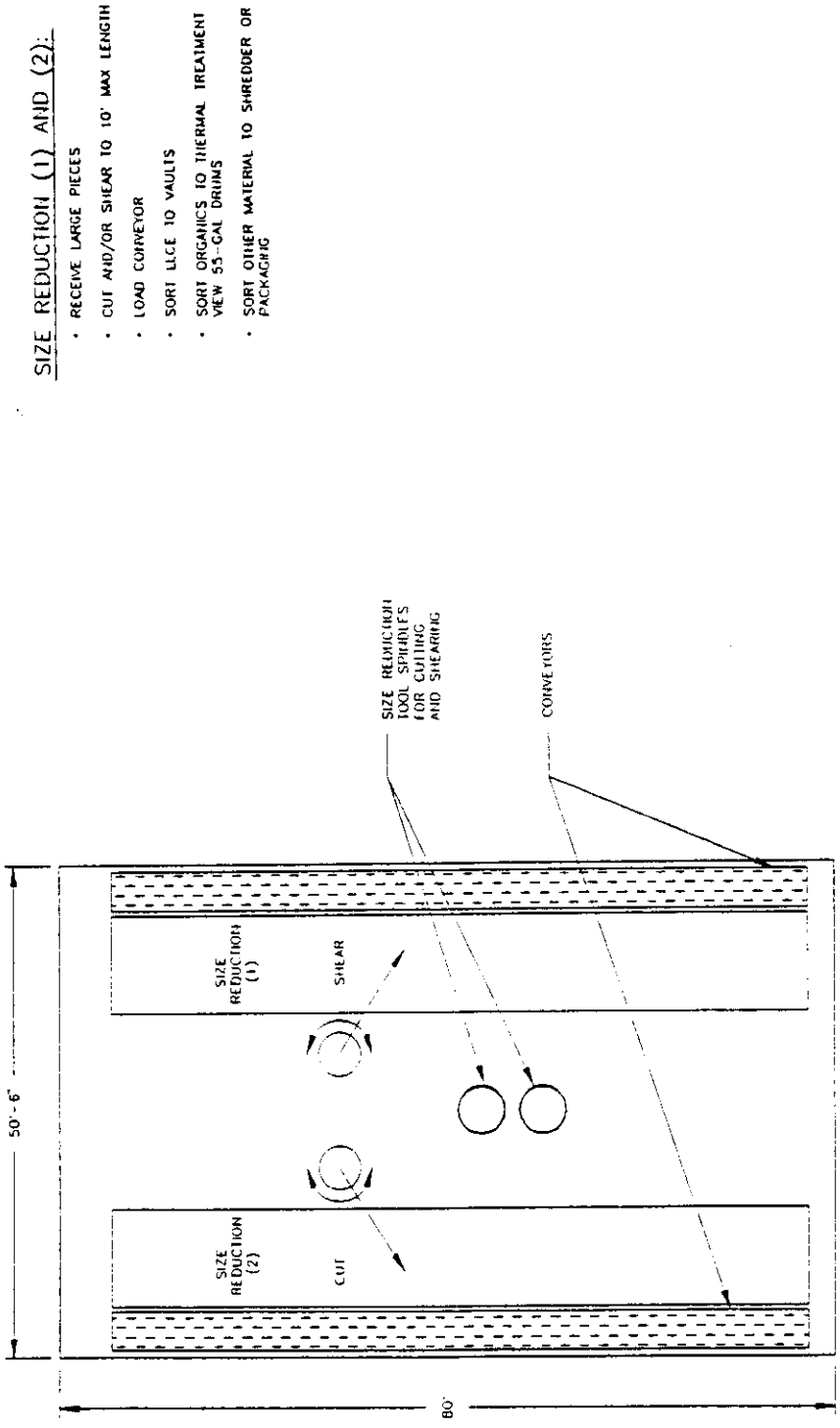


Figure 6.6.2-15. Process Flow Diagram, Scenario 2 at Grout Vaults

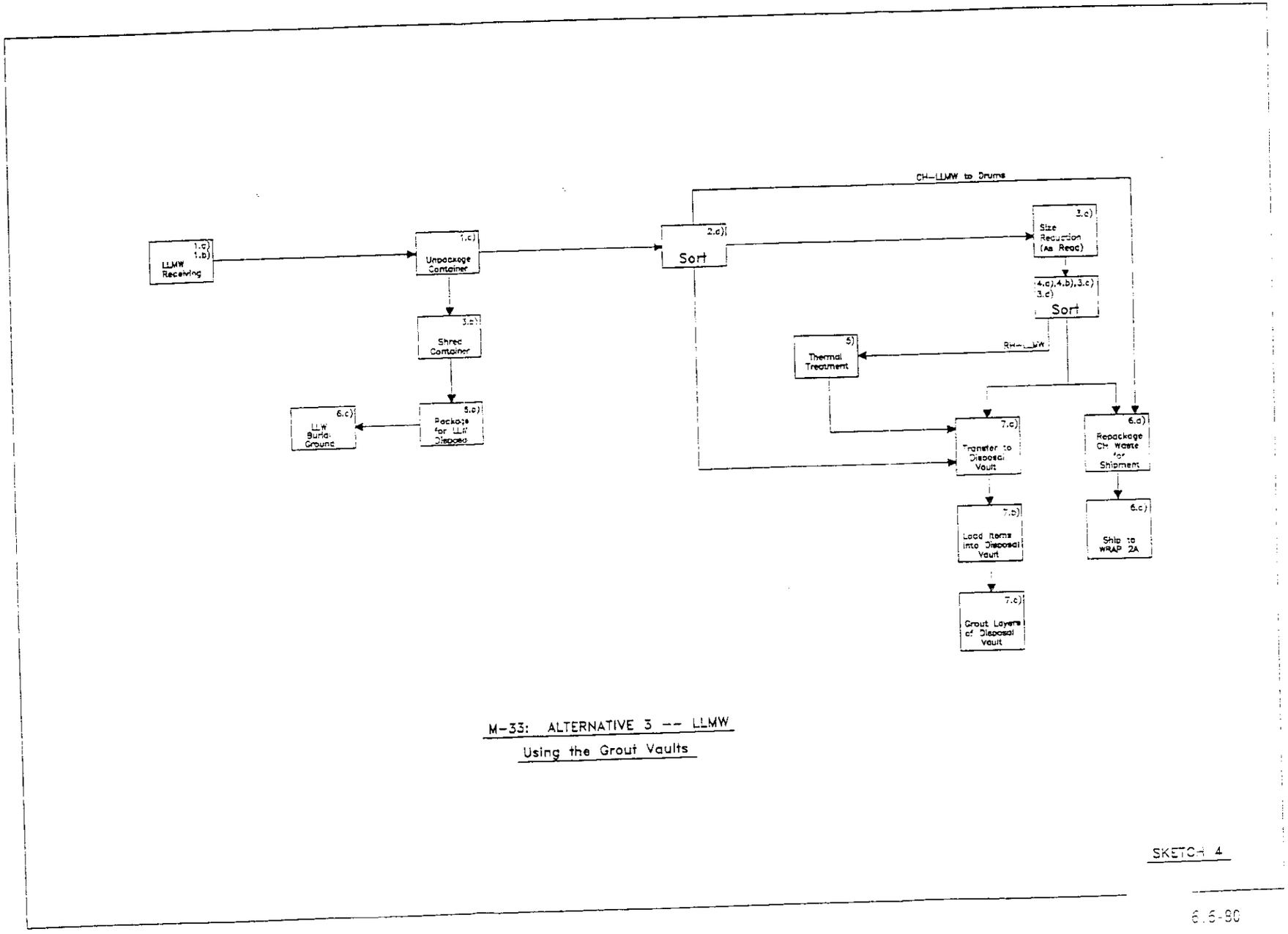


Figure 6.6.2-16. Process Logic, Scenario 2 at Grout Vaults.

Process Flow Logic for LLMW at the Grout Vaults

1. Receiving/Shipping LLMW in Receiving Area Corridor
   a) LLMW packages received on truck in corridor
   b) Transfer package to crane
   c) Remove LLMW item from packaging in unpackaging/decon area

2. Staging Area Prior to Processing
   a) Separate waste and/or place in size reduction/segregation areas of vaults

3. Size Reduction Area
   a) Size reduction to maximum 10 foot segments
   b) Shred container and non-lead shielding
   c) Remove organics for thermal treatment
   d) Use conveyor and buckets with barricade system to direct process to optional sorting/packaging steps

4. Sorting Area
   a) Sort for thermal treatment or stabilization
   b) Sort LLMW/LLW

5. Thermal Treatment
   a) Load thermal container
   b) Ash stabilization system
   c) Off-gas treatment
   d) One on-line system with floor space for second

6. Package for Shipment/Disposal
   a) Package LLMW
   b) Package LLW
   c) Assay packages
   d) Stage to receiving/shipping area

7. LLMW to Disposal Vault
   a) Stage LLMW item to conveyor belt to disposal vault transfer area
   b) Use disposal vault crane for placement of item into the vault
   c) Grout layers of Disposal Vault

Figure 6.6.2-17. Throughput Analysis, Scenario 2 at Grout Vaults.

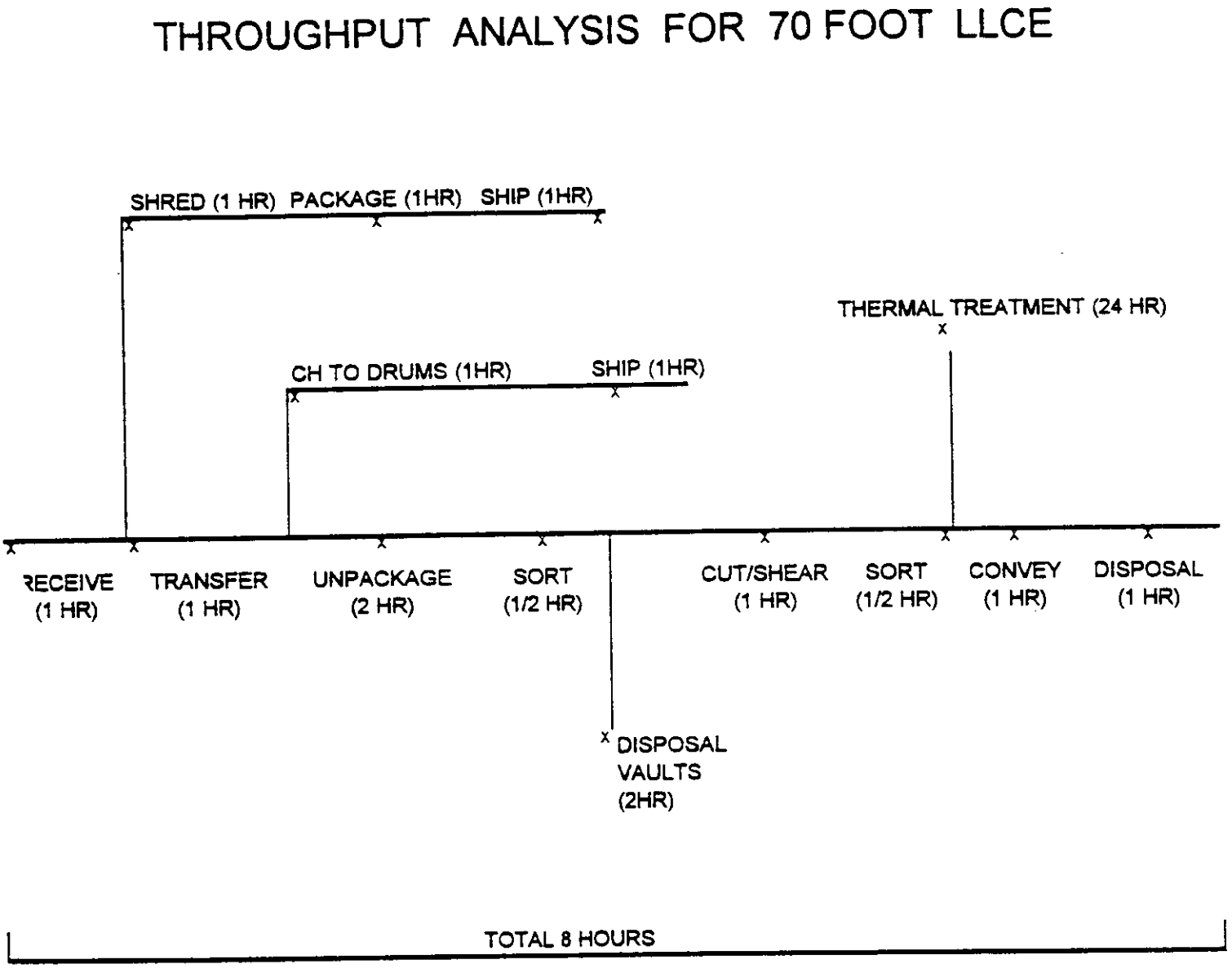
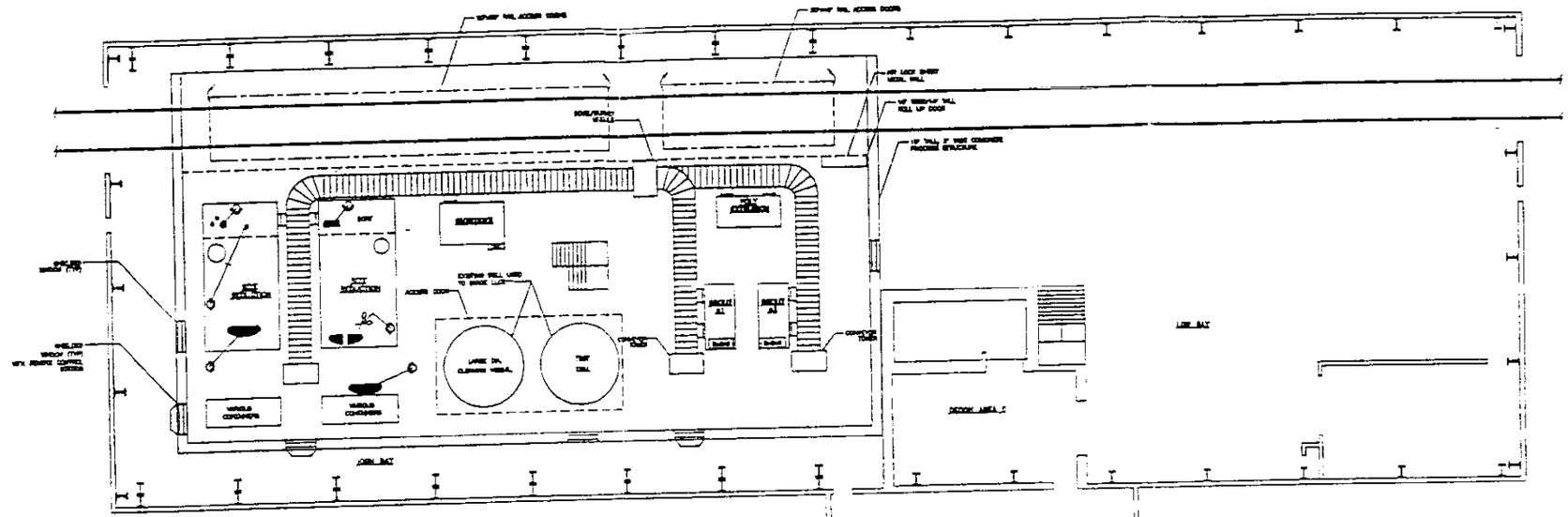


Figure 6.6.2-18. Process Layout for LLMW at the MASF.

MASF PROCESS LAYOUT – LLMW
RH & CH IN LARGE CONTAINERS



RECEIVING & SHIPPING

- VIA RAIL OR TRUCK
- CAN RECEIVE AND UNLOAD UP TO 3 RAIL CARS AT ONE TIME.
- CONTAINMENT OF PROCESS LINE MAINTAINED BY AIR LOCK SHEET METAL WALL
- UNLOAD / LOAD WASTE THROUGH THE TWO LARGE RAIL ACCESS DOORS
- LLCE/CASKES RAISED TO A VERTICAL POSITION UNDER LARGE RAIL ACCESS DOOR.
- LLCE/CASK PICKED UP BY BRIDGE CRANE AND TRANSPORTED OVER LARGE RAIL ACCESS DOOR.
- LLCE/CASK LOWERED INTO EXISTING WELLS.
- LLCE REMOVED FROM CAST BY THE CRANE IN VERTICAL CONFIGURATION.
- SIZE REDUCED TO < 6', 10,000 LBS WHILE IN VERTICAL CONFIGURATION.
- LLCE LOWERED 6' AY A TIME FOR FURTHER SIZE REDUCTION.

UNLOADING

- PICK & PLACE UNLOAD CONTAINERS
- LOAD CONVEYOR WITH SMALL PIECES
- DELIVER LARGE PIECES TO SIZE REDUCTION

SIZE REDUCTION

- RECEIVE LARGE PIECES
- CUT TO < 3', 400 LBS.
- DELIVER TO SORT

SORT

- SEGREGATE WASTE FOR THERMAL TREATMENT OR GROUT TREATMENT
- DELIVER TO SORT

THERMAL TREATMENT

- LOAD BUCKETS ONTO BAKER'S RACKS
- BATCH DEVOLATIZATION
- TREAT OFF GASES
- LOAD DEVALITIZED BUCKETS/WASTE ONTO CONVEYOR FOR GROUT

SERVICE WING
(NO MODIFICATIONS)

- CONTROL ROOM
- PROCESS EQUIPMENT ROOM
- LOAD OUT BAY
- MECHANICAL EQUIPMENT ROOM
- OFFICES
- CONFERENCE ROOM

GROUT

- EMPTY BUCKETS INTO FINAL DISPOSAL CONTAINER
- MANIPULATOR & SHAKER OPTIMIZE PACKING
- SCALE TO VERIFY LOADING CAPACITY
- BATCH GROUT

Figure 6.6.2-19. Process Flow for LLMW at the MASF.

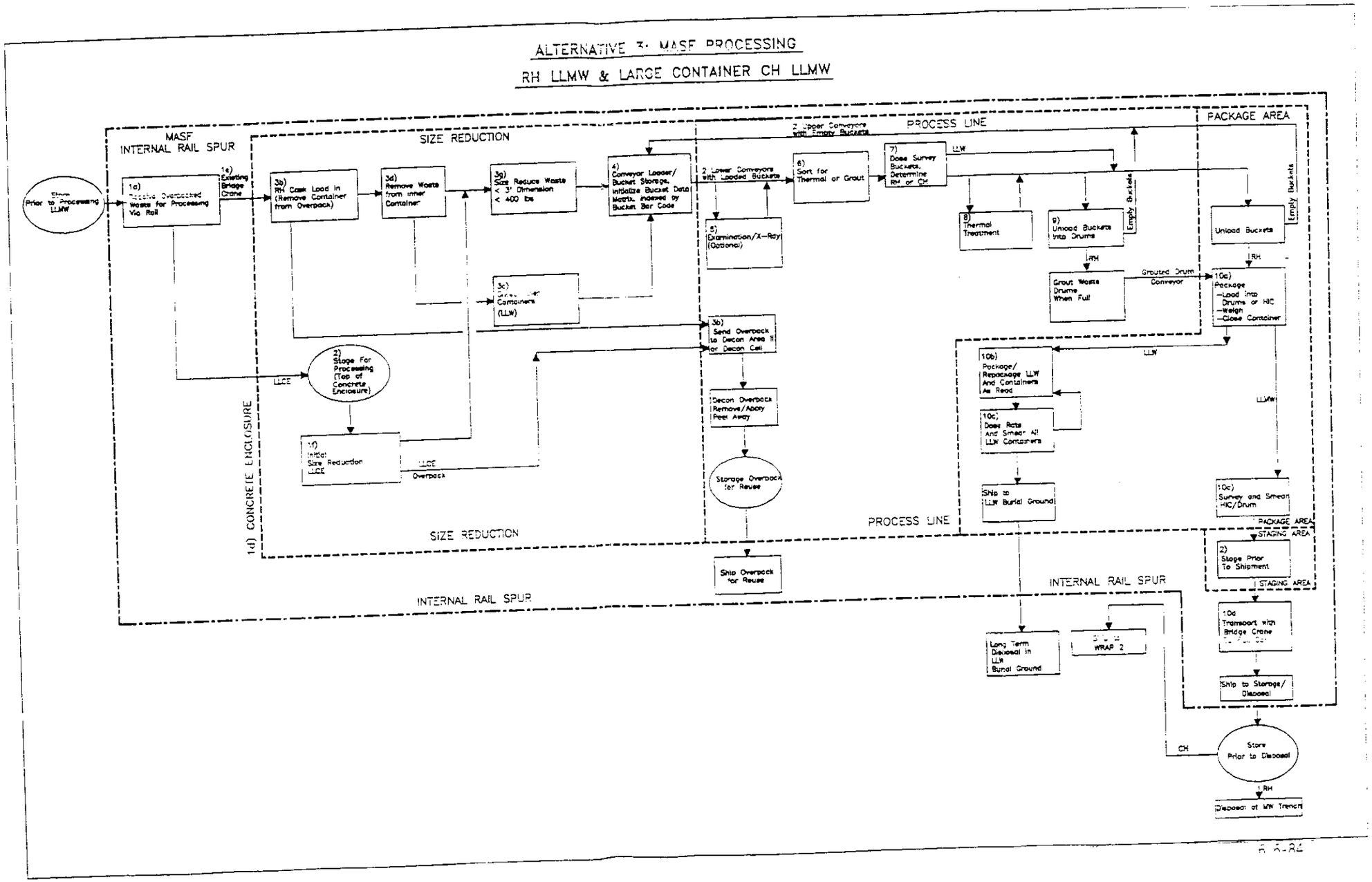


Figure 6.6.2-20. Process Logic for LLMW at the MASF.

Process Flow Logic for Processing RH LLMW and CH LLMW in Large Containers in MASF

1. Receiving/Shipping TRU in High Bay Area
   a) LLMW Waste Packages Received on Rail Car
   b) Up to Three Rail Cars Backed into Facility on Rail Spur at North End
   c) Transport LLCE to Vertical Vessels for Staging
   d) 2 ft Thick Concrete Enclosure Surrounding Process Area
   e) Packages Retrieved from Rail Car with 200 Ton Crane Through Ceiling Bay Doors Over Enclosure
   f) Initial Size Reduction of LLCE in Vertical Vessels

2. Staging Area
   a) Staging on Roof of Concrete Structure
   b) Segregated Areas for Staging Waste Packages Prior to Packaging, Filled Containers Prior to Shipment, Empty Containers/Overpacks, and Overpacks Prior to Decontamination
   c) Staging of LLCE in Vertical Vessels

3. Size Reduction Area
   a) Final Size Reduction of LLCE to Maximum Dimension of 3 ft and 400 lbs
   b) Remove Container from Cask/Overpack
   c) Decontamination of Cask/Overpack in Decontamination Area #2
   d) Remove Waste From Container
   e) Shred Containers/Shielding (Assumes No Lead Shielding)
   f) Load Waste and Shredded Containers Into Conveyor Buckets
   g) Size Reduction to Maximum Dimension of 3 ft and 400 lbs

4. Conveyor System
   a) 2 Conveyor Track Systems (Heavy/Light), 4 Stacked Layers (Lower 2 Levels are Loaded Buckets, Upper 2 Levels are Return System/Empty Buckets)
   b) Buckets with Bar Code Scanning System Directs Buckets to On-Line Process Modules and Tracks Waste

5. Examination/X-Ray Area (Optional)
   a) Identify LLMW or LLW

6. Sorting Area
   a) Sort for Thermal Treatment or Stabilization
   b) Sort for LLMW or LLW (Optional)

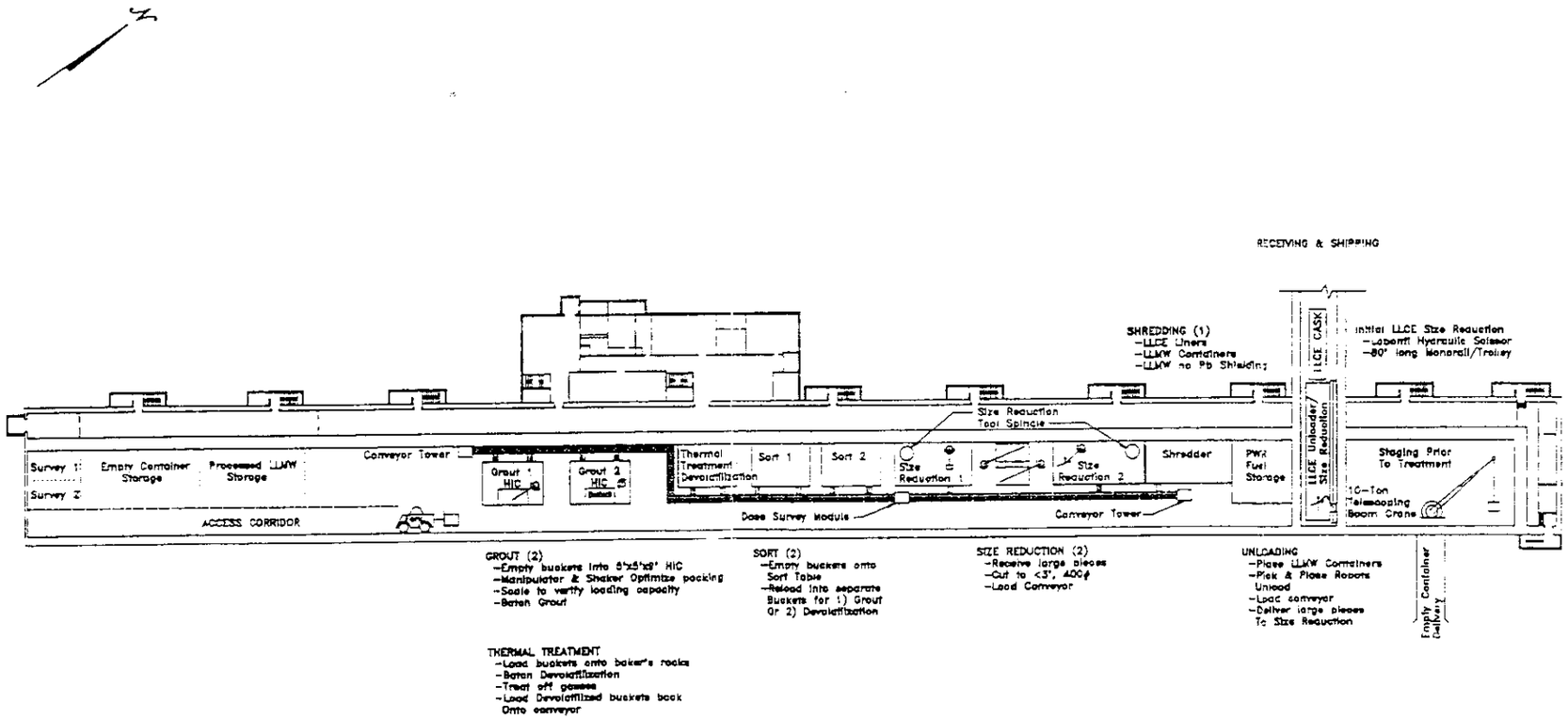
7. Survey/Dose Rate Buckets
   a) Survey Both LLW and LLMW Buckets
   b) Determine CH and RH
   c) Send LLW Through to Packaging, By-Pass Processing

8. Thermal Treatment Devolatilization Process
   a) Small Piece Combustibles
   b) Load into Thermal Containers
   c) Off-Gas Treatment

9. Stabilization
   a) Vibragrout

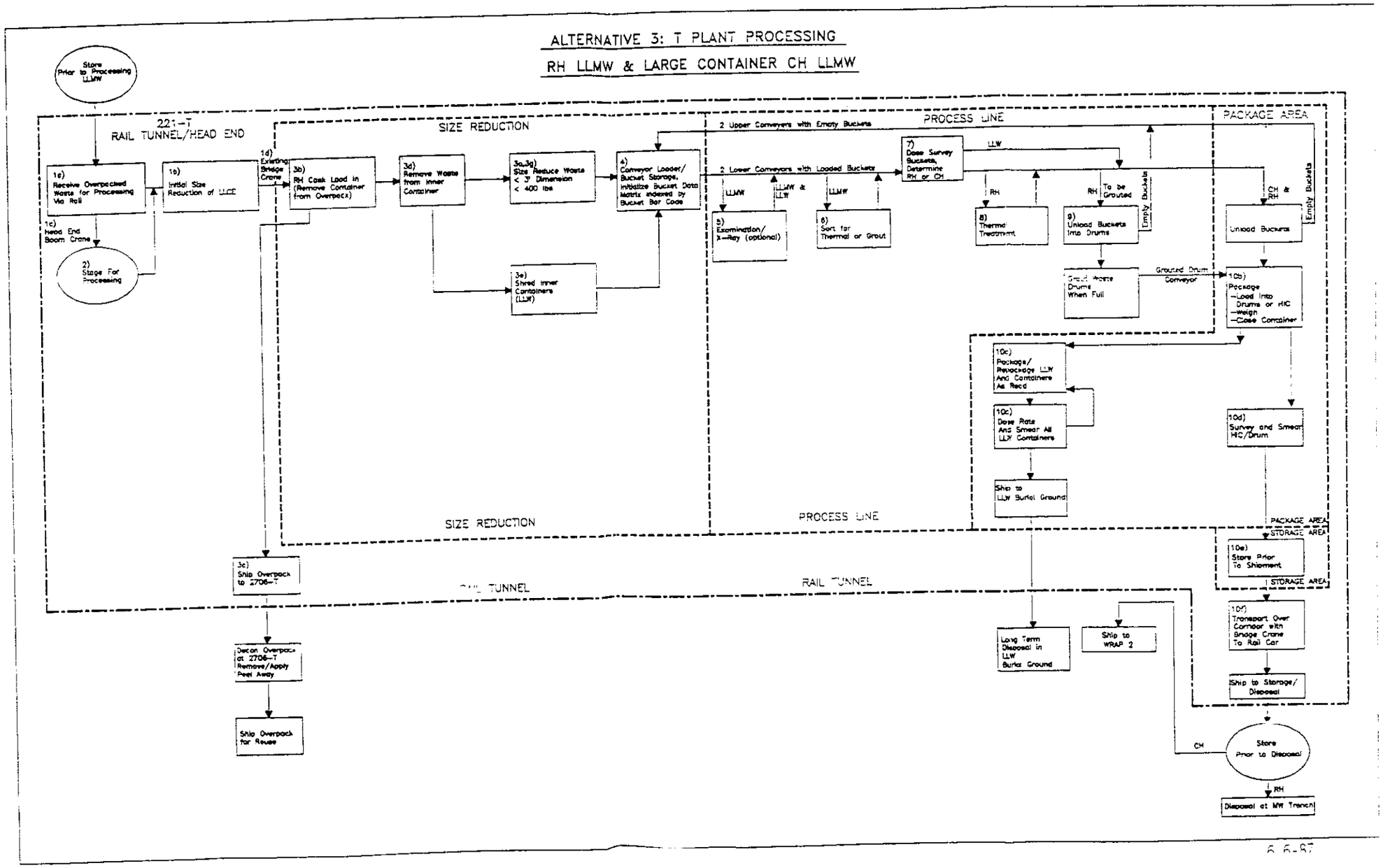
10. Packaging/Staging Area
    a) Package LLMW (CH and RH)
    b) Package LLW (CH and RH)
    c) External Survey of Containers Prior to Shipment
    d) Transport by Crane to Rail Car or Staging Above Enclosure
    e) Mobile Manipulator/Forklift to Access Conveyor

Figure 6.6.2-21. Process Layout for LLMW at the T Plant.



RH & CH LLMW PROCESSING AT T PLANT

Figure 6.6.2-22. Process Flow Diagram for LLMW at the T Plant.



6-6-97

Figure 6.6.2-23. Process Logic Diagram for LLMW at the T Plant.

Process Flow Logic for Processing RH LLMW and CH LLMW in Large Containers in T Plant Canyon

1. Receiving/Shipping LLMW in Tunnel
   a) LLMW Waste Packages Received on Rail Car in Tunnel
   b) Initial Size Reduction of LLCE to Maximum Dimension of 6 ft and 2 Tons
   c) Packages Retrieved from Rail Car with Boom in Head End for RH Storage
   d) Packages Retrieved from Rail Car with Existing Canyon Crane for Processing/Size Reduction Area

2. Staging Area for LLMW Prior to Processing
   a) RH LLMW Storage in Head End (Retrieve from Rail Car with 10 Ton Boom located in Head End)
   b) CH LLMW Storage on Asphalt Pad West of 2706-T Facility

3. Size Reduction Area
   a) Final Size Reduction of LLCE to Maximum Dimension of 3 ft and 400 lbs
   b) Remove Container from Cask/Overpack
   c) Send Cask/Overpack to 2706-T by Rail Car for Decontamination and Reuse
   d) Remove Waste from Container
   e) Shred Containers/Shielding (Assumes No Lead Shielding)
   f) Package Container/Non-Lead Shielding as LLW
   g) Size Reduction to Maximum Dimension of 3 ft and 400 lbs

4. Conveyor System
   a) 2 Conveyor Track Systems (Heavy/Light), 4 Stacked Layers (Lower 2 Levels are Loaded Buckets, Upper 2 Levels are Return System/Empty Buckets)
   b) Buckets with Bar Code Scanning System Directs Buckets to On-Line Process Modules and Tracks Waste

5. Examination/X-Ray Area (Optional)
   a) Identify LLMW and Non-MW (LLW)

6. Sorting Area
   a) Sort for Thermal Treatment or Stabilization
   b) Sort for LLMW or LLW (Optional)

7. Survey/Dose Rate Buckets
   a) Survey Both LLW and LLMW Buckets
   b) Determine CH and RH
   c) Send LLW Through to Packaging, By-Pass Processing

8. Thermal Treatment Devolatilization Process
   a) Small Piece Combustibles
   b) Load into Thermal Containers
   c) Off-Gas Treatment
   d) One On-Line System with Floor Space for Second

9. Stabilization
   a) Vibragrout

10. Packaging/Staging Area
    a) Staging Area for Empty Containers
    b) Package LLMW (CH and RH)
    c) Package LLW (CH and RH)
    d) External Survey of Containers Prior to Shipment
    e) Staging Area for Filled Containers Prior to Shipment
    f) Transport by Crane to Rail Car Over Corridor

Figure 6.6.2-24. Cs and Sr Capsule Storage Schematic at the FMEF.

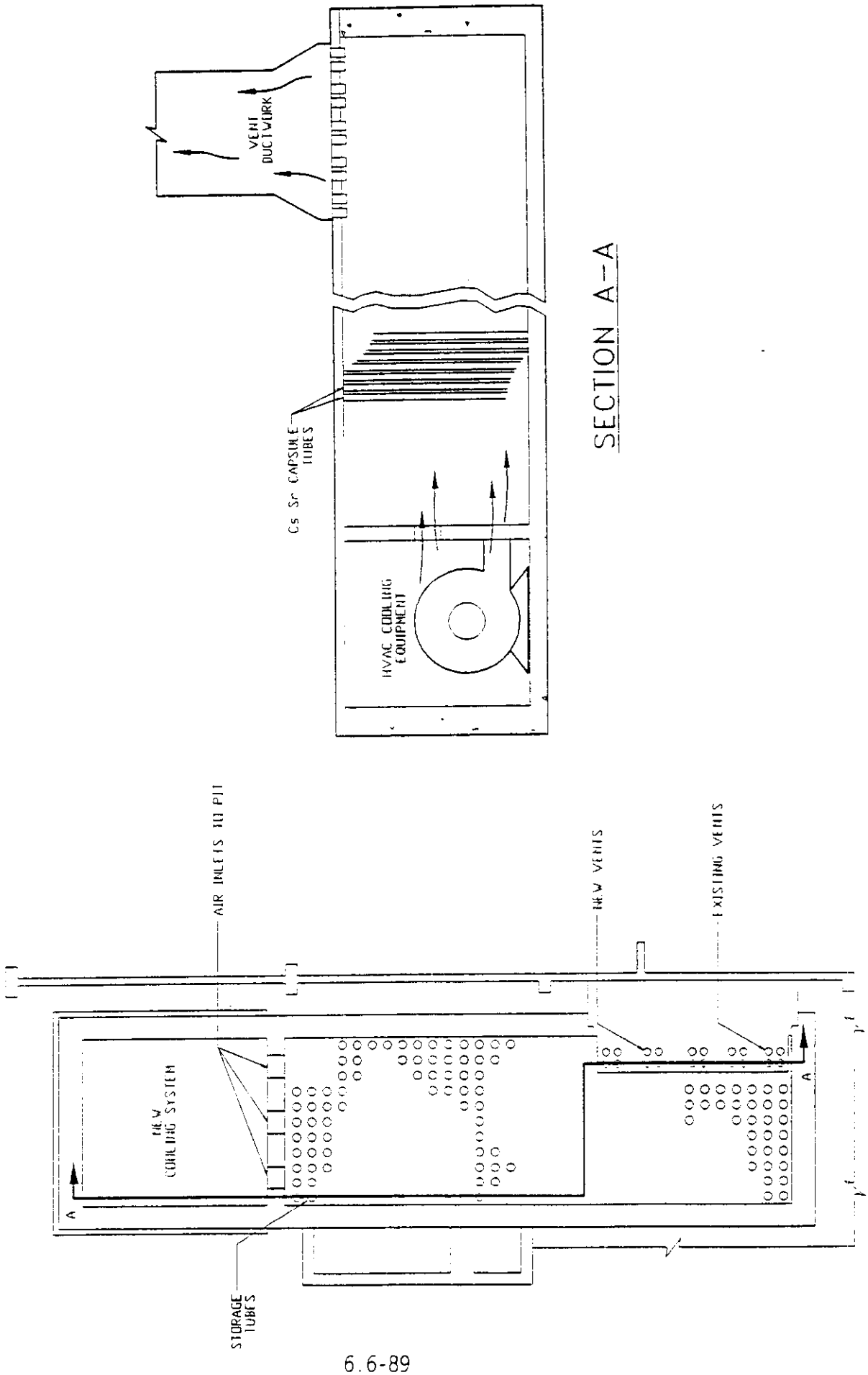
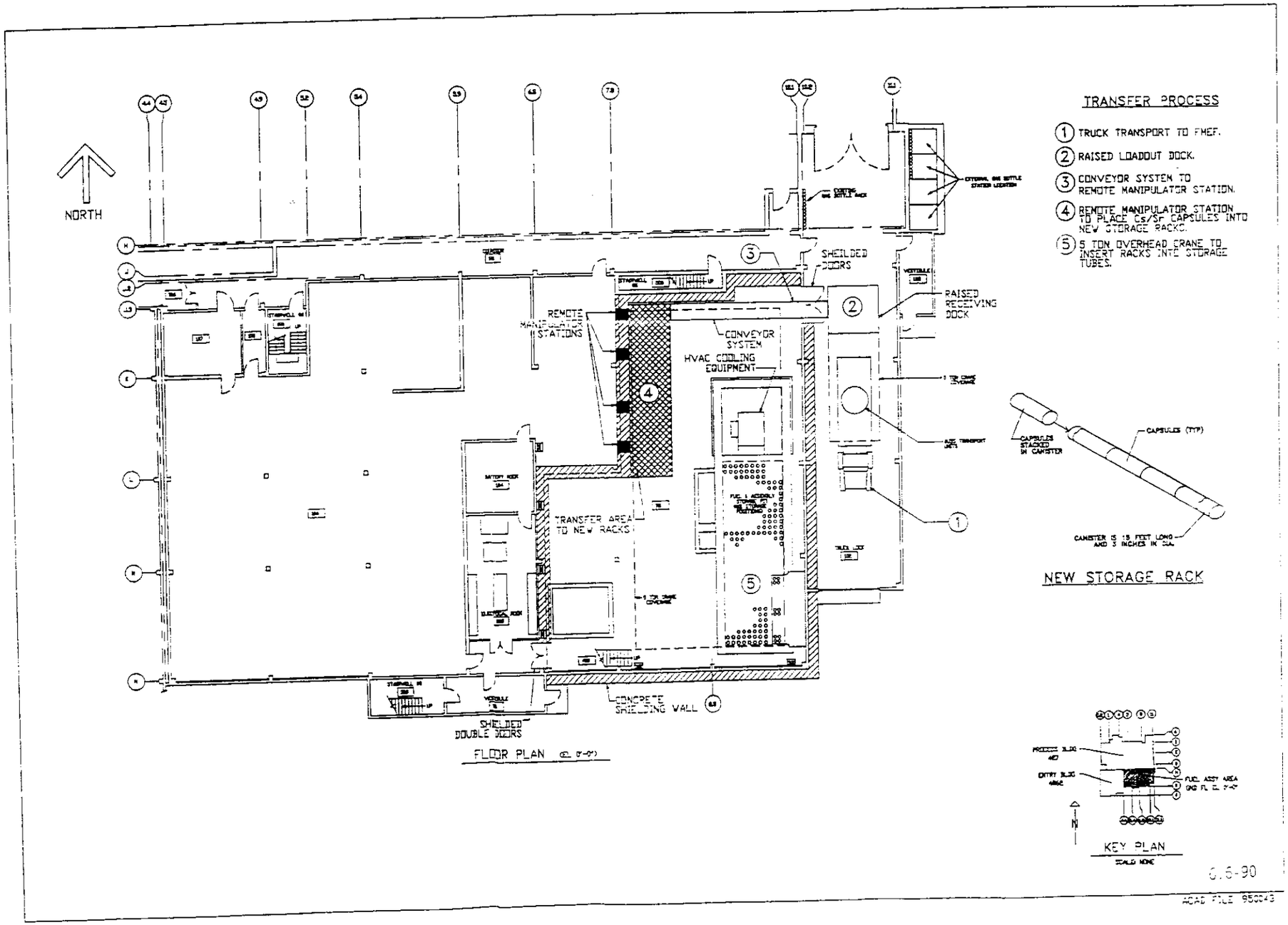


Figure 6.6.2-25. Fuel Assembly Area Floor Plan at the FMEF.



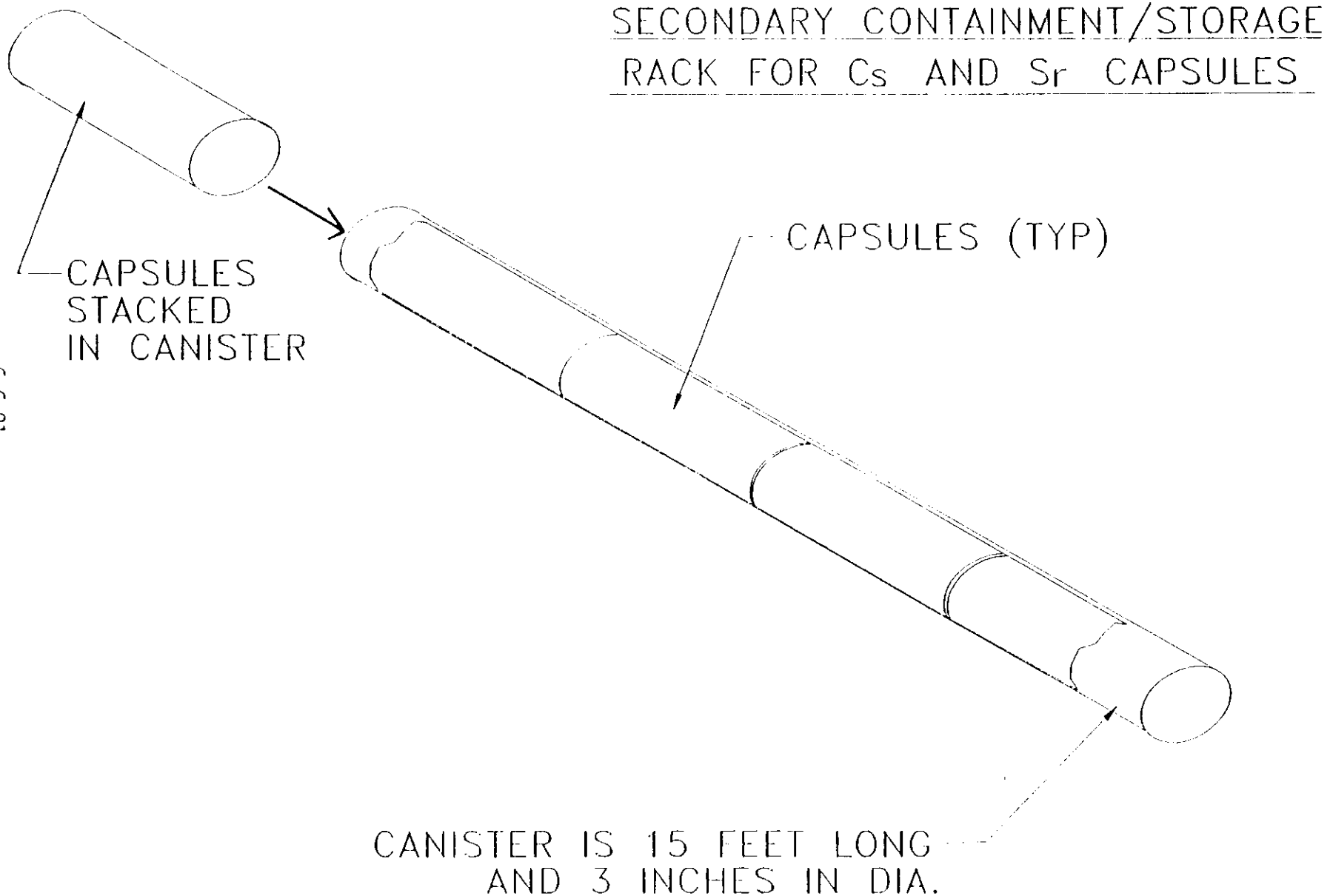


Figure 6.6.2-26. FMEF - Storage Rack for Canister

Table 6.6.1-1. Estimated Total Volume Annual Treatment Rates for LLMW and TRU Waste.

Waste Type	Total Waste Volume	Per Annum
RH TRU	42,000 m^3	1,940 m^3
CH TRU	31,500 m^3	1,500 m^3
RH LLMW	97,000 m^3	4,500 m^3
CH LLMW	1,600 m^3	75 m^3

RH TRU: Remote-Handled Transuranic Waste
CH TRU: Contact-Handled Transuranic Waste
RH LLMW: Remote-Handled Low-Level Mixed Waste
CH LLMW: Contact-Handled Low-Level Mixed Waste

Table 6.6.1-2. Estimated Quantities of Miscellaneous Sources.

TYPES	AMOUNTS (15 m^3 OVERALL)	STORAGE AREA
Borosilicate Glass Canisters - 47 Canisters	4.7 m^3 total	Building 324 B Cell (15 canisters) Building 324 A Cell (32 canisters)
High-Dose Rate LLW and RMW - Dispersible Fines - Dry Residue From Melter Runs - Oil Absorption Materials - Liquid Metal Sealant	10, 200 liter drums of fines 170 liters of dry residue	Building 324 B Cell
RH TRU Materials From Cell Operations	0.7 m^3 total, in 202, 1-gallon cans	327 Building
Strontium Fluoride Contained in four 2-in.-dia. pipes	0.0015 m^3 total (777 grams)	325A B Cell
Neptunium Oxide Powder	0.2 m^3 total volume 48 grams net mass of oxide	Building 324 basement
Non-Fuel Bearing Reactor Components Fuels assembly parts: - Control Rod - Poison Rod - Column Blade	0.2 m^3 total volume	Building 324 B&D Cells

Table 6.6.1-3. Container Size.

U.S. SIZE	METRIC VOLUME	U.S. DIMENSIONS	METRIC DIMENSIONS	MAX WEIGHT LIMIT
55-gal Drum	200 Liters	22-in. dia. x 34 in.	559-mm dia. x 866 mm	380-kg Gross
96 cubic ft	2.719 m^3	4-ft x 4-ft x 6-ft Box	1.216-m x 1.216-m x 1.829-m Box	
128 cubic ft	3.625 m^3	4-ft x 4-ft x 8-ft Box	1.216-m x 1.216-m x 2.439-m Box	2.260-kg Gross
576 cubic ft	16.31 m^3	6-ft x 8-ft x 12-ft Box	1.829-m x 2.439-m x 3.658-m Box	
175 cubic ft	4.956 m^3	5-ft x 5-ft x 7-ft Box	1.524--m x 1.524-m x 2.337-m Box	
67.21 cubic ft WIPP	1.903 m^3	37-in. x 71-in. x 54.25-in. Box	0.94-m x 1.803-m x 1.378-m Box	1.840-kg Gross
225 cubic ft Metal Overpack	8.333 m^3	5-ft x 5-ft x 9-ft Box	1.524-m x 1.524-m x 2.743-m Box	
HLW Vitrification Canisters	1.689 m^3	27-in. dia. x 15 ft	686-mm dia. x 4.57 m	3.350-kg Gross
WIPP Canister	= 600 Liters	26-in. dia x 10 ft., 1 in.	66-mm dia. x 3.07 m	3.600-kg Gross

Table 6.6.1-4. Container Size-Reduction Logic.

Step	Procedure
1.	Average Container Dimensions (45 m^3, or 1,600 cu. ft.) are 8 ft x 10 ft x 20 ft = 1,600 sq. ft.
2.	Net Container Volume = 9 m^3 (318 cu. ft.).
3.	Sections Cut to fit a 1.2 m x 1.2 m x 2.4 m plywood box (no weight consideration).
4.	The pieces would fit into 2.7 boxes, with pieces being 1.1 m x 2.2 m. • Box 1 - Pieces 1 to 5 and 11 to 15 (10 cut pieces). • Box 2 - Pieces 21 to 25 and 30 to 34 (10 cut pieces). • Box 3 - Pieces 39 to 41 and 44 to 46 (6 cut pieces). Small Pieces: 6, 7, and 8 (3 pieces) 26,27, and 28 (3 pieces) 17, 9, and 29 (3 pieces) 18, 42, and 47 (3 pieces) • Box 4 (Miscellaneous small pieces) Small pieces: 16, 43, and 48 (3 pieces) 19 (1 piece) 35 (1 piece) 36 (1 piece) 37 (1 piece) 38 (1 piece)

Table 6.6.1-5. Estimated Volume of Waste to be Stored (per average container).

Waste Type	Estimated Volume
Small-size waste	0.5 m^3 200-L drums
Size-Reduced waste	7 to 13 m^3 HIC boxes
Contingency	0 to 2.0 m^3
LLW Containers	13 m^3 in Plywood boxes to LLW burial ground, if required

Table 6.6.1-6. Storage Requirements Prior to Treatment and Disposal.

CATEGORY	PRE-PROCESSING YEAR WITH MAX PROJECT STORAGE VOLUME	MAX VOLUME m^3 PRIOR TO TREATMENT*	POST-PROCESSING YEAR WITH MAX PROJECT STORAGE VOLUME	MAX VOLUME m^3 PRIOR TO DISPOSAL OR FINAL PROCESS BY WRAP-1 OR -2A**
HLW Canisters	2006	451	2023	15.460
CH LLMW (Drums)	2001	860	2023	871
RH LLMW (HICs)	2002	11.200	2023	38.500
CH LLMW GTC 3	1995	N/A	2023	4.500
CH LLW GTC 3	2001	N/A	2023	43.000
RH LLMW GTC 3	1995	N/A	2023	1.600
RH LLW GTC 3	1995	N/A	2023	41.500
CH TRU - Treated (Drums)	2001	8.500	2023	16.860
RH TRU - Treated (WIPP)	2006	14.500	2023	30.640
Cesium Capsules		3	2010	TBD
Strontium Capsules		1	2010	TBD
Miscellaneous Sources	1995	15	2023	60
Contaminated Metallic Sodium	2008	177		N/A
Unirradiated Uranium	2006	144	2023	144 TBD

*No allowance for container/packagestorage.
**Volume includes containers and access space for handling containers.

Table 6.6.1-7. Estimated Costs for CH and RH Storage Facilities.

ESTIMATED COSTS FOR CH AND RH STORAGE FACILITIES		
Work Breakdown Structure	Contact-Handled Cost Per Sq. Ft.	Remote-Handled Cost Per Sq. Ft.
1.0 Design and A/I During Construction	$13,923,144	$63,582,579
2.0 Procurement	$0	$21,170,000
3.0 Construction	$18,543,000	$84,680,000
3.1 Construction Management (ICF KH)	$8,829,117	$40,319,781
4.0 Project Management (WHC)	$2,376,153	$10,851,141
Contingency	$11,207,919	$51,183,014
Total	$54,879,333	$271,786,515
ESTIMATED COST PER SQ. FT.		
1.0 Design and A/I During Construction	$52.56	$300.34
2.0 Procurement		$100.00
3.0 Construction	$70.00	$400.00
3.1 Construction Management (ICF KH)	$33.33	$190.46
4.0 Project Management (WHC)	$8.97	$51.26
Contingency	$42.31	$241.77
Total	$207.17	$1,283.83
Volume (m^3)	46,703	42,589
Floor Space (Sq. Ft.)	264,900	211,700

Table 6.3.3-1. Cost Estimate Basis Sheet.

1. DOCUMENTS AND DRAWINGS

See the report for Alternative 3, including the list of figures.

2. MATERIAL PRICES

Material prices represent current prices for equipment at the time the LTDS estimate was prepared. Prices were developed based on vendor budgetary quotations, estimating manuals (Richardson, R.S. Means, etc.), historical data and estimator experience.

3. LABOR RATES

Labor rates are based on the Hanford Site Stabilization Agreement and included fringe benefits, labor insurance, taxes, small tool allowance, etc. For labor that must be performed in contaminated areas, an allowance for reduced productivity due to working in personal protective equipment is included in the hourly labor rate.

4. GENERAL REQUIREMENTS

It was assumed that the construction contract would be competitively bid on a fixed price basis.

5. REMARKS

See the main body of the report, Alternative 3, for greater detail of the assumptions for costing purposes.

Table 6.3.3-2. Contingency Analysis Basis Sheet.

CONTINGENCY ANALYSIS BASIS SHEET

THE U.S. DEPARTMENT OF ENERGY ORDER 4700.1 "PROJECT MANAGEMENT SYSTEM" DATED 3-6-87, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THIS ESTIMATE IS BASED ON A PRE-CONCEPTUAL DESIGN, WITH MANY DETAILS NOT YET DEFINED. SINCE THE LEVEL OF DETAIL IS SIMILAR FOR EACH PHASE OF THE PROJECT, A UNIFORM CONTINGENCY OF 35% HAS BEEN APPLIED TO ALL PORTIONS OF THE ESTIMATE. THIS IS CONSISTENT WITH THE RECOMMENDATIONS OF THE COST ESTIMATING HANDBOOK FOR ENVIRONMENTAL RESTORATION, DATED 3-30-95.

ENGINEERING	35%
CONSTRUCTION	35%
AVERAGE PROJECT CONTINGENCY	35%

Table 6.3.3-3. Alternative 3 Cost Estimate Summary.

WASTE STREAM	FACILITY	CONSTR COST	TITLE I & II	TITLE III	CONSTR MGMT	PROCESSING WHC PROJ MGMT	OPC	TOTAL	WITH CONTINGENCY	LCC CURRENT $	LCC ESCALATED
RH TRU											
	T PLANT	$35 418 906	$7 437 989	$3 187 710	$3 541 900	$2 479 330	$5 206 592	$57 272 617	$77 317 807	$342 478 684	$662 273 651
	MASF	$23 737 496	$4 984 874	$2 136 375	$2 373 750	$1 661 625	$3 489 412	$38 383 531	$51 817 767	$312 902 654	$628 379 220
RH LLMW											
	GROUT SC1	$18 803 223	$3 948 677	$1 692 290	$1 880 322	$1 316 226	$2 764 074	$30 404 812	$41 046 496	$217 911 461	$364 139 271
	GROUT SC2	$19 791 600	$4 156 215	$1 781 235	$1 979 160	$1 385 405	$2 909 351	$32 002 856	$43 203 855	$307 570 234	$525 958 142
	MASF	$21 608 180	$4 537 718	$1 944 736	$2 160 818	$1 512 573	$3 176 402	$34 940 427	$47 169 577	$305 708 788	$518 967 658
	T PLANT	$33 231 154	$6 978 542	$2 990 804	$3 323 115	$2 326 181	$4 884 980	$53 734 776	$72 541 948	$337 364 532	$558 241 035

WASTE STREAM	FACILITY	CONSTR COST	TITLE I & II	TITLE III	CONSTR MGMT	STORAGE WHC PROJ MGMT	OPCs	TOTAL	WITH 35% CONTINGENCY	LCC CURRENT $	LCC ESCALATED
HLW CANISTERS	CANYONS (3)	$117 000 000	$24 570 000	$10 530 000	$11 700 000	$8 190 000	$17 199 000	$189 189 000	$255 405 150	$325 786 518	$428 644 240
RH TRU	FMEF	$3 044 329	$639 309	$273 990	$304 433	$213 103	$447 516	$4 922 680	$6 645 618	$188 499 373	$360 390 666
LLMW	FMEF	$3 044 329	$639 309	$273 990	$304 433	$213 103	$447 516	$4 922 680	$6 645 618	$188 499 373	$360 390 666
Cs/Sr	FMEF	$3 077 003	$646 171	$276 930	$307 700	$215 390	$452 319	$4 975 514	$6 716 944	$77 100 570	$145 876 714
UU	FMEF	$1 640 603	$344 527	$147 654	$164 060	$114 842	$241 169	$2 652 855	$3 581 354	$73 350 360	$141 014 464
MISC SOURCES	FMEF	$133 239	$27 980	$11 992	$13 324	$9 327	$19 586	$215 447	$290 854	$66 924 399	$131 121 482

Table 6.3.3-4. Storage Facility Cost Comparison (Costs in Millions).

	CONSTRUCTION	LIFE CYCLE
TRANSURANIC WASTE STORAGE		
Fuel Materials Examination Facility (FMEF)	7[1]	187
Central Waste Complex (CWC) Expansion	26[2]	
LOW-LEVEL MIXED WASTE STORAGE		
FMEF	7	187
CWC Expansion	26[2]	
GREATER THAN CATEGORY III STORAGE		
Future Remote-Handled (RH) Storage Facility at CWC	272[3]	
Future Contact-Handled (CH) Storage Facility at CWC	55[3]	
HIGH-LEVEL WASTE CANISTER STORAGE		
Canyon Facilities	255[4]	528
Modular Vault Dry Storage	100[5]	429
CESIUM/STRONTIUM CAPSULE STORAGE		
FMEF	7	77
Waste Encapsulation and Storage Facility	30[6]	671
UNIRRADIATED URANIUM AND MISCELLANEOUS SOURCE STORAGE		
FMEF	5	74
Existing Locations	0.04[7]	32

1. Storage Space available at FMEF is less than required.
2. The cost of RH and CH GTC3 storage includes the cost of RH and CH TRU and LLMW storage.
3. Estimates are based on projected storage space required and average cost per square foot.
4. Based on the costs to upgrade u Plant, applied to three canyons.
5. Based on Foster Wheeler estimate and engineering judgement.
6. Estimate for construction costs provided by WEST staff; M&O costs obtained from current ADS documents.
7. Based on current operating costs and a $400,000 upgrade estimate.

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Acronyms

ACAM	automatic continuous air monitor
AHU	air handling unit
ALARA	as low as reasonably achievable
ASME	American Society of Mechanical Engineers
ASRS	automatic storage and retrieval system
ACT	air cleanup train
AWJ	abrasive water jet
BOP	balance of plant
BPA	Bonneville Power Administration
BTU	british thermal units
CCTV	closed-circuit television
CFR	Code of Federal Regulations
CH	contact handled
CSB	Canister Storage Building
D&D	decontamination and decommissioning
DAPP	Design Asset Preservation Program (at WNP-1)
DE	drum equivalents
DOE	Department Of Energy
EFSEC	Energy Facility Site Evaluation Council
EL	elevation
FFTF	Fast Flux Test Facility
GSB	General Services Building
GTC	greater than category
HEPA	high efficiency particulate air
HLW	high level waste
HSF	fuel handling area HVAC (at WNP-1)
HVAC	heating, ventilation, and air conditioning
HWVP	Hanford Waste Vitrification Plant
ICF-KH	ICF Kaiser Hanford
IEEE	Institute of Electrical and Electronics Engineers
IEST	Interactive Estimating
IX	ion exchange
LEC	long equipment containers
LLMW	low level mixed waste
LLW	low level waste
MTU	metric tons uranium
NQA	nuclear quality assurance
NRC	Nuclear Regulatory Commission
ODC	other direct cost
QA	quality assurance
QC	quality control
RCB	Reactor Containment Building
RCW	Revised Code of Washington
RH	remote handled
RR	rail road
SWB	standard waste box
SWTSF	Solid Waste Treatment and Storage Facility
TGB	Turbine Generator Building
TPC	total project cost
TRU	transuranic
UU	unirradiated uranium
WHC	Westinghouse Hanford Company
WNP-1	Washington Nuclear Plant No. 1
WESF	Waste Encapsulation Storage Facility

List Of Units of Measure

km	kilometer
mi	mile
m^2	square meter
ft^2	square foot
m^3	cubic meter
ft^3	cubic foot
lb/hr	pound per hour
kg/hr	kilogram per hour
psig	pound per square inch gage
Pa	pascal
kg	kilogram
g	standard acceleration of free fall
mrem	milli-roentgen equivalent man
mrem/yr	milli-roentgen equivalent man per year
cfm	cubic feet per minute
m^3/sec	cubic meter per second
kPa	kilopascal
lb/ft^2	pound per square foot
kg/m^2	kilogram per square meter
ft	foot
m	meter
l	liter
gal	gallon
cm	centimeter
in.	inch
m^3/min	cubic meter per minute
lb	pound
BTU/hr	British Thermal Unit/hour
J/sec	Joules/second
mm	millimeter
ton	ton

6.7 ALTERNATIVE 4: MAXIMIZING USE OF THE WASHINGTON NUCLEAR PLANT-1 (WNP-1) FACILITY INTEGRATING (WHERE EFFECTIVE STORAGE AND PROCESSING NEEDS FOR ALL WASTE AND MATERIAL STREAMS)

6.7.1 Process Description

The description of the process for storage and treatment of waste and materials has been interspersed in the facility description. This is due to integration of the various processes into the existing facility. Where practical existing systems within the facility were utilized to the benefit of processing. Discussions of processing relative to the general plant area descriptions can be found in section 6.7.2.2.2. Discussions of processing relative to the conversions of the plant area descriptions can be found in section 6.7.2.2.3. Discussions of processing relative to equipment sizing basis are in section 6.7.2.3.

6.7.2 Facility Description

The function of the Hanford Solid Waste Treatment and Storage Facility (SWTSF) is to provide treatment and storage of high level waste (HLW), transuranic (TRU), low level mixed waste (LLMW) and low level solid radioactive waste streams which is received in various forms from the Hanford Site. The Alternative 4 locates the facility within the essentially completed, but never fueled or operated WNP-1 Facility, also on the Hanford Site. As a consequence of achieving this mission, the WNP-1 facility is to be converted into a form that is divided into specific processing and storage areas dedicated to the performance of the various tasks. The SWTSF overall Block Flow Diagram, Figure 6.7-1 and Figure 6.7-2, titled Solid Waste Treatment and Storage Flow Diagram, provides the conceptual process flow for the converted facility.

WNP-1 is a stand alone nuclear power plant designed to be licensed by the Nuclear Regulatory Commission (NRC) to generate, process, and store nuclear materials including waste products at the plant site. (NRC Docket Number 50-460, *Supply System Nuclear Project Number 1 Final Safety Analysis Report*) WNP-1 is located 12 mi (19.3 km) north of Richland, WA and 2.4 mi (3.86 km) from the Columbia River. The plant is designed to store 663 metric tons of uranium (MTU) in the form of new and spent nuclear fuel, as well as annually process for disposal tens of millions of curies of radioactive waste streams. These storage and processing functions take place Reactor Containment Building (RCB) and General Services Building (GSB). The study of plant conversion evaluated these two buildings for process and storage functions, plus the Turbine Generator Building (TGB) for waste storage and the Spray Pond structure for conversion to HLW canister storage.

The GSB is a very large Safety Class 1 concrete and steel structure that has in excess of 400,000 ft^2 (3.72E+04 m^2) of floor area and in excess of 8,000,000 ft^3 (2.27E+05 m^3) of building volume. The GSB would be utilized to process all the waste and store the high level and remote handled Hanford solid waste. The structure contains the following installed systems that would be utilized to process and treat solid waste materials:

- Radioactive waste processing systems (solid, liquid, and gaseous waste) including radioactive drains, sumps, collection tanks, 4 evaporators,

solid and liquid waste separation equipment and a solid waste grout system.

- Fifteen (15) separate zoned HVAC systems, 10 of which have redundant air handling units and HEPA cleanup trains installed. A total of 24 cleanup trains are available for GSB conversion.
- Fuel handling, storage, and monitoring equipment whose design is consistent with NRC requirements.
- Plant fire protection loops, with standpipes installed and functional in the buildings.
- Redundant auxiliary electric steam boilers, each with a capacity of 120,000 lb/hr (5.44E+04 kg/hr) at 250 psig (1.72E+06 Pa).
- Operational freight elevators [9,000 lb (4,080 kg) capacity] and floor loading capability generally in the range of 250 to 300 lb/ft^2 (1.2E+04 to 1.4E+04 Pa).
- Cranes, many of which are installed and functional, e.g., Containment polar crane at 500 ton (4.5E+05 kg) capacity, rail access cask handling crane at 105 tons (9.5E+04 kg), TGB crane at 250 tons (2.27E+05 kg), heater bay crane at 125 tons (1.385E+05 kg), radioactive waste shipping bridge crane at 25 tons (2.27E+04 kg), fuel handling bridge crane at 10 tons (9.07E+03 kg), and two refueling canal and spent fuel pool bridges with a lifting capacity of 6 tons (5.44E+03 kg).

The GSB also contains maintenance areas (instrument and mechanical shops), offices, locker, shower and laundry facilities, health physics areas, and laboratory areas (both hot and non-contaminated chemistry labs, sampling, and counting rooms).

The TGB is a very large Safety Class 3 structure constructed of structural steel with insulated sheet metal sides that has in excess of 100,000 ft^2 (9.3E+03 m^2) of floor area and over 3,000,000 ft^3 (8.5E+04 m^3) of building volume. The TGB would be used for storage of contact handled waste in the plant conversion.

In addition to the process and storage areas mentioned above, the WNP-1 site also includes over 500,000 ft^2 (4.64E+04 m^2) of warehousing and office space which includes 5 large warehouses and numerous other metal sided buildings that can be used for additional storage of treated waste, consumable material staging and storage, and waste incoming and outgoing short term storage facilities. The plant site is served by the Hanford rail system with all rail spurs installed and functional.

6.7.2.1 Approach. WHC provided the bases documents for the studies which were common to all options. The M-33 Waste and Material Inventory, Waste and Material Inventory Information Summary, the Alternative 1 Process Flow Sheet, and the individual waste stream throughput and process diagrams served as the basis for determination of facility needs.

The information provided was assessed to determine specific throughput before and after processing, unique storage requirements, and special handling or process needs which are required to store and process the waste in this facility option. Utilizing the results of this assessment the facility attributes were summarized based on historical data, existing processes, commercial experience and reference data.

In parallel with this effort the WNP-1 plant capability related to systems, structures and components were tabulated for use in comparison to the waste storage of processing requirements. The alignment of the requirements with the existing capabilities yielded the subset of modifications needed to address the needs of the storage and processing.

The identified modifications were then estimated using typical methods such as comparison to existing estimates, factoring and scaling based on size and throughput, industry guides and standards, or individual estimating tools such as quantity takeoff, vendor quotes and unit rates. Specific functions which had a firm estimate such as sodium storage and treatment were incorporated into the overall estimate with little or no change. Equipment lists were compiled and used not only as a basis for material costs but also played a part in determining the life cycle costs.

The traditional breakout of costs was applied, as well as certain percentage allocations for such items as engineering, construction management, escalation and other activities which have a strong historical basis or DOE standard. After calculating the direct costs, and deriving the percent allocations, a value for Total Project Cost (TPC) was obtained. Utilizing an operating staff assumption provided by WHC as well accepted programs and methods used at site, life cycle cost was then determined. A final assessment was then made to ensure the reasonableness of the estimate based on comparison to other projects and corporate experience.

Sections 6.7.2.3, 6.7.2.4, 6.7.2.5 and 6.7.2.6 provide study level summaries relative to basis, assumptions, uncertainties, and institutional issues. Overall facility compliance to such issues as safety assessments, seismic qualifications, and assurance of a "robust" design was verified to ensure that plant conversion within cost estimates were low estimate risk concepts. Due to the initial design purpose of the facility it was determined that no problems of this nature existed.

The final study activity was to provide concepts and initial layouts to assure feasibility of the conversion of the WNP-1 facility to a solid waste material storage and handling facility. The facility is sized such that it can accommodate the specified waste streams. The subsequent paragraphs provide a more definitive assessment relative to this ability.

6.7.2.2 General Plant Description. A general description of the existing plant is provided below followed by a description of modifications and processes required to achieve the converted plant configuration for solid waste treatment and storage.

6.7.2.2.1 Washington Nuclear Plant 1 Description. The Washington Nuclear Plant 1 (WNP-1) site is located in the southeast area of the Hanford Site approximately 12 miles (19.3 km) north of the City of Richland. The site is square shaped encompassing an area of approximately 972 acres (3.93E+06 m^2). Figure 6.7-12, titled Hanford Reservation Boundary Map, shows the location of the site relative to the Hanford Site as a whole. Figure 6.7-3 shows major WNP-1 buildings and facilities.

WNP-1 was designed in the mid-1970's and early 1980's to be a 1250 megawatt electric generating station powered by a pressurized water nuclear steam supply system. The RCB and GSB house safety related equipment, control

areas, backup power, radioactive waste, and fuel storage areas. These two major structures, with the addition of the plant ultimate heat sink Spray Pond, were designed to the NRC's Seismic Category I criteria for the site which includes 0.25 g horizontal acceleration at the ground surface. This is consistent with the vibratory acceleration that would be associated with an intensity VIII earthquake occurring on the Rattlesnake-Wallula structure at a distance of over 10 miles (16.1 km) from the site without attenuation. The Turbine Generator Building (TGB) is sited adjacent to the RCB.

WNP-1 is a nuclear facility with design features that make it essentially a zero release plant. The annual cumulative total body radiological effect of plant operation, considering all pathways, is approximately 0.5 mrem/yr for the average person. The dose contribution from liquid effluents is 0.05 mrem/yr, about 2% of the 10CFR50 Appendix I limit of 3.0 mrem, and the dose contribution from gaseous effluents is 0.14 mrem at the nearest residence (Taylor Flats) to the plant. This annual total body does is about 3% of the federal limit (NRC Docket Number 50-460, *Supply System Nuclear Project Number 1 Environmental Report Operating License Stage*). These low dose rates point to the effective radiological process and control systems within WNP-1 that are designed to contain the liquid and solid waste radiological source terms specified as the design basis for the plant.

As an example, the design of WNP-1 is required to accommodate the potential for leaking reactor fuel assemblies which contaminate the circulating reactor coolant. This coolant undergoes a feed and bleed cleanup process to maintain as low as reasonably achievable (ALARA) dose to plant operations and maintenance personnel. Ultimately, the cleanup process and the storage of radioactive waste is conducted in a manner that allows the annual doses cited above to be small fractions of conservative federal limits. Table 6.4-1 provides a comparison of the radionuclide inventory included in the design basis assumptions for WNP-1 with the total inventory of cesium capsules currently stored in Waste Encapsulation Storage Facility (WESF); each capsule at WESF contains approximately 45,000 curies of Cs-137. Although WNP-1 would probably not have been operated in a manner that would allow the buildup of the design basis coolant inventory, the comparison shows that the systems within WNP-1 are designed to annually process the equivalent of 735 cesium capsules. The process systems provide the ability to remove radioisotopes from the coolant and ultimately solidify the contaminants in 100 cubic foot blocks of grout for burial at the US Ecology site near the 200 Area of Hanford.

Radiological control within the plant is achieved through a combination of radioactive waste collection and process systems and zoned HVAC systems. These systems prevent the spread of radionuclide contamination to non-radiological areas. All ventilation systems that serve radiologically controlled areas include HEPA filters, many of which are redundant, and air handling units (AHU) that maintain radiologically controlled areas at a negative pressure relative to adjacent non-radiological areas. Table 6.4-2 provides summary data on the WNP-1 HVAC systems. The GSB contains 15 systems, 9 of which are fully redundant. The combination of systems provides a wide variety of equipment that can be used in the converted facility, including 26 AHUs ranging from 10,000 to over 100,000 cfm (4.7 to 47 m^3/sec), and 22 air cleanup trains (ACT) each of which contain multiple HEPA filter banks and inlet air humidity control. The exhaust of potentially radiologically contaminated air from the GSB is routed to a common discharge plenum with

provisions for isokinetic sampling and monitoring building discharge air flow. Each system includes sample, monitoring, and test penetrations that allow individual system diagnostics and performance testing and fans, environmental control components (temperature and humidity), and filter performance.

WNP-1 design includes systems that support liquid, gaseous, and solid waste processing. The plant has four evaporator systems with a capacity to process and condense approximately 36,000 lb of liquid waste per hour. Table 6.7-3 summarizes the characteristics of several major components of the steam supply and evaporator systems. Steam is supplied from either of two redundant electric boilers that have a supply range of from 6,000 to 120,000 lb/hr at 250 psig. The total demand from four simultaneously operating evaporators, and steam heating of the GSB in winter-time conditions is approximately 56,000 lb/hr. Thus, the demand on the boilers is well within the capacity of a single boiler. The combination of liquid and solid waste processing systems at WNP-1 make it practicably a zero release, zero discharge facility with the obvious exception of shipments of treated waste to licensed landfill.

The plant design, procurement of equipment, construction, and subsequent plant preservation and maintenance since construction suspension in 1982 has been conducted to quality assurance and control programs meeting the 10CFR50 Appendix B requirements as well as ASME NQA-1 requirements. Safety related mechanical systems and components were designed and constructed to ASME Section III code as applicable to fluid systems. Electrical components meet aging, environmental, and seismic design criteria of IEEE. Although the plant was formally terminated in January 1995, plant preservation will continue for approximately 2 years under the existing QA/QC program.

6.7.2.2.1.1 Plant Structure/Facility Attributes. The RCB is a 150 ft (45.7 m) inside diameter reinforced concrete cylindrical structure with a hemispherical dome and a flat reinforced concrete circular mat foundation. The free volume within the Containment is 3,000,000 ft^3 (8.5E+04 m^3). It has a design pressure of 52 psig (358 kPa gage) and has been pressure tested and N Stamped to Division 2 requirements of ASME Section III. Access to the Containment is provided by means of two personnel air locks and a 25 ft (7.62 m) diameter equipment hatch accessible by a ramp.

The GSB is a rectangular reinforced concrete structure with structural steel framing, 223 ft (68 m) wide and 363 ft (110.7 m) long. The building extends from 60 ft (18.3 m) below grade to approximately 60 ft (18.3 m) above grade with five intermediate floors generally with 25 ft (7.6 m) floor height. Floor loading used in the design basis for the structure generally includes 250 lb/ft^2 (1.2E+03 kg/m^2) live load which gives the building significant capability to store solid waste. The GSB contains auxiliary systems, control equipment, storage areas, plant support systems and office space necessary to support operation and maintenance of the plant. It is divided into distinct functional areas and served by HVAC systems that accomplish isolation of contaminated areas, or potentially contaminated areas, from non-contaminated areas. Several of these areas are important to the conversion of the GSB to solid waste processing and storage because they can be used with little or no modification to support the solid waste processing and storage mission. These areas are discussed below.

The fuel handling and storage area consists of two levels and contains all equipment necessary to support refueling of the reactor. This area

includes cask and fuel handling equipment, a decontamination area, a maintenance area, and fuel storage areas. It includes a dedicated HVAC system with capability to isolate the area from the balance of the GSB.

Waste treatment occupies area on two floors of the GSB and contains the required liquid and solid waste treatment systems required to accomplish zero liquid waste discharge. The systems include evaporators and condensers, mixing, centrifuge, and solidification equipment that mixes concentrated liquid waste with filter demineralizer resins in 100 ft^3 (2.83 m^3) grout blocks formed in stainless steel disposable containers. Contact handled solid waste is compacted in drums for shipment.

The service areas are located on two floors of the GSB, and provide staging for necessary equipment, testing laboratories, and facilities for plant personnel. The areas include office spaces, conference and meeting rooms, mechanical, electrical and instrumentation shops, chemistry, hot chemistry, and shielded counting rooms, change areas, friskers and access control features.

The GSB has approximately 400,000 ft^2 (3.7E+04 m^2) of floor area, of which approximately 250,000 ft^2 (2.32E+04 m^2) can be cleared of existing equipment and converted to processing or storage functions. The balance of the area includes those selected areas discussed above which house systems having value in the converted plant, as well as areas that may be too congested or lack the access necessary to make them viable for immediate consideration under a solid waste mission.

The TGB is a rectangular structure 200 ft (61 m) wide and 326 ft (99.4 m) long, having steel framing and insulated metal siding. This building houses the turbine generator unit and the heater bay, served by 250 ton (2.27E+05 kg) and 125 ton (1.13E+05 kg) cranes respectively that are currently operational. The TGB extends 136 ft above grade. While the TGB has a relatively high volume, 3.1E+06 ft^3 (8.78E+04 m^3) it has few intermediate floors, resulting in a usable area of approximately 1.0E+05 ft^2 (9.3E+03 m^2).

The ultimate heat sink Spray Pond was designed to be a water tight Seismic Category I structure containing 1.4E+07 gal (5.3E+07 l) of water for post accident plant cooling. It is a below grade structure 25 ft (7.62 m) deep, 300 ft (91.5 m) long, and 250 ft (76.2 m) wide. It includes a hardened pumphouse with redundant equipment vaults. Other significant plant structures include the Circulating Water Pumphouse and adjacent circular mechanical cooling towers, and a hardened security guard house for plant access control. The site is served by the Hanford rail system and includes rail access to bays both in the GSB and TGB with spurs serving the site warehouses, equipment storage yards, and transformer yard.

6.7.2.2.1.2 Status of Construction. Table 6.7-4 provides the overall status of construction of the plant by engineering/construction discipline, while Table 6.7-5 provides construction status by commodity installation. Equipment purchases for the plant are 95% complete and include 80,000 items received and logged by the inventory control system. The acquisition cost of this prepurchased equipment is approximately $400 million ('95 dollars). Major equipment is nearly 100% installed; 4 warehouses provide 61,000 ft^2 (5.67E+03 m^2) of storage for non-installed equipment and components, as does other temporary buildings and outdoor storage areas. Examples of equipment

currently in storage (not installed) include 7,000 valves, 5,000,000 ft (1.52E+06 m) of cable on 1,500 reels, thousands of feet of piping, and thousands of square feet of steel plate, both carbon and stainless steel.

The major to-go construction includes cable pulling and termination, instrumentation and tubing sensing line installation, and installation of small bore piping [≤ 2 in. (5.1 cm) diameter]. The only concrete work remaining in the plant is closure of construction openings. In excess of $2 billion has been spent to advance the plant to its current stage of completion. These costs include construction, equipment procurement, engineering, and plant maintenance.

6.7.2.2.1.3 Status of Documentation. Design and quality documentation are located in controlled rooms and vaults at the plant site. A redundant set of design documentation is located in Valley Forge, PA in a controlled commercial warehouse facility. Design documentation was brought to a "current" status in the mid-'80's by incorporation of all outstanding document change notices. Configuration control is assured through programs subject to NRC and ASME surveillance and audit.

To-go work on each plant system and facility was disclosed in the plant Design Asset Preservation Program (DAPP) file. This file includes disclosure of required remaining equipment procurement and design basis documents that require completion. On the whole, the DAPP disclosure files are not a valuable asset for conversion of the plant to a solid waste mission. However, selected systems and structures that do support conversion provide the design basis for safety related aspects of the structure, are immediately retrievable from document files and are available to support plant conversion studies and estimates. Table 6.7-6, titled Design Basis Document Overview, provides an overview of the existing design basis documentation status for the plant. Calculations are filed on a discipline basis.

Construction installation and procurement quality documentation are stored in hardened vaults at the site. Construction completion disclosure packages were developed by the construction manager to facilitate rapid mobilization anticipating a short notification of resumption of plant construction. This disclosure is valuable to identify the status of construction of each system, and to provide an immediate "punch list" of construction completion requirements for systems that will support plant conversion to the solid waste mission.

6.7.2.2.1.4 Plant Preservation Program. Both during active construction, and during the construction delay period over the past 12 years, the plant has been preserved by a quality assured program meeting the requirements of 10CFR50 Appendix B. This formal program started in 1975, and through the years the program's scope has continued to expand as equipment was received, placed in storage, and installed. Redefinition of the program to accommodate the extended construction delay was initiated in 1982 with long term conservative technical requirements specified by engineering to assure plant equipment and facilities would remain qualified for a design life following a protracted construction delay period. The program was established with rigorous documentation to preclude a viable challenge of the equipment and facilities' ability to perform safety related service.

The plant has been preserved by maintaining a benign environment for equipment storage. Humidity and temperature control measures have been established to form a protective envelope over most equipment. Combustible materials have been removed from structures, and equipment partially installed has been secured to prevent accidental damage. Humidity and temperature recorders have been used extensively to provide QC records of the plant storage conditions. Additionally, particularly sensitive equipment has been provided with conditioned air as an added measure to absolutely preclude condensation damage.

Both maintenance program and facility inspections have been conducted by third parties to audit the effectiveness of the program. These have included the NRC, ASME boiler inspector, contracted third party inspection teams, State inspectors and in-house independent inspection teams. Where areas of potential improvement were identified, they were implemented. However, in no case has a significant fault been identified in the program. The Owner has maintained a viable ASME N-Stamp Quality Assurance Program, in addition to the NRC mandated QA program, which also controls the storage of equipment and documentation at the site. Periodic inspections and audits have been conducted with no significant deficiencies. The plant is expected to continue with its preservation program until mid-1997.

6.7.2.2.2 **Hanford SWTSF Functional Arrangement Alternative 4. General Description of Plant Areas.** The following paragraphs describe areas and facilities of the plant to be modified to achieve the plant conversion and describe at a summary level the process and activities associated with treatment and storage.

6.7.2.2.2.1 Receiving Area - Yard Storage (Reference Figure 6.7-3, titled Site Plan). Incoming receiving storage of shipping casks, boxes, drums and miscellaneous containers from rail and truck shipments is located in the fenced and secured freight yard at the WNP-1 site. Yard storage will be limited to items that can be stored out-of-doors. Incoming shipments that do not meet outdoor storage criteria will be brought inside the facility immediately on their arrival (which will require arrangement prior to shipment). Generally, similar items will be classified and stored together in accordance with their particular processing campaign.

6.7.2.2.2.2 Waste Staging Area. Incoming waste is staged outdoors at the plant entry, immediately prior to admission for processing or storage. This allows processing of waste to occur on a campaign basis or as desired by plant operators.

6.7.2.2.2.3 Shipping and Receiving Areas. (Reference Figure 6.7-4, titled General Services Buildings Elevation 455). After movement to inside the GSB, receiving of waste shipments in shipping casks, boxes, drums and miscellaneous containers from rail and truck shipments is performed in hands-on areas. There are receiving areas for both contact handled (CH) and remote handled (RH) waste. Shipping of treated waste to other storage facilities (outside the WNP-1 complex) also occurs within the shipping and receiving areas, as well as receipt of consumables. Area functions are listed below.

- Handling of incoming waste shipments by truck, railcar, forklift or mobile crane.
- Non Destructive Assay (performed externally) of incoming waste

shipments.

- Decontamination and smear of externally contaminated incoming shipping containers.
- Staging and admission of waste, by container category (i.e. boxes, drums), to container opening and sortation.
- Shipment of treated waste to facilities outside of the WNP-1 complex.
- Staging of treated waste shipments.
- Dock spaces and doors for shipping and receiving.
- Receipt of consumables.

Handling Category Determination: At the receiving area, inside the GSB, the contents of all incoming waste shipments are determined to be either contact handled (CH), or remote handled (RH). This is an important determination, due to both ALARA requirements and because throughput rates are heavily influenced by the handling method. A 400% or higher operational/processing expenditure is usually experienced for remotely handled material. Personnel health and safety will be the primary determination.

Waste shipments received are identified, externally assayed and checked for the presence of external contamination. Contaminated waste shipments are covered in a disposable material, brought in to the building and decontaminated if necessary

6.7.2.2.2.4 Remote Sorting and Segregating Area. (Reference Figure 6.7-4). Container opening and primary sortation is where incoming remotely handled waste containers are opened and the contents separated into several waste streams. One objective is to separate items which can be processed using contact handling methods following surface decontamination (See Figure 6.7-1). This will maximize the contact handled waste stream and minimize the stream that must be remotely handled.

- Incoming waste shipping containers are brought into the unmanned remote cell through an airlock.
- Incoming waste containers are opened and dumped remotely on the sorting table.
- Minor size reduction (if necessary) is performed by cutup of oversized waste items in LECs. The area includes a sump for washdown, remotely operated tools for cutting and a work table.
- Metals and contaminated equipment items are separated out from the incoming waste stream. Items with internal cavities are cut open, if necessary, to expose internal surfaces.
- Secondary sorting of Special Waste items which include lead, other hazardous materials and liquids is performed on the sorting table. Special wastes are temporarily re-packaged for movement within the facility to various special waste processing areas. Free liquids on the sorting table will be collected and temporarily re-packaged for movement to special waste processing areas.
- After sorting, items that will not be otherwise processed or treated are repackaged into drums.
- Shipping containers that will be reused are decontaminated internally (washed out), closed, and shipped out from the incoming waste airlock. External surfaces subject to contamination will be bagged in the airlock using hands-on methods. Nonreusable containers will be handled as ordinary waste, by decontamination (to meet contact handling criteria), and transferred to the contact handled processing area.

Control of the remote handled waste sortation manipulators is performed under visual guidance by operators in an enclosed booth with shield windows and CCTV near the sortation table.

6.7.2.2.2.5 Contact Sorting and Segregating Area. (Reference Figure 6.7-4). Container opening and primary sortation is where incoming contact handled waste containers are opened and the contents separated into several waste streams.

- Incoming containers are brought into the hands-on cell through an airlock.
- Incoming containers are opened and dumped on the sorting table.
- Minor size reduction (if necessary) is performed by cutup of oversized waste items in long equipment containers LECs. The area includes a sump for washdown, tools for cutting and a work table.
- Metals and contaminated equipment items are separated out from the incoming waste stream. Items with internal cavities are cut open, if necessary, to expose internal surfaces.
- Secondary sorting of Special Waste items which include lead, other hazardous materials and liquids is performed on the sorting table. Special wastes are temporarily repackaged for movement within the facility to various special waste processing areas. Free liquids on the sorting table will be collected and temporarily repackaged for movement to special waste processing areas.
- After sorting, items that will not be otherwise processed or treated are repackaged into drums.
- Shipping containers that will be reused are decontaminated internally (washed out), closed, and shipped out through from the incoming waste airlock. External surfaces subject to contamination will be bagged using hands-on methods in the airlock. Nonreusable containers will be handled as ordinary waste.

Control of the sortation manipulators in the contact handling area is performed under visual guidance by operators in an enclosed booth, with large viewing windows and CCTV adjacent to the sorting table.

6.7.2.2.2.6 Waste Treatment and Repackaging. (Reference Figure 6.7-5, titled General Services Building Plan Elevation 421). Sorted waste, discharged from the sorting tables, is moved , via chute, by gravity, to the next lower level in the GSB. Several treatment, processing and packaging cells, which are described below, are present in the waste treatment and repackaging areas within the GSB.

6.7.2.2.2.7 Waste Shredding Area. (Reference Figure 6.7-5). As contact handled, sorted waste, minus special and high rad materials, is discharged through the chute from the sorting table, and passes through the shredder.

Shredding of sorted waste is performed in the CH Waste Treatment and Repackaging Area. Shredded contact handled waste is temporarily repackaged in transport containers for movement within the facility. Shredding of sorted CH waste (excluding lead and mercury and other hazardous metals) is performed to meet 60 mm debris criteria and to allow efficient compaction. Shredded waste is temporarily repackaged in transport containers for movement within the

facility. Due to the need for hands-on maintenance access to the shredder, highly active materials will not be shredded. A local control area is provided for the shredder unit(s).

Remotely handled waste is not shredded. Instead, a cutup area containing remote tools and remote manipulators is used to perform size reduction to permit efficient repackaging of remotely handled and high-rad material.

6.7.2.2.2.8 Remote Handled Waste Decontamination Area. Sorted material amenable to decontamination will be processed in the remote decontamination area in the RH Waste Treatment and Repackaging Area. One objective is to remove surface residues to allow classification of the waste material as LLW. Contaminated heavy metals, such as lead, will be packaged separately as LLMW.

6.7.2.2.2.9 Contact Handled Waste Decontamination Area. Decontamination of waste and packaging of the decontaminated material in transport containers for movement within the facility is performed in the CH Waste Treatment and Repackaging area.

- Decontaminated material is repackaged into drums for internal transport to the Compaction area
- Makeup of decontamination solutions and production of the abrasive slurry occurs at the facility. Treatment of the effluent from decontamination (the spent solution and used abrasive blast media) is processed within the facility.

6.7.2.2.2.10 Compaction Areas. Compactors are available for use with both remotely handled and contact handled items within the CH and RH Treatment and Repackaging Areas.

Drums of decontaminated material are compacted and the pucks are ejected and staged on a turntable for sorting for efficient filling of overpack drums. Compacted drums (pucks) are repackaged into overpack drums for internal transport to the Drum Decontamination Area.

6.7.2.2.2.11 Special Waste Treatment Areas. Treatment spaces within the RH and CH Treatment and Repackaging Areas are designated for installation of specialized treatment equipment particular to waste streams (to be identified). Examples of special waste treatment facilities are included below.

6.7.2.2.2.12 Lead Processing Area. Decontamination of lead by aggressive surface cleaning (such as CO_2 blasting) and repackaging of decontaminated lead into drums for internal transport to the Drum Decontamination Area is included in this area. Processing station includes provision for collection and filtration of effluent from lead surface decontamination.

6.7.2.2.2.13 Mercury Processing Area. Mercury processing (future, if justifiable).

6.7.2.2.2.14 Liquid Waste Treatment Unit. Treatment of Received Liquid Waste (future, if justifiable). Treatment of facility generated liquid waste is included through the existing radioactive waste treatment systems.

6.7.2.2.2.15 Stabilization Areas. Stabilization of fines and collected dust (smaller than 3 mm) by in-drum grouting (future, if justifiable). Due to a lack of complete waste characterization data at this conceptual stage of investigation, actual treatment methodologies have not been selected at this time. Areas, however, for implementing typical treatment systems are included in the area allotment.

HLW, TRU, presence of chemicals including sodium that enhance leachability, acid based streams, reactive chemicals, debris, and organics are not grouted.

- Transfer containers and drums containing fines are dumped, the material is classified and mixed with concrete, dry and liquid additives and process water. Drums are filled with the stabilized waste and cured.
- Polyethylene stabilization of treated sludges, and packaging and cooling of drums (future, if justifiable).

6.7.2.2.2.16 Drum/Overpack Wash Areas. Drums and overpacks of treated and packaged waste are externally decontaminated and smear tested within the RH and CH Treatment and Repackaging Areas.

- Drums containing grouted waste or otherwise stabilized waste are externally decontaminated and shipped.
- Overpack drums are externally decontaminated and shipped or transferred to interim storage.
- Drums containing lead are externally decontaminated and shipped.
- Drums containing other special waste are externally decontaminated and transferred to interim storage.

6.7.2.2.2.17 Secondary Waste Processing. During waste treatment operations, during operation of the equipment, during quality control tasks, following failure or maintenance of the equipment over the life of the facility, and as consumables are used, secondary waste will be created at the SWTSF. Secondary (internally generated) waste streams include spent decontamination solution, contaminated frit from abrasive decontamination, effluent (which has been pretreated), contaminated ventilation and process HEPA filters, laundry, lab waste, samples, smears, and temporary packing. These waste streams will be processed to the extent practicable as ordinary waste. Where required, provisions will be available for treatment and packaging of secondary waste.

6.7.2.2.2.18 Processed Waste Surge Storage Area. Processed waste is either transferred to on-site interim storage areas or shipped directly to after repackaging and container decontamination. A small (1 week capacity), covered storage area for palletized drums accessible by fork lift is provided for staging of product shipments.

6.7.2.2.2.19 Aqueous Make-Up Area. Process liquids, powdered chemicals, water systems, and decontamination solutions are stored and mixed in the Aqueous Makeup Area. Capabilities in support of the SWTSF mission include:

- Water purification (with tank)
- Sodium Hydroxide Tank
- Service Waste Tank
- Nitric Acid Tank

6.7.2.2.2.20 SWTSF Space Ventilation. The SWTSF is partitioned into numerous separated ventilation zones. Supply and Exhaust air handling and filtration equipment is provided in separate rooms in the GSB. Process needs for air handling and filtration are accomplished locally to the particular service as required.

6.7.2.2.2.21 Maintenance and Decontamination Areas. An area allowance for decontamination and maintenance of plant equipment is provided. Fork lift movement between areas is featured for movement of equipment requiring maintenance. A significant facility design consideration, which has been implemented, is to allow each piece of equipment to be removed, decontaminated within the building ventilation confinement, and relocated to the maintenance area.

6.7.2.2.3 Description of Plant Conversions. The following sections provide a description of specific WNP-1 facility conversions required to accomplish solid waste processing and storage. Major structures involved in the conversion include the Spray Pond, GSB and TGB. Site infrastructure facilities and systems provide support for conversion.

6.7.2.2.3.1 High Level Vitrified Waste. During Hanford Site cleanup activities, high level radioactive waste will be vitrified into borosilicate glass. The molten glass will be poured into stainless steel canisters which are then cooled, sealed, decontaminated and prepared for shipment. This section evaluates modification and use of the WNP-1 Spray Pond for storage of the high level vitrified waste canisters.

6.7.2.2.3.1.1 Description of Existing Facility. The WNP-1 Spray Pond was designed as a two division, safety related structure holding a 30-day supply of water for use following a reactor loss of coolant accident coincident with a loss of offsite power and an assumed inability to provide makeup water. The spray headers, pond inventory, and water circulation pumps were designed to withstand a design basis earthquake (DBE) and provide for dissipation of reactor core heat decay and emergency system heat loads.

The Spray Pond was designed and constructed to the quality assurance requirements of 10CFR50, Appendix B. The structure is classified Quality Class 1 which is equivalent to a Safety Class 1 designation under DOE Order 6430.1A with ensured structural integrity following a DBE.

The pond is nearly square in plan, with an east-west dimension of 300 ft (91.5 m) and a north-south dimension of 250 ft (76.2 m). The pond was designed to contain approximately 14 million gallons of water when filled to the 25 ft (7.6 m) operating depth. The spray piping network is supported above the pond surface by ninety 30 in. (0.76 m) diameter reinforced concrete columns at approximate 25 ft (7.62 m) centers. Figure 6.7-13 provides a plan view of the pond structure.

Prior to constructing the Spray Pond, the existing soil was excavated to approximately 50 ft (15.2 m) below grade, exposing the highly dense "Ringold" formation. A highly compacted fill, not subject to liquefaction during a DBE, was then installed to bring the excavation back to a depth of approximately 27 ft (8.23 m). The reinforced concrete pond structure is founded on this fill.

The pond walls taper from 2 ft (0.61 m) thick at grade to 4 ft (1.22 m) thick at the base. The pond floor is 4 ft (1.22 m) thick at the perimeter and approximately 2 ft (0.61 m) thick in the central area. Wall and floor slab joints are keyed to prevent separation, and are provided with an embedded flexible waterstop to make the joints watertight.

A divided pumphouse is located centrally on the north side of the pond. Each half of the pumphouse contains space for enclosing and protecting a water pump, HVAC unit, switchgear, piping, valves, and an electrical vault. The pumphouse walls, slab and roof consist of 2 ft (0.61 m) thick reinforced concrete. An intake well is located under the pumphouse and extends into the pond area.

Except for the pumphouse intake well, there are no penetrations of the pond walls or floor below grade. The pond is surrounded by an 18 ft (5.49 m) wide splash apron at grade.

The structures nearest to the WNP-1 Spray Pond are the WNP-1 GSB, located 380 ft (115.8 m) to the north, a mechanical draft cooling tower located 225 ft (68.6 m) to the northeast, a plant security access and office building located 200 ft (61 m) to the west, and a warehouse located 200 ft (61 m) to the southwest. Railroad Spur "A", which serves the GSB, passes within 50 ft (15.2 m) of the west side of the pond.

6.7.2.2.3.1.2 Storage Requirements. Storage is required for a total of 300,000 ft^3 (8,600 m^3) of vitrified high level waste, contained in 6,800 canisters. Each canister has an outside diameter of 0.69 meters 27 in. (0.69 m) and an overall length of 15 ft (4.57 m) and holds approximately 1.26 m^3 of vitrified waste. Beginning in the year 2010 and continuing through 2028, 451 m^3 (358 canisters) per year will be received at the storage facility.

Several storage arrangements utilizing various floor opening sizes, spacings and stacking arrangements were evaluated. Other features, such as the existing Spray Pond configuration and canister handling options, were reviewed to select an arrangement that provides the required storage capacity while minimizing modifications to the existing facility.

The selected canister arrangement, shown in Figures 6.7-14 and 6.7-15, can accommodate the required number of canisters within the existing Spray Pond foot print. Canisters will be stacked two-high within sealed storage tubes similar to those planned for the Hanford Waste Vitrification Plant (Project B-595) Canister Storage Building (HWVP CSB). Storage tubes have an outside diameter of 31 in. (0.79 m) and a center to center spacing of 45 in. (1.14 m). Tube rows are staggered to improve ventilation air distribution.

6.7.2.2.3.1.3 Description of New Facility. The new facility is comprised of two main structures; a CSB and a Cask Unloading Area. The CSB includes a storage vault, operating deck, canister handling cranes, vault ventilation fans, exhaust stacks, emergency diesel generators and an operating deck enclosure. The Cask Unloading Area includes a railroad well, cask receiving pit, a cask unloading crane, a canister distribution crane and enclosure. This facility will be utilized when the canisters are removed from storage and placed in casks for off site shipment to the permanent repository. The CSB generally encompasses the existing Spray Pond while the Cask Unloading Area is

a new structure located on the south west corner of the Spray Pond. Figures 6.7-16 through 6.7-20 provide sample plans and cross-sections of the proposed facility.

In order to fully utilize the available Spray Pond volume, optimize canister handling activities, and minimize operating deck spans, a series of ten bays oriented in an east-west direction is planned within the storage vault. Each bay has a width of 22.5 ft (6.86 m) and a length of 280 ft (85.4 m). With the exception of the center wall, the bays are divided by two foot thick reinforced concrete walls which support both the operating deck and a canister handling crane rail. The center wall is nine feet thick and supports two crane rails and the operating deck roof structure. Ventilation tunnels, which group two bays together, are located on the east and west end of each bay.

Canister storage tubes are arranged within each bay in staggered rows, five tubes per row. Each bay contains 340 storage tubes. Figure 6.7-16 provides a plan view of the storage bay arrangement. In this arrangement approximately eleven feet of free space remains at the east end of each bay. Although not a parameter in this study, this space could be utilized for storage of high level waste over pack canisters.

Stacking the canisters requires an internal storage vault height of 34 ft (10.4 m). As a result, the Spray Pond walls must be increased in height approximately 10 ft (3.05 m). Reinforced concrete walls are 5 ft (1.52 m) with footings are planned on the north and south walls. In addition to radiation shielding, these walls provide crane rail and roof structure support.

The west side of the storage vault is occupied by the vault ventilation fans and filters; the east side by the ventilation exhaust stacks. The increase in operating deck height above the existing walls allows the ventilation fans to be placed at grade while providing a natural path for ventilation in and out of the vault.

It is anticipated a portion of the existing splash apron can be incorporated into the fan and stack structures. Additional reinforced concrete structures will be required to support and enclose the ventilation fans and stack and support the canister storage crane transfer cart above the fan rooms. These structures will also provide missile shield protection for the ventilation system.

Modifications to the existing Spray Pond to accommodate the storage vault include removal of the spray piping network and support columns and filling the pumphouse intake well with reinforced concrete. The south wall of the pumphouse and portions of the slabs, walls and roof must be removed to accommodate the new perimeter wall. Other pumphouse modifications are required for installation of two 1-megawatt diesel generators to provide emergency power for the storage vault ventilation fans. A two foot thick reinforced concrete slab will be placed on the existing pond floor to provide additional strength and doweling for the bay walls.

The operating deck is divided into two large, open areas, each approximately 130 ft by 320 ft (39.6 m x 97.6 m) in plan. The areas are separated by a series of roof support columns on the storage vault center

wall. A canister storage crane can operate above each of the ten storage bays to transport canisters to all storage tubes. Figure 6.7-17 provides a plan view of the operating deck.

Access to the storage tubes is provided by a floor plug mounted in the operating deck above each tube. The floor plugs have a stepped outline, to ensure activities on the operating deck are shielded from radiation, and are gasketed to seal the storage tubes in the unlikely event of canister leakage.

The relatively short span between bay walls, approximately half of the HWVP CSB span, and the use of a rail mounted crane, as opposed to a wheeled transporter, permits an alternate deck design to be used. The deck is 4 ft (1.2 m) thick and composed of one inch thick steel plates on top and bottom with integral trusses centered between alternate rows of floor openings. Deck units approximately 24.5 ft (7.47 m) by 15 ft (4.57 m) can be fabricated, set in place, and filled with concrete for shielding. The storage base plates, tubes and seals are installed after the concrete is placed to assure tube verticality.

The canister storage crane rails are spaced uniformly, on the centerline of each bay wall, to permit utilization of the same crane above each bay. Canister handling and crane operation are described in the Canister Handling section.

The operating deck is enclosed by a structural steel frame covered with insulated metal siding and a metal roof deck with insulated roof membrane. Bearing columns are located on the north and south exterior walls and the center bay wall. The internal clear height is 36 ft (10.97 m); the exterior height is 46 ft (14.0 m). Although approximately 3.5 times as large in area, the roof span is very similar to the HWVP CSB and steel member sizes should be comparable.

The Cask Unloading Area, shown in Figure 6.7-18, is located at the south west corner of the storage building. A railroad spur will be extended from existing Spur "A" approximately 800 ft (244 m) to the railroad well in the Cask Unloading Area. The railroad well includes a bridge crane capable of removing the shipping cask from the rail car and transporting it to the cask receiving pit. The assumed cask size used in this study is 9 ft (2.74 m) in diameter and 21 ft (6.4 m) in length. The assumed weight is 100 tons (9.07E+04 kg).

The cask receiving pit is a reinforced concrete structure located between the railroad well and the CSB. The pit is sized to receive a shipping cask and to store the cask lid when removed by the canister distribution crane. The pit opening is configured to mate with the shielded housing on the canister distribution crane to provide radiation shielding during canister removal.

The Cask Unloading Area is enclosed by a structural steel frame covered with insulated metal siding and metal roof with insulated roof membrane. The overall building size is 110 ft (33.5 m) in length, 32 ft (9.75 m) in width, and 66 ft (20.1 m) in exterior height. A roll up door is provided at the exterior entrance to the railroad well. This facility also includes decontamination services for crane maintenance and cask handling activities.

Although not shown on the referenced figures, an office and change facility located near the Cask Unloading Area is also planned.

6.7.2.2.3.1.4 Canister Handling. Canister handling, depicted by Figures 6.7-19 and 6.7-20, is performed by a series of three rail-mounted cranes from receipt through final positioning of the canister in a storage tube. All cranes are electrically powered.

The Cask Unloading Crane, operating within the Cask Unloading Area, removes the shipping cask from the rail car and transports it to the cask receiving pit. The Cask Unloading Crane is a standard bridge crane with a 25 ft (7.62 m) span and 150 ton (1.36E+05 kg) capacity.

The Canister Distribution Crane, operating in both the Cask Unloading Area and the CSB, opens the cask, extracts the canister, and transports it to one of ten transfer storage tubes located in each CSB bay. The transfer tubes are included in the total storage tube count of 3,400. Twenty canisters could be stored in the transfer tubes in each bay before repositioning is required.

The Canister Distribution Crane is a floor-mounted bridge crane with an integral, shielded container. The container is sized to cover the cask receiving pit when the cask is opened and includes two trolley cranes for cask lid removal and canister extraction. The crane span is 18 ft (5.49 m) and it is nominally rated at 20 tons (1.81E+04 kg).

The Canister Storage Crane, operating in the CSB, removes the canister from the transfer tube and positions it in its final storage tube within the bay. The Canister Storage Crane is a floor-mounted bridge crane with an integral, shielded container that can traverse between the crane rails to allow alignment with all storage tubes within a bay. The container is sized to accommodate the floor plug during canister insertion into a tube. The crane span is 24.5 ft (7.47 m) and it is nominally rated at 10 tons (9.07E+03 kg).

Due to the uniform spacing of crane rails in each bay, the same Canister Transfer Crane can be used throughout the facility. The crane is moved from bay to bay by a Transfer Cart located on the west end of the operating deck. The Transfer Cart is rail-mounted and electrically powered. Depending upon canister distribution criteria within the storage vault, the Canister Storage Crane could operate nearly two years within a bay before it is filled.

6.7.2.2.3.1.5 Canister Storage Vault Ventilation. The temperature of canisters stored in the vault is maintained within the acceptable range by a forced draft ventilation system, depicted by Figure 6.7-20. While a passive, natural draft cooling system would be desirable from an operations standpoint, its viability in this facility could not be determined within the scope of this study.

Use of forced draft ventilation places the rotating equipment in an optimum environment for operation and maintenance. Its use is practicable due to the sealed storage tubes and maintenance of the operating deck area at a subatmospheric pressure to contain any leakage from the storage vault ventilation plenum. In addition, the shielded container on both the canister distribution and storage cranes includes ventilation and HEPA filter equipment for confinement during canister handling and floor plug removal.

The *ER0665ES, Hanford Waste Vitrification Plant Project Interim Storage Facility for Hanford Waste Vitrification Plant Canisters Evaluation of Alternative* dated June 1990 indicated an airflow of 75 cubic feet per minute (cfm) (2.12 m^3/min.) per canister is required to maintain the proper canister temperature. A value of 150 cfm (4.25 m^3/min.) per canister was used in the current study since the canister being addressed contains twice the waste volume. This equates to a total ventilation requirement of approximately 1.02E+06 cfm (2.89E+04 m^3/min.)

Ten 1.0E+05 cfm (2.83E+03 m^3/min.) to provide this airflow. Due to the need for total fan reliability, full redundancy is provided. A total of twenty fans are installed in the facility; four fans per ventilation unit. A ventilation unit consists of the fans, intake air filters, ventilation tunnels, two storage bays and an exhaust stack.

The fans are located on the west side of the CSB in a series of five reinforced concrete fan rooms. The fans force the cooling air through the ventilation tunnels, around the sealed storage tubes and out the exhaust stack located on the east side of the CSB.

6.7.2.2.3.1.6 Utilities. Electrical power is the most critical utility requirement. The ventilation fans require an uninterruptible power supply to ensure nearly continuous operation. Normal electrical supply is provided through the electrical grid. Back up power is provided by two 1-megawatt diesel generators located in the modified Spray Pond pumphouse.

Electrical power is also required for the canister and cask handling cranes, general building ventilation equipment, and lighting. Other utility requirements include potable and fire protection water, sanitary drains for the office and change areas, decontamination solution storage and collection, and telephones.

6.7.2.2.3.2 TRU Waste. Description of TRU Waste Processing in the converted WNP-1 facility.

6.7.2.2.3.2.1 Waste Shipment Receiving. A loading dock with large doors is utilized to receive waste shipments by truck. Casks are received at an existing rail dock. Incoming waste shipments are moved by truck, rail, mobil crane, overhead crane or forklift. Shipments weighing up to 100 tons (9.07E+04 kg) and over 70 ft (21.3 m)long may be received and handled using these methods.

TRU Waste is received, processed, repackaged and interim storage is provided on the ground floor level elevation (EL) 455 in the SWTSF. TRU Waste is received in both contact handled and remotely handled categories. When it is received, the waste package is externally assayed, checked for external contamination, and identified. At the receiving area, inside the GSB, the handling category determination is made based on the expected contents of incoming waste shipments, and the waste shipment is identified for processing in the appropriate area of the SWTSF. Waste accountability and shipping container identification steps are also taken.

To minimize the possibility of spread of contamination to the Shipping and Receiving area, the incoming waste shipment is decontaminated if necessary. Incoming waste shipments are moved into one or the other waste

processing areas following passage through a double door, positively sealed airlock. The airlock serves as a positive ventilation barrier.

6.7.2.2.3.2.2 Container Opening. Following passage through the airlock, the waste package is placed within the open, sort and segregate area. Material handling equipment (both remotely and contact operated) is provided for transport and placement. Waste containers of various configurations are received, handled, placed, and opened. These include shipping casks, long equipment containers (LECs), large boxes, standard waste boxes (SWBs), concrete, steel, wooden or fiberglass containers, steel or poly drums, smaller containers, overpacks, and/or miscellaneous containers. Container opening equipment exists to allow removal of the lid, or otherwise open the container to gain access to the contents inside.

6.7.2.2.3.2.3 Dump. After the container is opened the contents are removed. A dump operation is used, if appropriate. A tipping dump platform, with a waste container clamping arrangement, is utilized for container dumping. The tipper capacity is such that a 4 ft X 4 ft X 16 ft (1.2 m X 1.2 m X 4.9 m) box, weighing up to 12,000 lb (5.44E+03 kg), or up to five 55 gal (208 l) drums may be dumped. The contents are dumped onto a large sorting and segregating table. If a container dumping operation is not appropriate, material may be lifted out of the container using an overhead grab, or a manipulator may be employed to pick out individual items. Visual observation equipment including cameras and windows is present to allow detailed inspection of the container and contents.

6.7.2.2.3.2.4 Used Containers. Used, disposable waste containers will be treated as ordinary waste. They will be emptied, shredded, decontaminated and compacted as appropriate. If possible, following decontamination, the containers will be treated for disposal as LLW. LECs and other reusable waste shipping containers will also be emptied and decontaminated, however, due to the investment in the container and transport system, they will be reused. To avoid the possibility of external surface contamination, exterior parts of the container that are exposed to the container opening cell will be covered with a disposable plastic wrap material.

6.7.2.2.3.2.5 Size Reduction. If necessary, minor size reduction of the contents of LECs and other large containers is preformed to allow subsequent handling and processing operations to continue. This is performed in the case of oversized equipment in LECs which may be risers, instrument trees, and long objects that have been removed from service and are contaminated with TRU waste. Cut-up and minor size reduction operations may be performed with saw, plasma, abrasive water jet (AWJ), or disassembly, as appropriate.

6.7.2.2.3.2.6 Sorting. Sorting of the waste is conducted to separate the TRU waste stream into several output streams. Identification, by operators, and segregation of hazardous materials, heavy metals, free liquids, equipment that is amenable to decontamination, particulate, construction debris, packaged waste, material that may and may not be shredded, materials that are excluded from specific waste treatment processing operations, and other sortation operations are performed as prescribed by procedures. Waste items that have been packaged in plastic wrap must be removed from the covering prior to sortation. Disposable containers that are potentially contaminated internally are also dealt with on the sorting table.

6.7.2.2.3.2.7 Decontamination. Following sortation, specific streams which have been segregated are passed forward to subsequent processing and treatment operations. It is highly desirable to minimize the processed TRU waste stream. Metallic objects and other items with surface contamination are decontaminated. Removal of surface contamination allows their subsequent treatment, repackaging, and storage as LLW. It will be necessary to open items with internal cavities to ensure access to allow decontamination efforts to be effective.

6.7.2.2.3.2.8 Treatment. As material is sorted on the sorting table, it is passed by operators, through large chutes to the level below EL 421. Material suitable for shredding is shredded as it flows, by gravity, to this level (below grade). Shredded material is captured in transport containers which are then moved to repackaging and or compaction treatment stations. Alternatively, material may be positioned for decontamination, or segregated into transport containers placed around the sorting table. Transport containers are available for lead, liquid waste, and other special materials that require specific treatment, packaging and/or storage. Enclosed decontamination stations, using high pressure spray or abrasive decontamination techniques are utilized.

6.7.2.2.3.2.9 Waste Treatment and Repackaging. Elevation 421 in the SWTSF is used mainly for treatment and repackaging. Contact handling and remote handling cells are featured in the arrangement. Special material processing stations (such as lead and mercury), decontamination cells, shredding, cutup and other size reduction capability, compactors, stabilization areas (grouting and polyethylene encapsulation), liquid waste treatment and repackaging areas are utilized as required for waste treatment and repackaging operations. Typical arrangements of these areas, which are not necessarily specific to the arrangement that will be present at WNP-1 are included in the report. (See Figures 6.7-20 through 6.7-25) These have been included to illustrate the basis for the area allotments (on a square footage basis) shown on the converted facility sketches provided and described in Facility Sizing Basis in section 6.7.2.3. It is anticipated that these processing cells or stations will be modularly constructed and can be added as required to accommodate the wide variety of waste forms requiring treatment.

6.7.2.2.3.2.10 Interim Storage of Treated and Repackaged TRU. Following treatment and repackaging, the treated waste, in drums, or overpacks are moved within the facility to Interim Storage. Repackaged, treated LLW is shipped out. Repackaged and treated TRU is moved to interim storage locations on the WNP-1 site.

The WNP-1 site has been converted for receiving, treatment, repackaging and storage of treated and repackaged waste. Interim storage of drummed waste will take place in several areas at the WNP-1 site. Storage areas include Levels 395, 421, and 501 of the GSB, Levels 452, 476 and 508 of the TGB, existing warehouses (formerly used for construction and on-site support), and newly constructed warehouses (if necessary). Locations for interim storage of drummed waste is allocated in accordance with the external radiation level of the waste container. Accountability and waste type identification records are maintained. Due to the presence of existing concrete shield walls up to 3 ft (0.91 m) thick, the GSB interim storage locations will be used for higher rad waste. The TGB and warehouses will be used to house waste with low external rad fields. Contact handled drums are moved by forklift and stored on metal

pallets placed on storage racks in the GSB and in the warehouses, and on storage racks or an automatic storage and retrieval system (ASRS) in the TGB.

6.7.2.2.3.2.11 Ion Exchange Columns. One specific form of TRU waste that is to be received, handled, treated and repackaged are used ion exchange (IX) columns. IX columns are received in casks, the casks are transferred to container opening, the casks are opened, and the columns (vessels) are removed. The vessels are overpacked in prefabricated vessels made from 0.5 in. (1.27 cm) plate. Overpacks for IX columns are 5 ft (1.5 m) in diameter by 7 ft (2.13 m) tall. The overpack containers will then be remotely placed into interim storage (on metal pallets). While in storage, overpacked IX columns will require inspection. No compaction or other processing of overpacks will be performed. No free liquids are assumed to be present, however, this assumption cannot be proven (IX col's will not be opened) therefore, inspection aisles are provided. Aisles are suitable for remote inspection by CCTV. Heavy shielding is required in the interim storage location, therefore these will be stored in the GSB.

6.7.2.2.3.3 Low Level Waste and Low Level Mixed Waste. Low Level Waste (LLW) and Low Level Mixed Waste (LLMW) is also received in contact and remotely handled categories. The description of LLW and LLMW receiving, opening, dumping, sorting, size reduction, treatment, and repackaging is similar to TRU processing steps listed above.

6.7.2.2.3.4 Greater than Category III Low Level Waste. Greater Than Category III (GTC-III) Low Level Waste and Low Level Mixed Waste, again, is received in contact and remotely handled categories. The description of GTC-III LLW and GTC-III LLMW receiving, opening, dumping, sorting, size reduction, treatment, and repackaging is similar to TRU processing steps listed above.

6.7.2.2.3.5 Metallic Sodium. Analysis of the storage requirements of metallic sodium shows that a capacity of 83,700 gal (3.17E+05 l) will be necessary. This volume includes 75,000 gal (2.84E+05 l) plus 158 drums of sodium. This inventory does not include the sodium from FFTF (256,445 U.S. gallons). Suitable storage space is available at WNP-1 subject to a number of restrictions and special considerations, due to the physical and chemical properties of the material. These restrictions and considerations include:

- The corrosive alkaline nature of the metal.
- Reheating requirements to liquefy the metal.
- Purging and receiving/shipping of the liquid metal.
- Fire protection.

Review of candidate storage areas at WNP-1 indicates there is not an existing storage area or receptacle for the quantity of sodium involved, which would provide an effective alternative to the plan presented in WHC-SD-FF-SSP-004, Rev. 1, *Fast Flux Test Facility Transition Project Plant*. A plan of the facility is shown by Figure 6.7-26. However, in support of a facility to handle 100% of the waste stream contemplated for this report, WNP-1 has sufficient areas available, adjacent to railroad spurs, to accommodate both the sodium storage and sodium processing facilities described in WHC-SD-FF-SSP-004. Costs for those facilities are not included in the conversion cost estimate for WNP-1. This option, if considered cost effective upon more detailed investigation and planning, will be added to the cost estimate for WNP-1 at a later date.

6.7.2.2.3.6 Unirradiated Uranium. The stockpiles of unirradiated uranium on site are especially suited for storage consolidation at WNP-1. Such consolidation will facilitate the DOE inspection and inventory requirements and provide a consistent environment, operations base and maintenance facility.

6.7.2.2.3.6.1 Volume of Unirradiated Uranium. The information necessary for the evaluation of storage requirements for unirradiated uranium (UU) was extracted from WHC-SD-CP-ES-163, Rev. 0, *Options Analysis for Uranium Consolidation* and WHC-SP-1139, Rev. 0, WHC FY 1995, *Materials Management Plan*, and is summarized in Tables 6.7-7 and 6.7-8.

The material is, for the most part, in a form that will not lend itself to cost-effective volume reduction. In view of the planned disposition, the material should remain in its present form for storage. The volumes indicated consider container placement in the most space conscious array, while meeting material strength, inspection, inventory requirements and structural limitations that may exist in the storage area considered.

6.7.2.2.3.6.2 Storage Requirements. The material is currently stored at several locations on site, all of which supply very limited environmental control. Essentially, only electrical service is provided to the storage areas. Waste Stream UU-1 is stored in the 300 area at buildings 3712, 303-A and 303-E. The fuel in the 251 boxes located at buildings 303-A and 303-E is surface contaminated and is double-wrapped, placed in wooden boxes, banded and provided with tamper indication seals. UU-2 is stored at building 3716. UU-3 is currently stored in the 200W area at building 2714-U. UU-4 and UU-5 are stored in the 300 area at building 303K. UU-6 is presently stored in the 400 area at building 4713. UU-7 is stored in hoppers on a 90 ft by 150 ft (27.4 m X 45.7 m) outdoor pad at the UO_3 Plant in the 200 west area. UU-8 is stored at buildings 3712, 303-B and 303-G in the 300 area. With the exception of the unfinished fuel at building 3716, the present storage is believed to meet DOE requirements for inspection and inventory.

6.7.2.2.3.6.3 Special Requirements for Storage. Several parameters related to the physical characteristics of the material require special consideration. These parameters are not necessarily limiting, but require the storage location be selected with these parameters in mind. The issue of weight is important for several reasons. First is the impact on handling, transporting and packaging. This is primarily an issue related to individual packages. Second is the selection of suitable storage areas. Original live-load design criteria for the various floor levels at WNP-1 are assessed to determine optimum storage locations for the various materials. If necessary, the specified values for the different storage areas are adjusted to allow for floor loading limitations.

6.7.2.2.3.6.4 Specific Storage Plans.

UU-1 - The finished fuel assemblies are packaged in red colored wooden boxes with a presumed footprint of six feet by three feet. A quantity of 251 of the total 1144 boxes contain contaminated fuel. However, it is not expected that there would be any difference in the methodology for receipt, handling and storage since the packaging is essentially identical to that of the other finished fuel assemblies. Based on current storage methods, the boxes, if stacked two or three high (the 155 boxes at 303-A are stacked three

high), would require 11,000 ft^2 (1,022 m^2) of storage space. Each box would have an average weight of 1,550 lb (703 kg) and can easily be accommodated by the GSB elevators; an area at EL 399 in the GSB is selected for storage.

UU-2 - The unfinished fuel assemblies are contained in 205 red colored wooden boxes (generally "outers") and 134 Model G-4214 boxes (generally "inners"). The red wooden boxes are open in front and do not have all the hardware and braces needed to make them certified red shipping boxes. The specified storage area of 3,500 ft^2 (325 m^2) is based on the red wooden boxes being stacked two high and the G-4214 boxes not being stacked. Individual box weight is an average of approximately 900 lb (408 kg); as with Stream UU-1, UU-2 is suitable for storage in the GSB at EL 399.

UU-3 - Depleted uranium trioxide powder is currently contained in 172 55 gal (208 l) drums. Each drum weighs an average of 1,700 lb (771 kg), which is specified as excessive for the container. Prior to transport, it is anticipated that the trioxide powder will be repackaged. For the purpose of this evaluation, it is presumed that repackaging will halve the amount of powder in any drum to an average of 850 lb (386 kg). This would change the specified quantity of containers to 344 and the required storage area to 2,400 ft^2 (223 m^2) (single stack). Such an arrangement will also reduce floor loading to 213 lb/ft^2 (1.02E+04 Pa), increasing the number of areas qualified for storage. The weight of individual drums is well within the capability of the GSB elevators. An area at EL 399 of the GSB is selected for storage of the uranium trioxide powder.

UU-4 - Uranium dioxide pellets, powder, fuel pins and fuel assemblies are stored in various containers and total 7,480 lb (3,393 kg) of material to be stored. The containers include taped slip lid cans, one to five gallon buckets (3.8 to 20 l) and cans within 55 gal (208 l) drums. Total required storage area is 525 ft^2 (48.3 m^2). Weight of the various units does not appear to be a factor which would preclude use of the GSB elevators. It is planned to store this material at EL 399 of the GSB.

UU-5 - Unirradiated thorium oxide is packed in two and one half gallon buckets and totals 1,034 lb (469 kg). Storage of the material is included in the space allotted for UU-4 at EL 399 of the GSB.

UU-6 - Depleted uranium metal requiring storage is in the form of eleven solid slabs measuring five feet by five feet by eight inches each. The slabs are contained within ten metal and one wooden container. Each slab will weigh 4,232 lb (1,920 kg). Based on the area specified for storage of 100 ft^2 (9.29 m^2), it is presumed the slabs are either stored on edge or stacked three high. The weight of an individual slab is within the limits of the GSB elevators. Sufficient storage area remains at EL 399 of the GSB, for storage of the depleted uranium slabs.

UU-7 - The Uranium Trioxide Powder is presently stored in 146 T-hoppers. Based on the total 677 MTU of powder, the average weight of the contents of each T-hopper is 10,200 lb (4,627 kg). The bottom diameter of the T-hopper is 4 ft (1.22 m) and is used as the basis for a floor loading of 811.56 lb/ft^2 (3.89E+04 Pa). Except for base-mat slabs and ground-level slabs, the floors inside WNP-1 are not suitable for such a loading. Vertical transportation using plant elevators is not possible due to elevator design limitations of 9,000 lb (4,082 kg) live load. The basement floor level of the TGB in the

area of the condensers provides a secure, discrete storage space, with nearby access to the TGB bridge crane.

UU-8 - Storage of Uranium Metal Billets would consider, besides weight and other physical/chemical properties, a location that would facilitate access to the material that is currently proposed for sale. The billets are currently packaged in wooden boxes containing four or five billets each. In their present storage configuration, which stacks boxes either three-high or five-high depending on the enrichment of ^{235}U, a storage area requirement of 6,000 ft^2 (557 m^2) is specified. The average weight per stack is 7,031 lb (3,189 kg). With a presumed contact area of 9 ft^2 (0.84 m^2) for the boxes, this would result in a 281 lb/ft^2 (1.35E+04 Pa) floor loading. In the area of the GSB intended for storage, floor live loading limitation is 250 lb/ft^2 (1.2E+04 Pa). Therefore, the area required for storage must be increased to 18.75 ft^2 (1.74 m^2) to allow for shorter stacks of wooden boxes. An area within the GSB has been selected for the required storage, which has vertical access by a nearby elevator with 9,000 lb (4,082 kg) capacity.

6.7.2.2.3.7 Cesium/Strontium Capsule Storage. The Spent Fuel Storage Pool and its support systems will be converted to storage of Cs and Sr capsules. The pool has dedicated cooling systems and HVAC. The area is served by a 105 ton (9.52E+04 kg) cask handling crane with rail access through a rail car decontamination vault. The area also contains a 25 ton (2.27E+04 kg) maintenance services crane and a 10 ton (9.07E+03 kg) new fuel handling crane which travel parallel to the cask handling crane. The capsule shipping cask can arrive by rail or truck. The cask will be lifted from its vehicle and placed in the cask offloading pit. This operation will be reversed when the capsules are removed from storage and placed in the final overpack and shipping cask for shipment to the geologic repository. It is assumed the same systems and equipment will meet the need to provide both capsule receipt and packaging of the final cask for offsite disposal. The pit includes a shelf for cask lid storage. The total pit depth is approximately 49 ft (14.9 m) which provides adequate water shielding during capsule transfer.

Capsules will be stored in modular racks within the storage pool. Movement of individual capsules can be accomplished manually, or with the fuel handling bridge which has the ability to traverse the entire width of the cask unloading and storage pool areas. Capsules will be placed in modular storage racks. A total of 46 racks are planned to accommodate the 2178 Cs/Sr capsules. Each rack will store 96 capsules and will be designed to allow stacking. Figures 6.7-27 and 6.7-28 depict the storage pool and rack design respectively. A loaded rack is project to weigh approximately 2,000 lb (907 kg). The fuel handling bridge is capable of a 6,000 lb (2.72E+03 kg) lift over its entire span of travel which allows the racks to be moved and stacked within the pool.

The projected heat load of the capsules is approximately 1.4 million BTU/hr (4.1E+05 J/sec). This is relatively small compared to the spent fuel pool cooling system design heat load of 34 million BTU/hr (9.96E+06 J/sec). Table 6.7-9 provides detailed information about the fuel pool cooling system. It is not clear that the system is required; if the pool is operated warm, evaporative cooling from the pool surface may provide adequate cooling. For the purposes of this study however, the cooling system is assumed to be required. Additionally, a canister type cleaning system will be installed to maintain pool water cleanliness. The permanent plant

purification system has too large a capacity for the purpose of solely storing Cs/Sr capsules.

The Fuel Handling Area HVAC system is designated HSF. The system will provide secondary confinement for capsule handling and storage by maintaining the area at a negative pressure relative to the atmosphere and by providing HEPA filtered ventilation air release. Table 6.7-10 provides an overview of the HSF system parameters. In summary, the system was designed as redundant Quality Class 1, Seismic Category I. This design basis is equivalent to DOE Safety Class 1. As originally designed for WNP-1, the system includes redundant air cleanup trains, each train containing both HEPA and charcoal filtration units; charcoal for the purpose of removing the iodine source term postulated with a commercial fuel handling accident. Mechanical elements of the system not required for the Cs/Sr storage mission will be isolated as required to minimize system operating equipment.

Shipping cask decontamination is accomplished in a dedicated pit adjacent to the unloading pit. Rail car and/or truck decontamination is accomplished in an isolation room adjacent to the fuel handling area. Water from both the cask and rail/truck decontamination processes is collected in the plant radioactive waste collection system for volume reduction and disposal. (The completion of radioactive waste systems is included in the scope of decontamination liquid radioactive waste disposal.)

6.7.2.2.3.8 Other Sources. Other miscellaneous sources will be stored in the spent fuel pool if the source is encapsulated as appropriate for wet storage. The source geometry will be matched for suitable rack placement. If the source is presently stored in a shielded container, the container will be placed at the lowest elevation of the GSB. Repackaging, if required will take place in the remote handled waste processing area to avoid a requirement to design and build a separate hot cell for this relatively small volume of waste storage, i.e., 2,082 ft^3 (59 m^3) total.

6.7.2.3 **SWTSF Equipment Sizing Basis.** A portion of the waste received is transferred directly to secured long term interim storage, however the majority of the flow receives sorting, treatment and/or repackaging prior to transfer to interim storage. The predominant output of sorted, treated and repackaged waste from the facility is in the form of industry standard drums and overpacked drums. Filled drums contain 7.0 ft^3 (0.2 m^3) and weigh up to 1,000 lb (454 kg). To provide common, standard unit of measure of facility process throughput, the waste to be handled is expressed herein in terms of Drum Equivalents (DE). The SWTSF using WNP-1 provides treatment and storage of HLW, TRU, mixed LLMW and Low Level Solid Radioactive Waste which is received in various forms from the Hanford Site. To achieve this mission, equipment has been tentatively sized in accordance with the expected throughput rates of the various waste forms. The plant is scaled for 100 DE per day with a capacity for 200 DE on a 24 hour operation. Full day operational capacity allows the facility to produce twice the average throughput rate required by basis diagrams and thus provides flexibility for basis uncertainty.

The waste inventory to be received is listed on the Inventory Information Table 6.7-11. For convenience, the different waste streams are referred to and numbered from 1-24. The section that follows describes

assumptions and allotments that define the bases for the proposed draft arrangement for the SWTSF at WNP-1.

6.7.2.3.1 Waste Flow. The SWTSF Block Flow Diagram, labeled Figure 6.7-1, outlines the major operations slated for implementation in the WNP-1 site associated with Alternative 4.

Waste in Streams 1, 3, 16, 21, 22, 23 and 24 is not "processed". These streams are received, shipping containers are opened (if applicable), and the material is transferred (using remote or contact handling techniques) directly to storage. There may be container integrity inspections and labeling, accountability, certification, and assay steps performed along the way; however, these detailed steps are beyond the scope of this brief study and are not shown.

Stream 20 requires addition of a new plant in the proximity of the WNP-1 complex. The remaining streams can be received, processed, treated and or repackaged, as applicable, using existing, modified or converted areas at the WNP-1 site. Also, a fraction of the M-33 inventory, including HLW, pool storage HLW and repackaged LLMW and LLW can be stored on site.

With reference to Figure 6.7-4, container opening, waste processing (using remote or contact handling techniques), support systems, the control room, and utilities are located within the GSB.

The RCB is not used in the scope of the Alternative 4 study, although it does have great potential as a process facility that requires assured confinement and high capacity remote handling equipment. The Spray Pond is used for HLW Canister Storage. The TGB, GSB and on-site warehouses are used for storage of treated and repackaged LLW and LLMW and TRU waste drums. Receiving surge storage occurs in the laydown yard to the East and South of the GSB. Waste staging, just prior to entry into the facility, is immediately to the South of the GSB.

The waste requiring processing is handled using contact or remote techniques. Processing includes repackaging, overpacking, sorting, stabilization, cutup, shredding, compaction, decontamination, segregation, separation of free liquids, separation of hazardous wastes and encapsulation. The waste quantity to be subjected to processing is shown on the Inventory Information - Table 6.7-11. Although overpack is included in the conceptual processes, overpacking of Stream 2 is not included in the tabulation. Waste Streams that are directly stored are also not included in the tabulation of waste requiring processing.

6.7.2.3.2 Waste Processing Rate. Streams 4 through 15, and 17 through 19 are slated for processing. The total of the inventory tabulation, divided by the 30 year facility mission provides an average rate of 92 drums per day. The average basis for process operation is, therefore estimated at <u>100 DE per day average</u>. The facility peak processing rate, to account for expected variations in the throughput, is twice this amount or <u>200 DE per day peak</u>. The facility equipment, for remote and contact waste processing proposed in Alternative 4 is sized to meet these rates. Waste processing requirements are shown on Table 6.7-12, titled Storage and Process Information. Processing rates are summarized on Table 6.7-13, titled Waste Processing Rates.

6.7.2.3.3 **Receiving Area.** Outdoor receiving storage of incoming shipping casks, boxes, drums and miscellaneous containers of packaged, pre-characterized and uncharacterized waste from truck and rail shipments is assumed to occur for Alternative 4 at the rate of 100 DE per day for 1 year. This equates to 22,000 DE storage. The basis for square footage used for outside interim storage is 4 drums per pallet, using 45 ft^2 (4.2 m^2) per pallet (this includes space for aisles). This is an approximation to account for miscellaneous containers, drums, boxes, casks and SWBs. An allowance of 220,000 ft^2 (2.04E+04 m^2) is provided for yard storage. This is shown on Figure 6.7-3. Ample space for receiving surge storage exists on the WNP-1 site. Even accounting for packaging of waste in shielded overpacks and casks which can result in a exterior container volume six times greater than the waste contained within, expansion of the area, allowance for waste transport vehicles, and categorization and segregation of the incoming waste inventory within a secured and fenced area can be accomplished. Note that Waste Stream 3, and 21 through 24 will not be accumulated in the receiving area storage yard.

6.7.2.3.4 **Waste Staging Area.** Immediately upstream of entry to the plant, incoming waste is staged and distributed appropriate to operational and processing campaign decisions made by plant operators. This provides one month of incoming waste staging and occupies 18,000 ft^2 (1.67E+03 m^2).

6.7.2.3.5 **Shipping and Receiving Areas.** Twelve (12) Dock Spaces 200 ft X 60 ft (61 m X 18.3 m) are required for incoming waste receiving, consumables receiving, and treated waste package shipping as follows:

- Incoming waste receiving and Processed waste shipping: (4) dock doors (for drums and boxes).
- Incoming waste receiving: (2) dock doors (for long length and oversize containers).
- Allocable: (4) dock spaces.
- RR car (covered) dock (for full cask receiving and decontaminated empty cask shipping).
- Consumables receiving (2) dock doors.
- Shipping and Receiving: 4,800 ft^2 (446 m^2) and 5,600 ft^2 (520 m^2) of RH and CH incoming waste shipments respectively.

6.7.2.3.6 **Process Equipment.** Process equipment is sized for a throughput rate of 200 DE per day. Waste processing equipment is featured in the Alternative 4 study in two forms: Contact Handling equipment and Remote Handling Equipment. According to the Inventory Information Table 6.7-11 remote handling throughput accounts for about 64% of the tabulated waste volume requiring processing. To allow a reasonable level of conservatism, and to account for variations in the character of the waste received, a 75% remote, 50% contact (which totals 125%) split is assumed. About 75% of 200 DE/day is 150 DE/day Remote Handling. 50% of 200 DE/day is 100 DE/day Contact Handling. These rates are applicable to the shipping container receiving, handling and opening, waste container opening, dumping and sorting steps shown on the Process Flow Diagram (Figure 6.7-1).

Sorting and Segregating Areas. Container opening and primary sortation, where incoming items are separated into several waste streams at the rate of: 200 DE/day for both the Remote and Contact handled waste sorting and segregating areas.

- Drum tipper capacity: (1) 4 ft X 4 ft X 16 ft (1.22 m X 1.22 m X 4.88 m) box at a time or up to 5 drums at a time.
- Drum delidding station can accept (2) drums simultaneously.
- Box delidding station can accept (1) box.
- Sorting table can receive 1 box at a time for sortation.
- Size reduction equipment (for minimal use to allow handling of oversized equipment) and miscellaneous tools.

6.7.2.3.7 **Contact Handling.** Area allotments for contact waste package handling, container opening, container dumping, waste sorting and waste segregation are:

- Open container: 2,400 ft^2 (60 ft X 40 ft); 223 m^2 (18.3 m X 122.2 m).
- Dump, sort and segregate: 2,700 ft^2 (60 ft X 45 ft); 251 m^2 (18.3 m X 13.7 m).

6.7.2.3.8 **Remote Handling.** Area allotments for remote waste package handling, container opening, container dumping, waste sorting and waste segregation are:

- Open container: 3,200 ft^2 (80 ft X 40 ft); 297 m^2 (24.4 m X 12.2 m).
- Dump, sort and segregate: 3,600 ft^2 (60 ft X 60 ft); 334 m^2 (18.3 m X 18.3 m).

6.7.2.3.9 **Waste Treatment and Repackaging.** Following waste shipment package opening, dump and sort, waste is treated and repackaged for storage or shipment. Contact handled waste and Remote handled waste is treated and repackaged in their own respective areas. Area allotments are:

- Contact Handled Waste Treat/repackage: 24,000 ft^2 (200 ft X 120 ft); 2,230 m^2 (61 m X 36.6 m).
- Remote Handled Waste Treat/repackage: 32,000 ft^2 (200 ft X 160 ft); 2,970 m^2 (61 m X 48.8 m).
- Remote Overpack: 2,500 ft^2 (50 ft X 50 ft) 232 m^2 (15.2 m X 15.2 m) (Stream 2).

Dedicated waste treatment systems within the Waste Treatment and Repackaging Areas perform specific treatment methods at the rates shown below.

6.7.2.3.9.1 Waste Shredding Area. Shredding of sorted waste that meets contact handling criteria is performed at the rate of: 200 DE per day.

- Shredder "throat" can accept a waste box.
- In-plant transfer containers are sized at 4 ft X 4 ft X 4 ft (1.2 m X 1.2 m X 1.2 m) and are limited to 12,000 lb (5.44E+03 kg). Size and weight of transfer container is limited by material handling equipment load capacity.

6.7.2.3.9.2 Remote Handled Waste Decontamination Area. Decontamination of waste amenable to use of decontamination solution spray or abrasive slurry blasting techniques at the rate of: 60 ft^3 (1.7 m^3) per hour is performed using remote handling techniques. One objective is to decontaminate remote handled items to allow subsequent treatment and repackaging steps to be conducted in the contact handled waste area if possible.

6.7.2.3.9.3 Contact Handled Waste Decontamination Area. Decontamination of waste amenable to use of decontamination solution spray or abrasive slurry blasting techniques at the rate of: 60 ft^3 (1.7 m^3) per hour is performed using contact handling techniques.

6.7.2.3.9.4 Compaction Areas. Drums of waste (decontaminated metal or other compactable waste) are compacted at the rate of: 9 drums per hour (input). Compactors are present both in the remote handled and contact handled waste treatment and repackaging areas. Compacted drums (pucks) are loaded in overpacks.

6.7.2.3.9.5 Special Waste Processing Areas. Decontamination, treatment and stabilization of hazardous material, heavy metals, liquids, organics, reactive chemicals and other items excluded from processing with the other LLW categories at the rate of: 30 ft^3 (0.85 m^3) per hour (average). Remote and contact handled special materials processing areas are provided.

6.7.2.3.9.6 Lead and Mercury Processing Areas Liquid Waste Treatment Unit. Treatment areas for RH and CH heavy metals and captive free liquids are provided. Area requirements are 40 ft^2 (3.7 m^2)for both the RH and CH treatment and repackaging areas. It is anticipated that these areas will be constructed (retrofitted) following justification of the need for these areas. Equipment and space has been included in the estimate and area allotments.

6.7.2.3.9.7 Stabilization Areas. Stabilization by grouting at the rate of: 2 drums per hour (output).

- Drum mixer is sized at 1/2 drum.
- Polyethylene stabilization of treated sludges, and packaging and cooling of drums (if justified).
- Drum curing (grout) or drum cooling (polyethylene): 48 hours, 96 drum capacity.

Remote and contact handled stabilization areas are provided. It is anticipated that these areas will be constructed (retrofitted) following justification of the need for these areas. Equipment and space has been included in the estimate and area allotments.

6.7.2.3.9.8 Drum/Overpack Wash Areas. Drums and overpacks of treated and packaged waste (drums containing grouted waste, overpack drums containing compacted drums, drums containing lead, drums containing mercury, and/or drums containing stabilized waste) are externally decontaminated, smear tested, assayed and automatically palletized at the rate of: 3 drums per hour. Remote and contact handled drum/overpack wash areas are provided.

6.7.2.3.10 **Secondary Waste Processing.** Treatment and temporary storage areas are provided for internally generated secondary waste streams including:

- Spent Decontamination Solution
- Contaminated Frit
- Pretreated effluent packaging
- Contaminated HEPA filter storage, compaction and packaging
- Laundry
- Lab Waste, samples and smears

- Concentrated process equipment waste and spent decontamination solutions are stored temporarily and packaged for shipment to HWVP.

6.7.2.3.11 Total Processing. The estimated floor space required for activities to be conducted inside the GSB involved in waste shipping and receiving, surge storage of treated waste, waste container opening, dump, sort and segregate, treating and repackaging is 80,000 ft^2 (7.43E+03 m^2).

The floorspace earmarked for these processing areas are on the 455 level (at grade) and the 421 level (below grade). Discounting space occupied by existing equipment, maintenance areas, items and spaces that are to be used as intended, personnel spaces, utilities, services, and spaces that have been deemed unusable for treatment or waste storage, approximately 128,500 ft^2 (1.19E+04 m^2) is available on these two levels alone. This leaves roughly 48,000 ft^2 (4.46E+03 m^2) available for storage. No areas are present on the ground floor for interim storage of waste, however 8,000 ft^2 (7.43E+02 m^2) on the ground level is used for consumables storage. Other levels inside the GSB are used for waste storage. There are 5 main levels inside the GSB.

6.7.2.3.12 Storage Area Allocation. Areas within the WNP-1 site for interim storage of treated and repackaged waste are present within the GSB, TGB, on-site warehouses and the Spray Pond as shown on Table 6.7-14. Areas that are <u>not</u> used include the circulating water pumphouse and cooling towers. The TGB is ideal for interim storage of low-rad treated and repackaged waste that is not to be buried or stored elsewhere on the Hanford site. The Spray Pond is suitable for HLW canister storage. The GSB, which is a Safety Class 1 building, is heavily shielded, earthquake proof, and secured. Areas in the GSB not used for waste processing or occupied by existing or hard to remove equipment are available for storage of high-rad waste. About 1,000,000 ft^3 (2.8E+04 m^3) of raw waste can be placed in interim storage in the GSB, and another 1,500,000 ft^3 (4.25E+04 m^3) of raw waste can be placed in interim storage in the TGB. These figures do not include storage of the entire expected HLW canister inventory (Stream 1), capsules (Streams 23 and 24), uranium (Stream 21), or sources (Stream 22) all of which can also be suitably housed on the WNP-1 site. These figures are supported as follows.

The TGB, using a stacker (ASRS) system and pallet racks, can easily house about 13,000 pallets with 4 drums per pallet. At 7 ft^3 (0.2 m^3) per drum this equates to 364,000 ft^3 (1.03E+04 m^3) of treated and repackaged waste. Assuming a 4:1 compaction (see assumptions), this provides storage of 1,450,000 ft^3 (4.11E+04 m^3) of raw waste (using actual calculated, conservative numbers).

The GSB has about 128,000 ft^2 (1.19E+04 m^2) of floor space available on 3 levels for storage. A pallet requires aisles for handling. An allowance of 40 ft^2 (3.7 m^2) is used for pallets to allow for aisles. This provides storage of 9600 pallets, on racks, stacked 3 high. At 4 drums per pallet and 7 ft^3 (0.2 m^3) per drum this equates to 269,000 ft^3 (7.62E+03 m^3) of treated and repackaged waste. Assuming a 4:1 compaction (see assumptions), this allows storage of 1,077,000 ft^3 (3.05E+04 m^3) of raw waste (again, using actual calculated, conservative numbers). Tables 6.7-15 and 6.7-16 summarize the detailed assignment of processing storage area respectively.

6.7.2.3.12.1 Processed Waste Surge Storage Area. A five day palletized drum surge storage area, for staging of product shipments (drums containing treated

waste, overpack drums containing compacted waste, drums containing special materials, and/or drums containing encapsulated waste) capacity: 250 drums/overpack drums.

6.7.2.3.13 **Balance of Plant.** Area allotments for the required balance of plant (BOP) equipment are provided. In many cases equipment is present and installed. To the extent practicable, this equipment will be utilized for its intended purpose under the context of waste treatment and processing supports and requirements for the personnel that will be operating and visiting the plant. These include:

- Utilities
- Support Systems
- Confinement systems
- Instrumentation
- Services
- Personnel ancillary spaces
- Monitoring
- Sample collection and sample transfer system
- Laboratory (materials identification)
- Control room
- Distributed Control System and site alarm systems
- Communication and public address systems

6.7.2.4 **Assumptions.** To provide a bases of estimate as well as list those attributes which require confirmation to validate the study results, specific assumptions were made in the Alternative 4 Study. For convenience they are summarized below although in some cases they are included in other sections of the report as well.

6.7.2.4.1 **Study Bases Assumptions.** General study basis assumptions include:

a. Waste Stream characteristics were provided by WHC. (See Section 4.0)
b. Input Volumes were provided by WHC. (See Section 4.0)
c. Selected processes are per WHC. (See Section 5.4)
d. Estimating guidelines were selected by WHC and are detailed in Appendix B.5.
e. Transfer of ownership of WNP-1 to DOE will occur in a manner that does not impact schedule milestones.

6.7.2.4.2 **Process Assumptions.** Specific process and storage related assumptions include:

6.7.2.4.2.1 Vitrified waste canister shipping cask weight: 100 tons (9.07E+04 kg). The existing cask unloading area (RR car) and cask decontamination areas are utilized as originally intended for Cs/Sr capsule cask handling.

6.7.2.4.2.2 Shredded and compacted waste has a 4:1 volume reduction (average). This is a conservative number. 10:1 is typical for shredded paper, clothing, etc.

6.7.2.4.2.3 Ion exchange (IX) columns are overpacked in a sealed .5 in. (1.27 cm) plate vessel. Overpacks for IX columns weigh 3,000 lb

(1.36E+03 kg). Overpacks are 5 ft (1.52 m) in diameter by 7 ft (2.13 m) tall. Each overpack requires a floor area 6 ft^2 (0.56 m^2). A 6 ft (1.83 m) aisle is required for handling and inspection, therefore 2 overpacks occupy 108 ft^2 (10 m^2) of floor (2 overpacks on opposite sides of aisle). No compaction or processing required. No free liquids are assumed to be present, however, this assumption cannot be proven (IX columns will not be opened) therefore, inspection aisles are provided. Aisles are suitable for remote inspection by CCTV. Heavy shielding required.

6.7.2.4.2.4 Alpha caissons (containing fuel), Stream 3, are received in an overpacked condition. They receive an exterior decontamination (washdown) and container integrity inspection. Caissons will be stored in a heavily shielded area.

6.7.2.4.2.5 Round, metal 55 gal (208 l) drums are used for storage of repackaged, cut up, high-rad debris. CH and LLW material repackaged in drums for disposal is shredded and compacted. It has been proven that square drums (twice as costly to buy as round drums) are cost effective for storage because of the 20% additional volume held in the corners saves facility costs which more than offsets the higher first cost of the drums. Round drums used for conservatism.

Each 55 gal (208 l) drum holds 7 ft^3 (0.2 m^3) (95% full), and weighs up to 1,000 lb (454 kg). Note that four drums fit on a 4'-6" pallet. A typical pallet spacing of 5 ft (1.52 m) is used to account for partial use of overpacks. Voids in debris drums will be filled with inert material. No inspection is required for drums filled with dry waste.

Fork lift aisles for CH repackaged waste are 14 ft (4.27 m) wide. Basis for pallets moved with fork lift and stored on pallet racks is 60 ft^2 (5.6 m^2) per pallet (footprint). This is used for all of the TGB that uses pallet racks, and most of the storage areas for repackaged (drummed) waste in the GSB. This may seem overly conservative (typical practice uses a 9 ft (2.74 m) aisle, 47.5 ft^2 (4.4 m^2) per pallet), however an 80% efficiency factor is included for existing obstructions (estimated) at WNP-1. Basis for ASRS is 40 ft^2 (3.7 m^2) per pallet (footprint).

6.7.2.4.2.6 Debris maintains its designation as debris following size reduction. Debris (60 mm and larger) and particulate (smaller) will not generally be mixed.

6.7.2.4.2.7 Particulate (smaller than 60 mm) will be repackaged in drums.

6.7.2.4.2.8 Sodium will not be processed or stored.

6.7.2.4.2.9 If reasonable, contaminated retrieved equipment will be decontaminated to the extent practicable. Spent decontamination solution will be evaporated. Decontaminated equipment will be repackaged as LLW. Lead and hazardous materials will be segregated. Equipment to be decontaminated will be cut or chopped to expose internal surfaces. Segregation requires dumping and sorting of waste containers.

6.7.2.4.2.10 Decontamination of contaminated equipment is performed to remove TRU and high activity material. A significant percentage of decontaminated equipment becomes LLW debris. Wet (spray) and abrasive (frit slurry)

decontamination techniques are used. High pressure water with acid or detergent is used for decontamination. Spent decontamination solution is evaporated in existing evaporators within WNP-1. Condensate from evaporator "overheads" is used in grout. Evaporator "bottoms" are containerized and transported over the road in a shielded cask to HWVP (vitrification facility). Abrasive cleaning will make use of frit slurry (frit and water). The liquid from spent decontamination slurry will be decanted and evaporated. Contaminated frit will be used by the vitrification process. Contaminated frit will be containerized and transported over the road in a shielded cask to HWVP.

6.7.2.4.2.11 LECs (Long Equipment Containers) provide shielding adequate for contact handling, confinement, and are reusable throughout the life of the item. They are supplied by the provider of Decontamination and Decommissioning (D&D) services where the equipment they contain is being retrieved. They will be decontaminated externally and emptied for reuse at the SWTSF.

6.7.2.4.2.12 Criticality alarms, extension of the site alarm system, and connection to the site data acquisition system is not included in the estimate. Isokinetic flue gas samplers, stack monitoring, Automatic Continuous Air Monitors (ACAM), air flow and differential pressure monitoring, air filtration systems, process controls, level controls, and other systems necessary to ensure safe and effective process operation are included.

6.7.2.4.2.13 The Uranium billets in boxes (part of Stream 21) is stored on the floor, in an existing room at EL 501 in the GSB beneath a concrete slab roof with insulated siding and adequate ventilation.

6.7.2.4.2.14 A new floor level is added to level 479 in the former water tank vault. This floor (above consumables storage on level 455) is used for storage of repackaged waste drums on pallets on racks.

6.7.2.4.2.15 The sorting tables are used to separate streams of waste with the intent of reducing the need for more expensive waste packaging, more rigorous treatment, to decrease needs for inspection in interim storage, and to reduce other costs related to waste storage and disposal. Performance of this task includes elimination of free liquids, organics, and surface contamination from a dilute stream and concentrating them into a more hazardous stream. During sortation and other waste handling operations, the reverse of this process can also occur; HLW and TRU contamination, organics or other hazardous compounds, for example, can spread to LLW which can increase waste remediation costs. There will be steps taken during design and operation of the SWTSF to reduce the probability of "cross contamination" such as: frequent cleaning of the sorting table; wide spread use throughout the facility of decontaminatable surfaces such as epoxy coatings and stainless steel liners; decontamination of container handling, container opening, and waste treatment equipment; frequent and thorough "housekeeping operations" which remove undesirable constituents; segregation of hazardous materials, dedicated waste treatment stations (such as lead processing, and mercury processing lines) and separate CH and RH lines; waste stream confinement systems (double wall process equipment liquid waste piping, minimization of particulate and aerosol generation, minimization of spread of airborne contamination, isolation of potential contaminants at their respective sources, adequate air flows and air flow patterns; imposition of periodic and

as-needed service and maintenance operations on plant equipment; quality assurance programs; operator training; safety precautions; and adherence to procedures which promote avoidance of actions which could cause cross contamination.

6.7.2.4.2.16 Floor loadings for interim storage of drummed repackaged waste in the GSB will meet or exceed 300 lb/ft^2 (1.44E+04 Pa).

6.7.2.4.2.17 Process facility will operate at an average rate of 100 DE per day, with capacity to process 200 DE on a three shift basis. This operational capacity allows the facility to produce twice the average throughput rate required by basis diagrams and thus provides flexibility for basis uncertainty.

6.7.2.5 Uncertainties. The preconceptual nature of this study predetermines the existence of a high degree of uncertainly. Compensation for uncertainly is accomplished through conservative estimating methods and high contingency allowance. Specific trade and engineering studies will reduce contingency; these include:

- Verify input volumes and processes to develop a higher degree of confidence in storage requirements and plant processing rates.
- Confirm that generated wastes are minimized and compatible with intended disposal methods.
- Obtain confirmation and agreement on the feasibility and timeliness of using WNP-1 for this specified use.
- Confirm the ability and jurisdictional needs of permitting a multi-use facility for storage and processing.
- Confirm cost estimate basis on a programmatic level.

6.7.2.6 Institutional Issues. Use of WNP-1 for processing and storage of Hanford wastes offers some unique advantages not found in any other alternative but also raises some issues requiring resolution to achieve those advantages. Conversion provides benefits by greatly reducing costs and time needed to establish solid waste processing facilities, and makes use of a quality Hanford structure that is otherwise subject to demolition at additional regional expense. The institutional issues involved with ownership of the plant, and occupying the leased Supply System property, are not addressed in detail by this study. However, the following information has bearing on resolution of this institutional issue:

- The construction of the plant is 65% complete with in excess of $2 billion investment at the time the project was terminated.
- The Supply System is initiating a sales program to dispose of WNP-1 property that can be transported from the site. Material and equipment is sold at some fraction of its original procurement price; the sale price is a function of current market value.
- In addition to the purchase of the WNP-1 physical plant asset, the design and construction software (inspection records, material certifications, test reports, etc.) are required to fully document the viability of the plant as a solid waste processing and storage facility. These records exist.
- The plant is sited on DOE leased property; access corridors to the Hanford rail and road infrastructure exist. Utilities, including power, water, warehousing, potable water, fire protection, and plant rail

transportation are operational.

- Cost savings arise from several aspects:
  1. The facility was constructed at a high sunk cost and is available at essentially no cost on an "as-is" basis, not only including the facility but also all equipment whether installed or in warehouses, e.g. 5 million linear feet (1.52E+06 m) of electrical cable are in storage.
  2. Much of the installed equipment such as turbine generators, emergency diesels, cooling water pumps and heat exchangers, and piping can be sold to offset the cost of conversion.
  3. Selected installed equipment and structures are consistent with the waste processing and concept with little modification. These include radioactive waste processing, liquid volume reduction, grouting, decontamination, cask handling, operational cranes and freight elevators, extensive HVAC systems with HEPA filter trains, laboratory and counting rooms, hot maintenance rooms, receiving and handling areas, office and locker areas, and security buildings and access control.
- The facility has been constructed to standards exceeding those needed for processing and storage functions with construction QA/QC records in site vault storage.
- Environmental benefits arise by using a facility which would be scrapped for purposes which can eliminate new disruptions of the environment and the additional natural resources needed to construct a new facility. WNP-1 already has installed many features for protection of the environment which would have to be provided at other sites.

The following issues require resolution to achieve the above benefits:

- DOE must determine if transfer of the facility is acceptable per its procurement regulations. The BPA is currently paying debt financing on bonds sold to finance WNP-1. The assets include equipment, facilities, and construction tools. Because BPA is subordinate to the federal government, one perspective is that the DOE would be obtaining ownership of a facility for which the government already has debt retirement responsibility. The Supply System, is the owner of the plant. Because the State is a stakeholder in the Tri-Party agreement with a vested interest in expedient Hanford cleanup, the principals required to be involved in an agreement to transfer ownership are represented within a relatively small circle.
- Tri-Party agreement stakeholders must be willing to allow waste to be processed and stored off the 200 Area plateau in exchange for the ability to perform Hanford rapid clean-up at greatly reduced cost. Consideration needs to be given to the fact that WNP-2 will continue to be operated and will subsequently be decommissioned over the period needed for Hanford cleanup; thus radioactive items already exist in the immediate vicinity of the WNP-1 site. This is also true for FFTF.
- Since modifications are required to perform the desired functions, agreement which allows a facility not designed for the specific purpose of solid waste processing and storage is in fact acceptable, e.g. layout may not be the most efficient.
- DOE must be willing to accept a facility built to meet NRC requirements rather and DOE design criteria. The NRC requirements are generally more restrictive. Agreement on criteria to be used for modification will need to be established.

- An interested party in WNP-1 site restoration is the Energy Facility Site Evaluation Council (EFSEC). The powers of the Council are listed in Title 80 of the Revised Code of Washington (RCW), Section 80.50.040. The powers of EFSEC include application of environmental and ecological guidelines to the construction and operation activities associated with energy facilities, and to represent State concerns to other interests such as the federal government. The site certification (EFSEC 1975) for WNP-1 dated August 8, 1975 discusses construction clean-up, temporary building removal, and re-vegetation in the context of construction impact mitigation, but not site restoration in the context of removal of permanent plant facilities and structures. EFSEC is therefore a potential stakeholder in the transfer of ownership of the plant; therefore a coordination effort at a minimum would be required in the process. Any stronger authority or interest in ownership transfer requires clarification.

6.7.3 **Secondary Waste Generation.** The SWTSF is designed to be a totally self contained facility, with no need for external services. There is a reliance on power and transportation systems from the Hanford Site external to the WNP-1 boundary. Except as noted below, nothing else is imported or exported. There is no water effluent (the process is designed to use all waste water generated). WNP-1 has its own water treatment and water wells. Internally generated secondary waste will likewise be processed as a part of normal operations. Secondary waste processing functions include:

6.7.3.1 **Spent Decontamination Solution.** Spent decontamination solution is evaporated. Bottoms are packaged and sent to HWVP. Overheads are condensed and used in grouting of waste.

6.7.3.2 **Contaminated Frit.** Contaminated frit, recovered from wet abrasive blasting operations during waste decontamination, is stored and processed at the SWTSF. Excess liquid is decanted and processed either as spent decontamination solution, or may be used directly in grouting (requires a water analysis). The used frit is packaged and sent to HWVP.

6.7.3.3 **Pretreated Effluent Packaging.** Any liquid waste that is received at the SWTSF and cannot be processed, will be packaged for treatment elsewhere on the Hanford site.

6.7.3.4 **Contaminated HEPA Filter Storage, Compaction and Packaging.** Process and ventilation HEPAs that become contaminated and require exchange will be stored and processed at SWTSF.

6.7.3.5 **Laundry.** The existing WNP-1 laundry will be utilized as originally intended. Potentially contaminated discharges will be processed internally.

6.7.3.6 **Laboratory Waste, Samples and Smears.** Internally generated lab waste and returned samples will be processed at the SWTSF

6.7.3.7 **Storage of Process Equipment Waste Concentrate and Contaminated Frit.** Concentrated process equipment waste and spent decontamination solutions, and contaminated frit are stored temporarily and packaged for shipment to HWVP. The duration and capacity of storage is heavily schedule dependent and therefore is to be determined.

6.7.3.8 Used and Failed Equipment. Through normal plant operation, service and maintenance activities, and plant decontamination operations, used and failed equipment and spent decontamination solution will be generated and will constitute a minor waste stream. This will be internally processed. Any organics generated (such as solvents, lubricants or hydraulic fluids) will be stored, packaged and shipped from SWTSF to a treatment facility at Hanford.

6.7.4 Cost

Appendix B.4 provides the cost estimate prepared for Alternative 4. The basis of the estimate is detailed within the Appendix and is consistent with the guidelines provided by WHC. The DOE escalation rates were utilized and the estimate was prepared in conformance to the ICF-KH cost estimating guidelines (1995) using the Interactive Estimating (IEST) program, Version 2.0. A summary of capital cost by Primary Waste Stream is provided in Table 6.7-17.

6.7.4.1 Approach. Alternative 4 has as its basis certain programmatic assumptions which dictated how the estimate was developed. The more important of these factors are as follows:

- WNP-1 was used as the basis and assumes no cost to DOE for the facility or the existing equipment.
- A plan to accommodate all waste streams is provided, however where justification exists for recommendations for alternate plans the cost is isolated for ease of identification. Sodium storage and processing costs are excluded.
- No allowance is provided for retrieval, loading or shipping the waste to WNP-1. It is assumed delivered to the receiving area. Also, no allowance is made for loading and shipping to final disposition.
- No repository costs are included.

Once the initial conditions were established the next step was to identify the candidate locations for the storage and processing of the individual waste streams. The specific qualifications required to receive, process and store the wastes were then identified and estimated.

Existing estimates for similar projects, estimating techniques and industry literature as well as estimating source guides and specific cost estimates by project personnel were used to compile the rough order of magnitude costs. Checks were performed based on corporate knowledge relative to "standard" costs per unit area and volume to verify estimating accuracy. The level of detail, back-up and contingency are indicative of a preconceptual estimate. Where available, data such as vendor budgetary estimates were utilized.

6.7.4.2 Assumptions. The individual write up in Section 6.7.2.4 contains specific assumptions relative to the treatment processes and storage requirements. In addition, the IEST Standard report DOE-R03 included in Appendix B.4 provides a comprehensive list of cost basis assumptions. Certain conditions agreed upon by WHC impact the estimate to a greater degree than others and some of these are identified as follows.

- Hot operation for the facility is 2006.
- The hot operation for high level vitrification is 2009, and has a 19

year operating life.

- A start date of 1998 (capital funds available) was selecting as being aggressive but achievable.
- All waste is to be final disposed by 2029.
- The facility can be permitted as necessary to support the schedule.
- D&D of the facility will start in 2028 and will be completed in 2033 utilizing the "at grade" approach.
- Engineering is 30% of direct costs (through detailed design = 21%, engineering inspection = 9%).
- Construction management is 10% of direct costs.
- Project integration is 10% of direct costs plus construction management.
- Other direct costs (ODCs) are 10% of engineering, direct costs, construction management and project management.
- Escalation was taken per DOE RL 5700.3 guidelines to the midpoint of the activity as defined in Section 6.7.5.
- Contingency was applied in accordance with DOE guideline for an Engineering Study (Engineering at 25%, construction at 35%, decontamination is at 45%, decommissioning at 35%, construction management at 25%, project management at 25%, and other costs at 35%).

6.7.4.3 **Uncertainties.** Preconceptual estimates are by nature full of uncertainties. Higher than average contingency and a conservative estimating approach was utilized to account for these uncertainties. Not withstanding this condition there are uncertainties with Alternative 4 that are worth special attention. These are:

- Ability to obtain Supply System approval to dispose of WNP-1 and its assets to DOE for the described use.
- Ability to modify a purpose built facility to a different mission and adequately capture the required modification to accomplish this.
- Resolution of regulatory issues that will be involved with the permitting and safety assessment of the facility.

6.7.5 Alternative 4 Schedule

At the preconceptual stage of the project the development of a schedule has two key purposes; first is to insure feasibility when checked for durations, logic and tie to other projects. Second is to provide a basis for determining costs associated with escalation. The schedule provided as Figure 6.7-29 meets these needs.

6.7.5.1 Approach.

The approach utilized to develop the schedule was to take specific milestones provided by WHC, which are needed to determine start or completion of major activities and then develop the remainder of the activities based on logic and historical data. The milestones used for Figure 6.7-29 are as follows.

- Capital Funds Available. This milestone restrains start of detailed design.
- Hot operations for new facility. This date defines (with logic and historical data) the construction complete as well as start of operations.
- High Level Vitrification (HLV) hot operations. This date defines the

start of operations for HLV and combined with a 19 year operating life defines the end of operations for waste generation. This activity (canister storage) governs over the other waste streams.

- All waste is final dispositioned. This activity signifies (and is governed by) the end of operations and the start of D&D. As part of the assumptions for D&D it also signifies the completion of mission life for the storage facility and requires all waste shipped to final disposition.

Sliding of the overall schedule is possible while maintaining the relation of the activities. This activity if performed would impact project cost via escalation. Impact to the other programs is best assessed by comparison to TPA milestones. Any adjustments to the schedule must be evaluated with respect to these impacts. It is essential to keep the project integrated with the overall waste management program.

A key feature of the proposed schedule is the activity titled Phase II Construction. This activity acknowledges the fact that waste stream projections, waste schedules, and assumptions relative to volume reduction of the waste can severely impact the amount and timing of required storage space. The Phase II construction is dedicated to warehouse construction and will be performed only on an as needed basis. This plan exercises a degree of risk mitigation and allows a custom fit to the needs of the program while minimizing capital cost. Figure 6.7-30 provides a visual representation of the conditions which make this the most judicious and cost effective plan for plant WNP-1 conversion.

6.7.5.2 Assumptions.

The only assumptions pertinent to the project are that the milestones selected are appropriate and the durations are adequate to perform the activities. Current information indicates that both of these are valid assumptions.

6.7.5.3 Uncertainties.

The initial milestone, capitol funds available is perhaps the greatest risk at this time. A 1998 start is an aggressive application of the DOE 4700 time scale for validation of a MSA project. Two other areas provide almost equal risk. These are the assumption of retrieval and transport of waste to the new facility and permitting of the facility itself.

The various waste streams have a variety of forms and in many cases have no currently approved shipping container or shipping methods approved. The involvement of regulatory agencies in the approval cycle of shipping containers causes a heightened concern relative to the assumption that the waste is delivered to the new facility and is removed to final deposition by 2028.

The permitting and regulatory jurisdiction can be a significant driver on projects of this type. The consolidation of various waste forms and functions (storage and processing) will provide a unique challenge to the project. Studies will need to be initiated to remove some of the unknowns involved with the concerns in order to provide more confidence in the project estimate and schedule.

6.7.6 References

ER0665ES, *Hanford Waste Vitrification Plant Project Interim Storage Facility for Hanford Waste Vitrification Plant Canisters Evaluation of Alternatives*, Kaiser Engineers Hanford Company, Richland, Washington.

NRC Docket Number 50-460, *Supply System Nuclear Project Number 1 Environmental Report Operating License Stages*, Washington Public Power Supply System, Richland, Washington.

NRC Docket Number 50-460, *Supply System Nuclear Project Number 1 Final Safety Analysis Report*, Washington Public Power Supply System, Richland, Washington.

WHC-SD-CP-ES-163, Rev. 0, *Options Analysis for Uranium Consolidation*, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-FF-SSP-004, Rev. 1, *Fast Flux Test Facility Transition Project Plant*, Westinghouse Hanford Company, Richland, Washington.

WHC-SP-1139, Rev. 0, *WHC FY 1995, Materials Management Plan*, Westinghouse Hanford Company, Richland, Washington.

Figure 6.7-1 Overall Block Flow Diagram

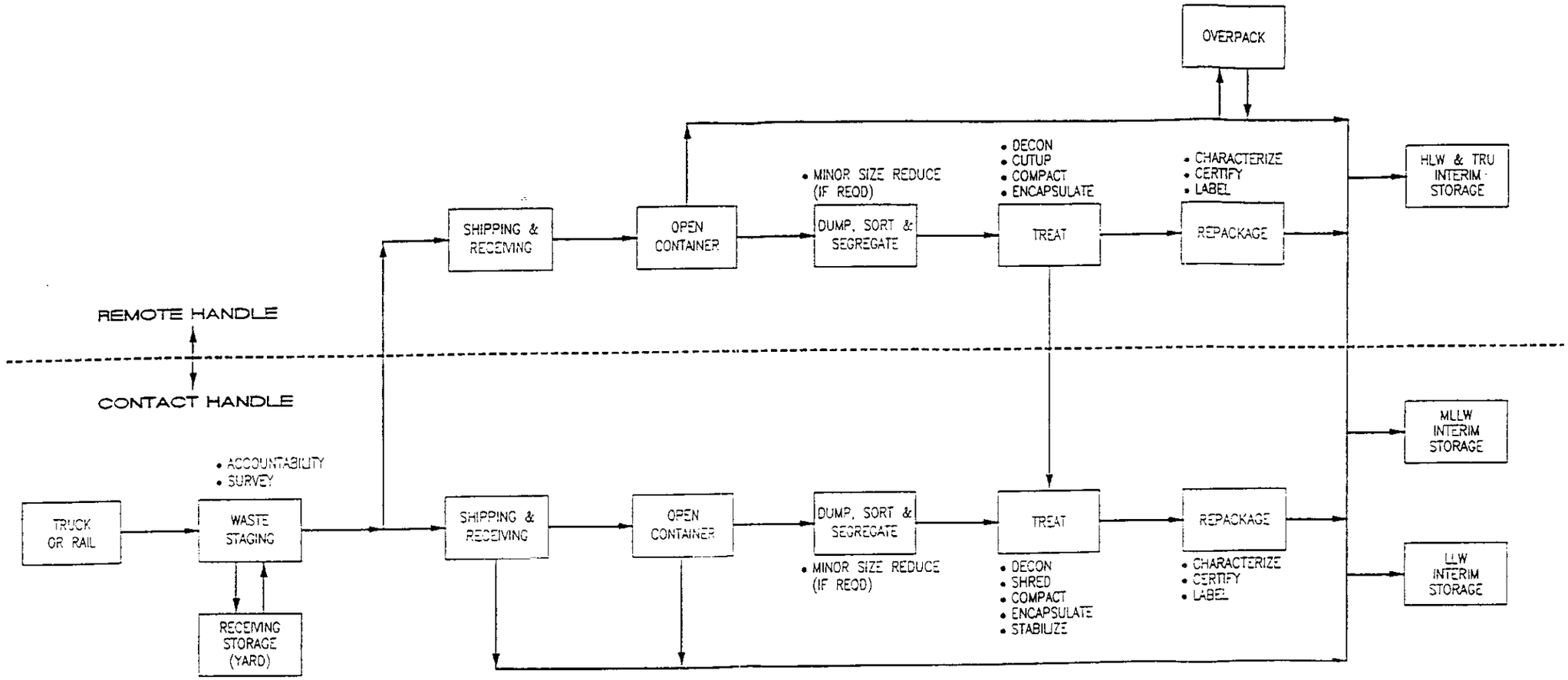
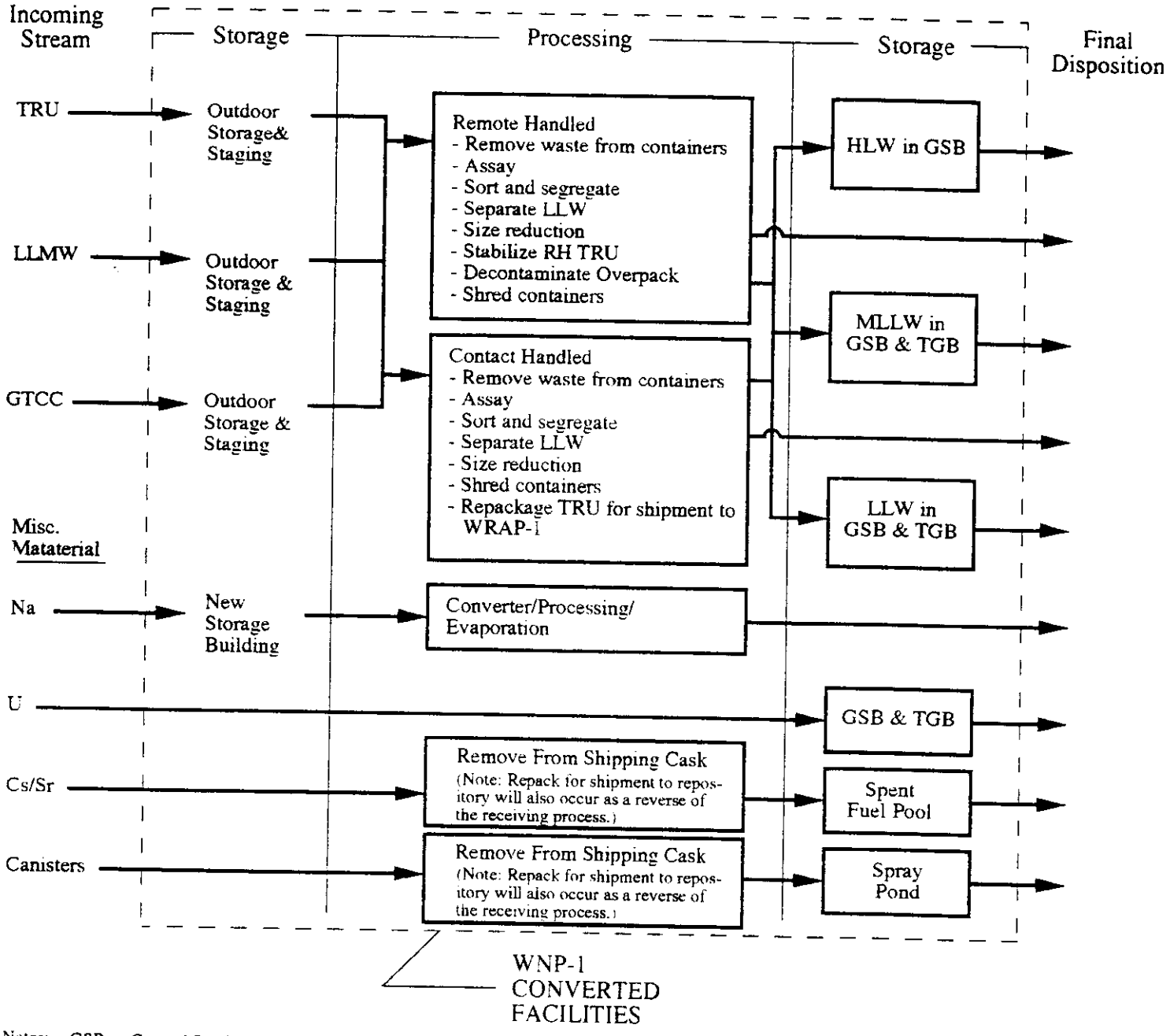


Figure 6.7-2 Solid Waste Treatment And Storage Flow Diagram



Notes: GSB - General Services Building
TGB - Turbine Generator Building

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Figure 6.7-3 Site Plan

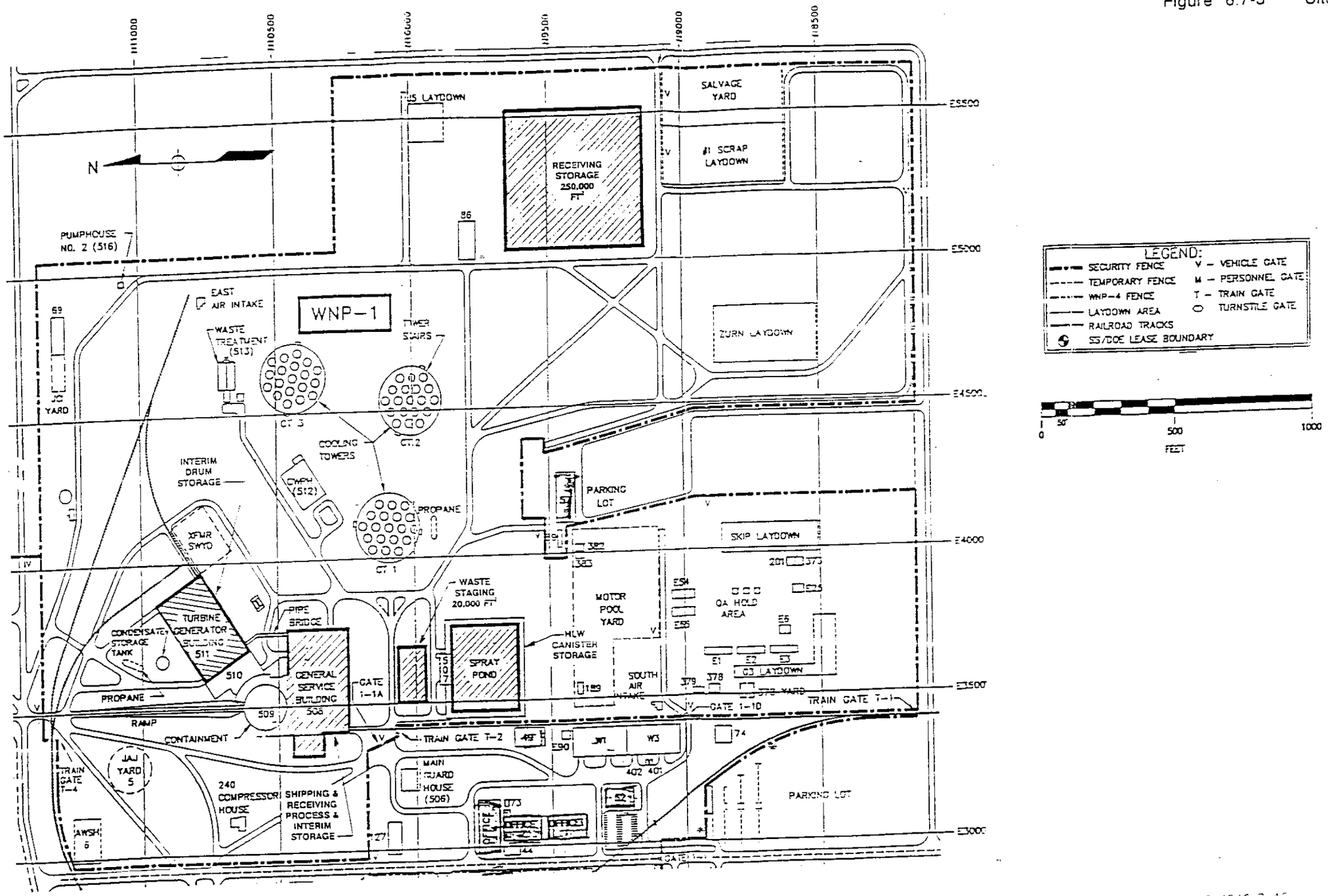
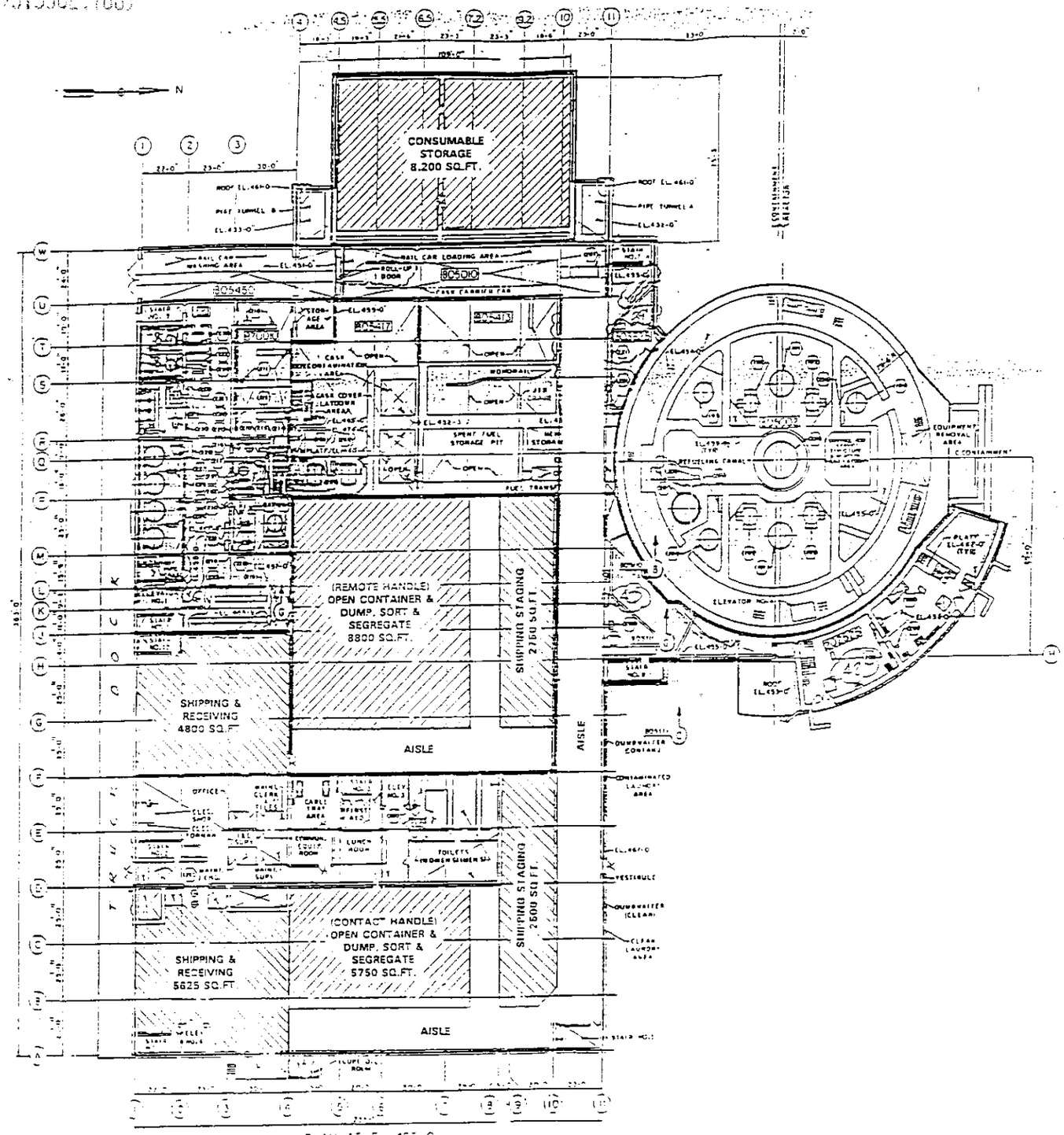


Figure 6.7-4 General Services Building Plan Elevation 455'



NOTE:

1. NO WASTE STORAGE ON THIS LEVEL.

Figure 6.7-5 General Services Building Plan Elevation 421'

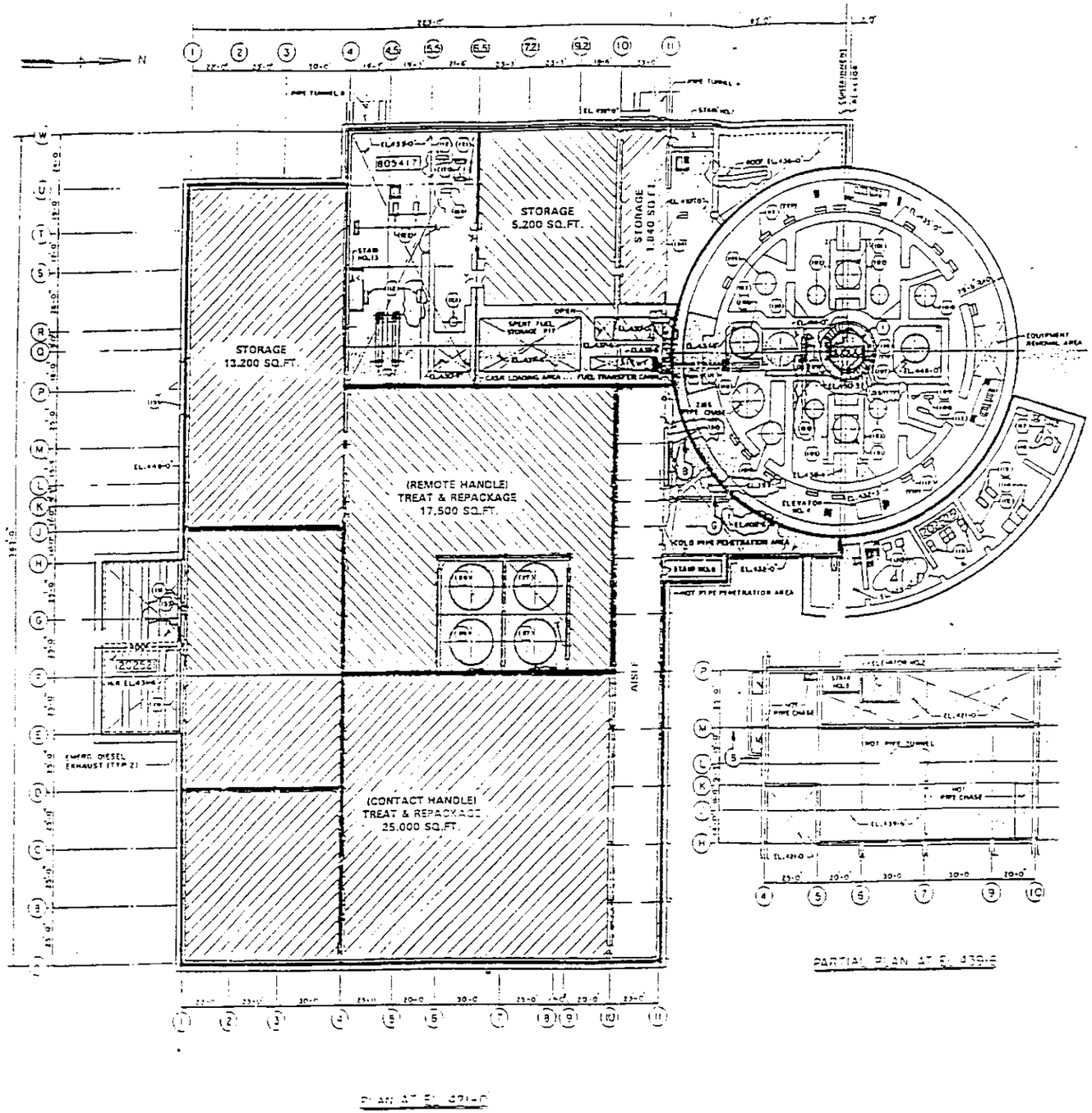


Figure 6.7-6 General Services Building Plan Elevation 395'

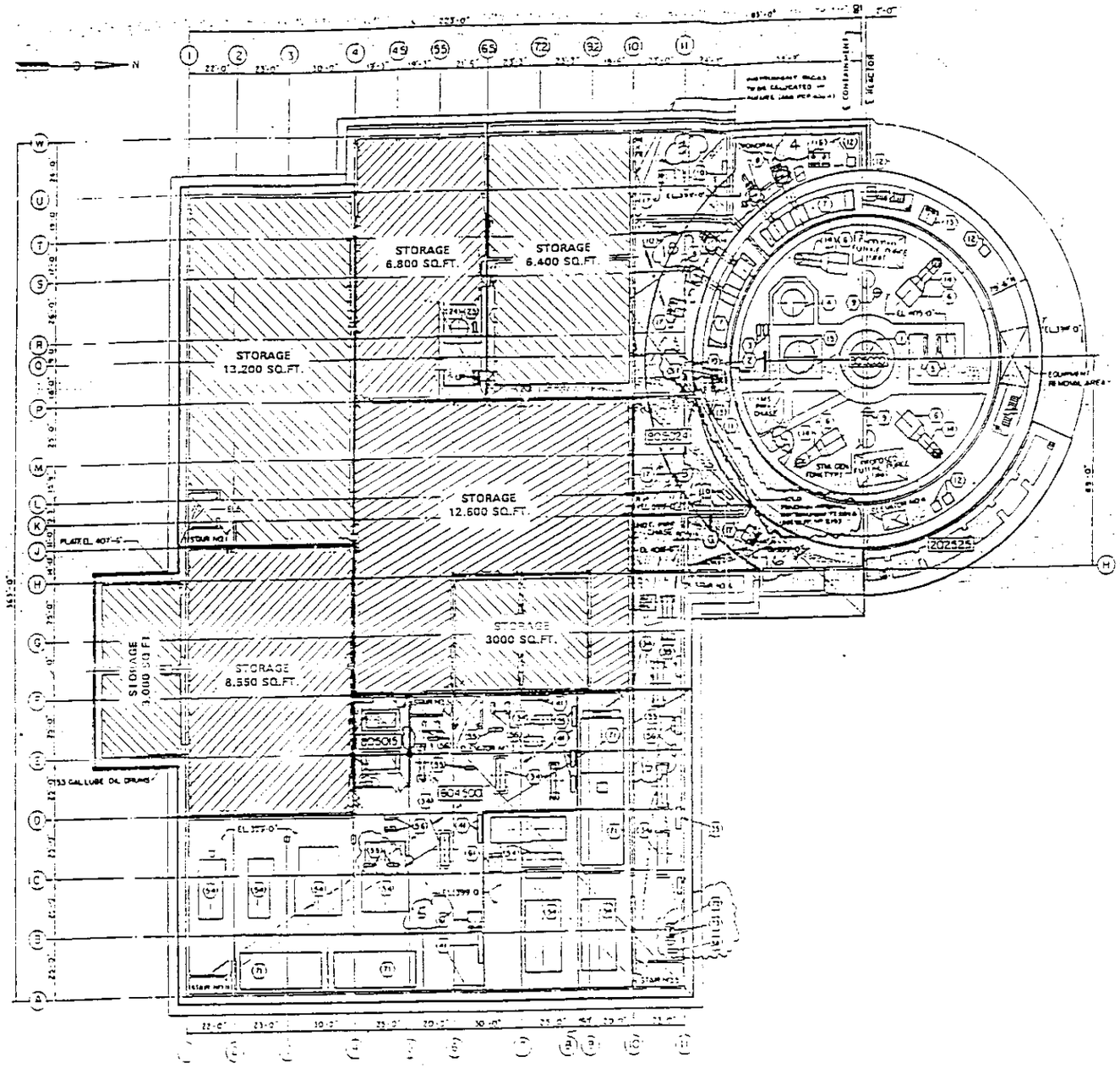


Figure 6.7-7 General Services Building Plan Elevation 479'

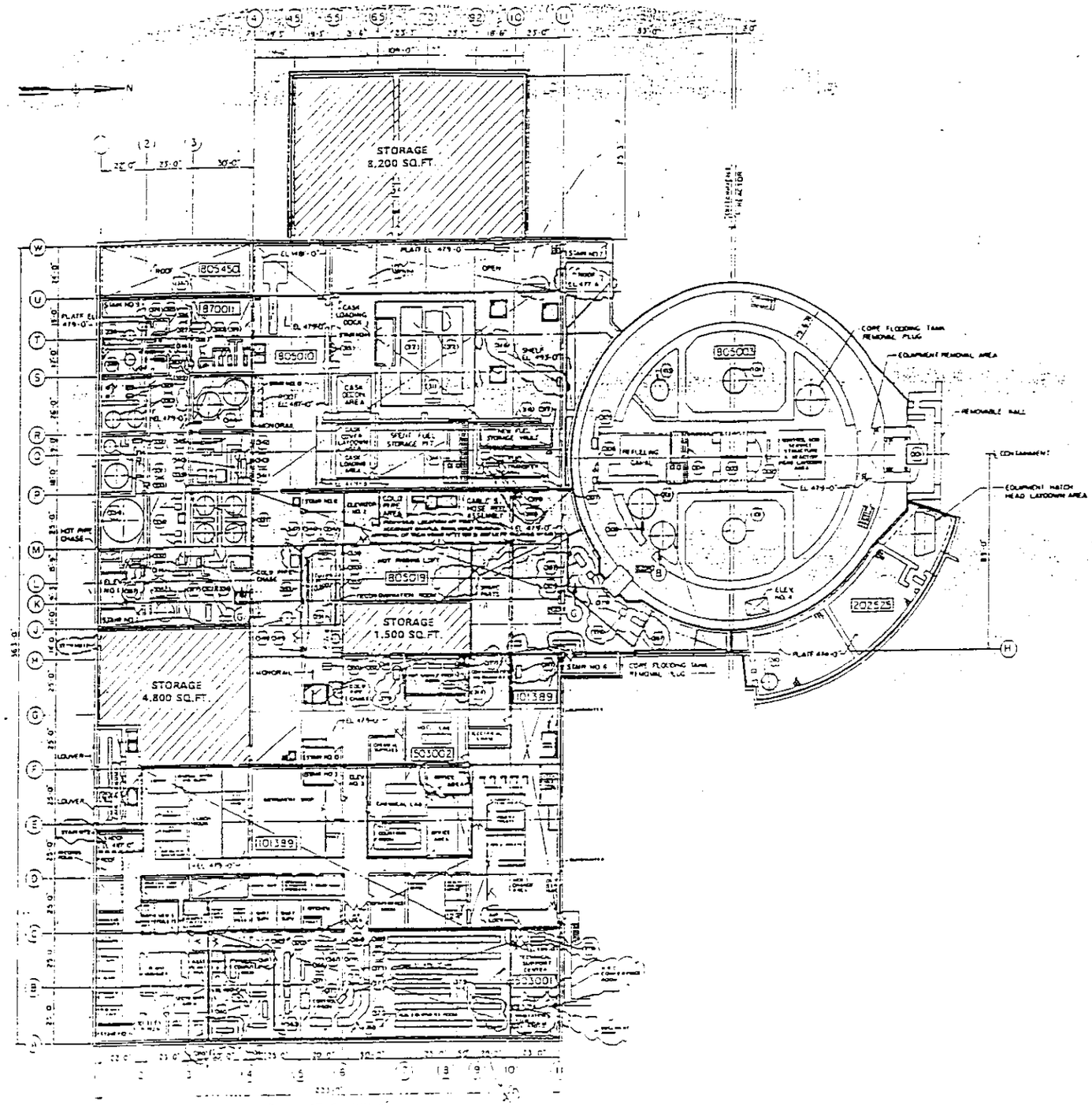


Figure 6.7-8 General Services Building Plan Elevation 501'

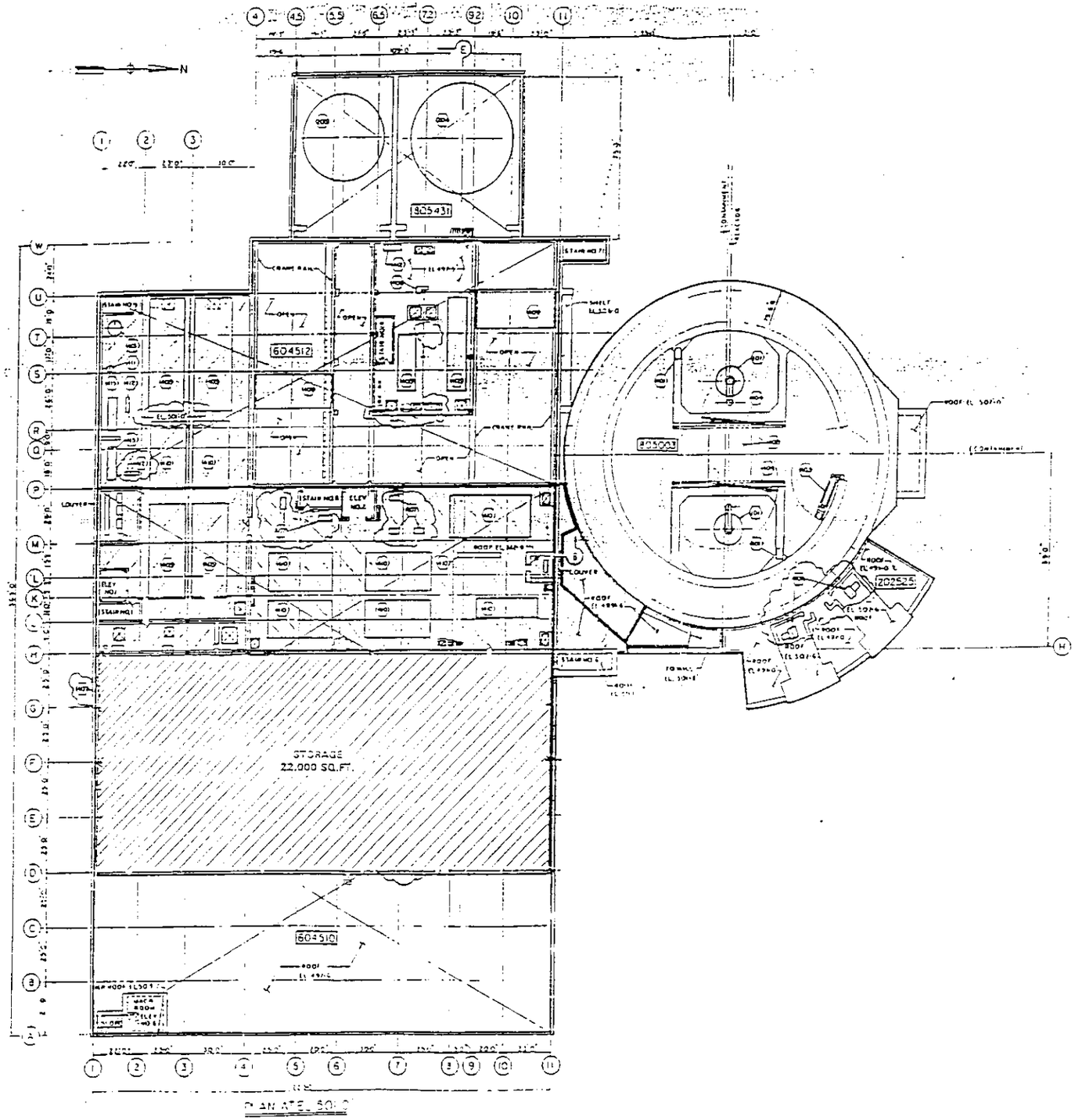
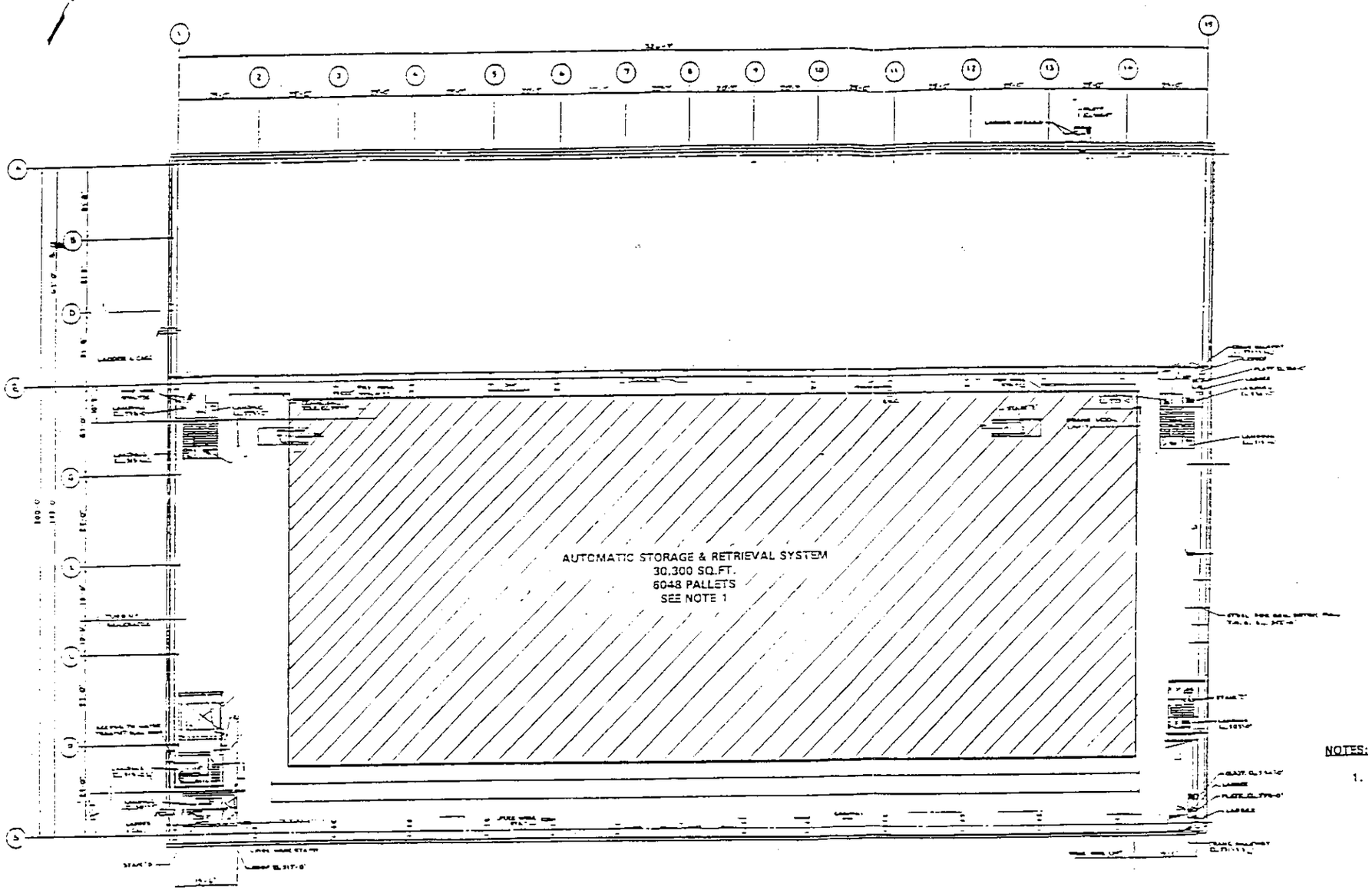


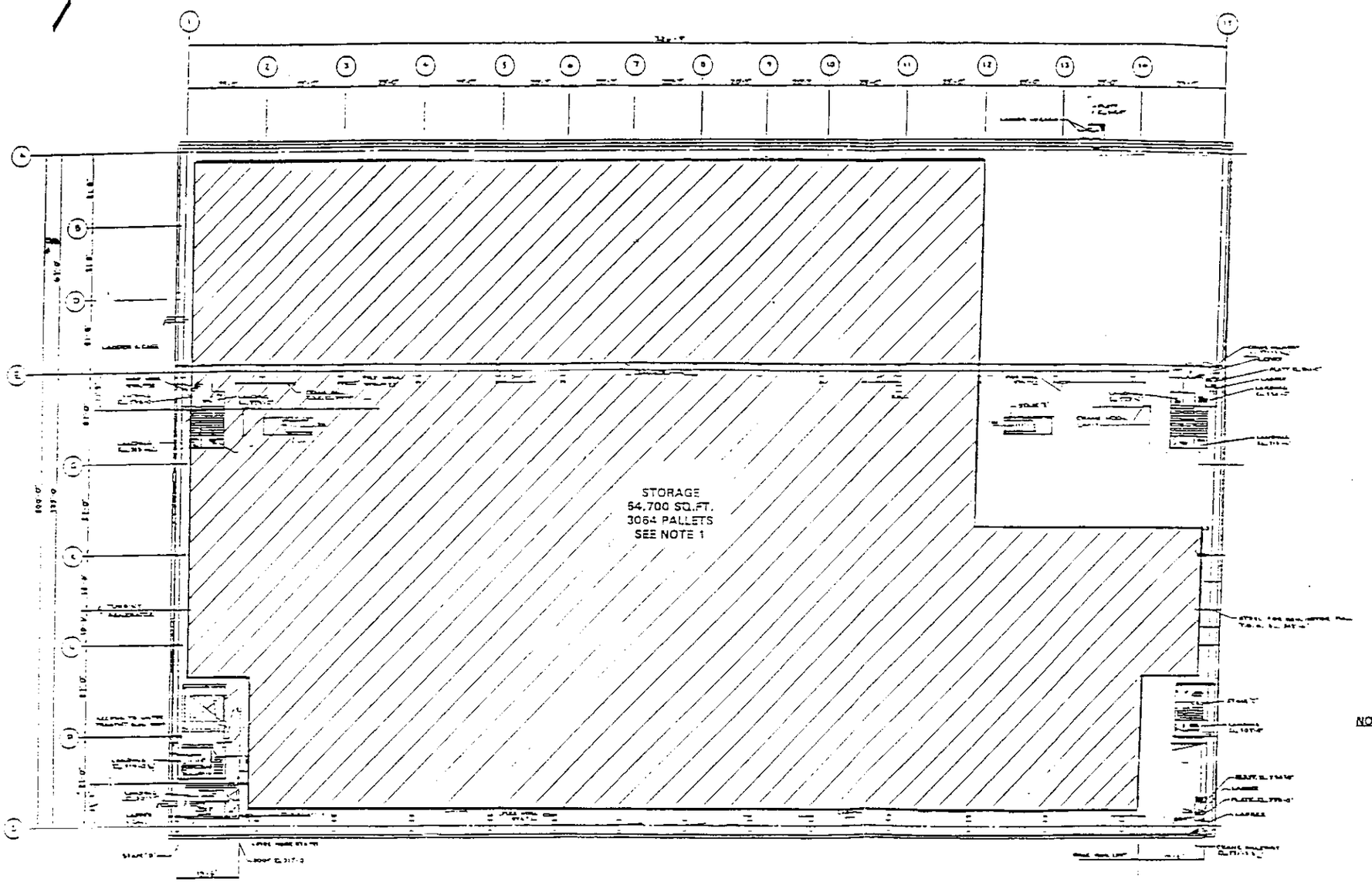
Figure 6.7-9 Turbine Generator Building Plan Elevation 508'



NOTES:

1. AUTOMATIC STORAGE & RETRIEVAL SYSTEM ACTUAL STORAGE 30,263 SQ. FT. (110.25' x 274.5') WITH 18 ROWS (ONE AISLE & TWO ROWS OF RACKS EACH) & 21 PALLETS LONG PER RACK. EACH RACK IS 8 HIGH TO YIELD 6048 PALLETS.

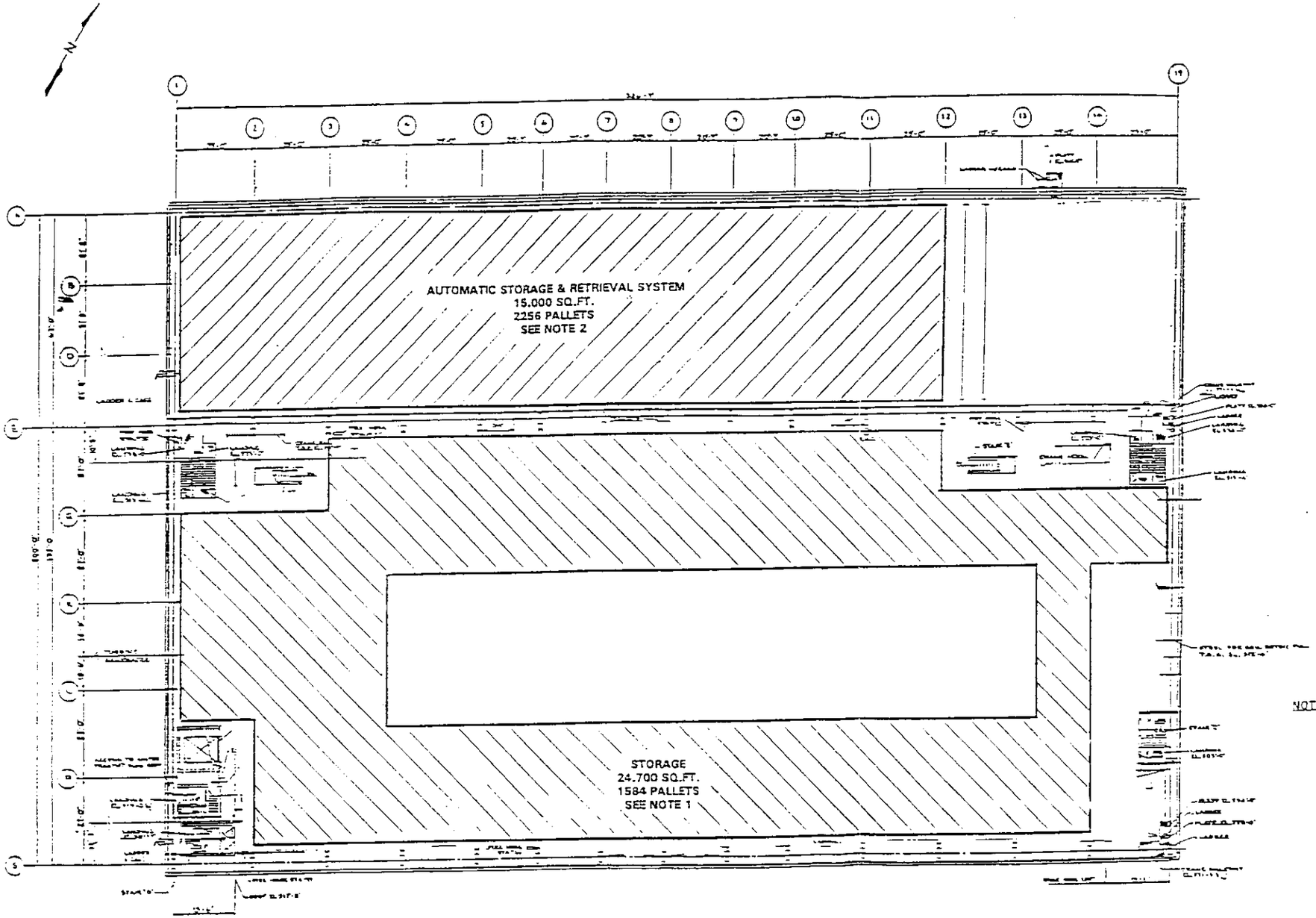
Figure 6.7-10 Turbine Generator Building Plan Elevation 452'



NOTE:

1. ACTUAL STORAGE 54,698 SQ. FT. WITH ACCESS & INSPECTION AISLES YIELDS 35% (19,144 SQ. FT.) USEABLE FOR PALLET RACKS. AT 25 SQ. FT. PER PALLET SPACE = 766 PALLET SPACES TIMES 4 HIGH = 3064 PALLETS.

Figure 6.7-11 Turbine Generator Building Plan Elevation 476'



NOTES:

1. ACTUAL STORAGE 24,728 SQ. FT. WITH ACCESS & INSPECTION AISLES YIELDS 40% (9,891 SQ. FT.) USEABLE FOR PALLET RACKS. AT 25 SQ. FT. PER PALLET SPACE = 396 PALLET SPACES TIMES 4 HIGH = 1584 PALLETS.

2. AUTOMATIC STORAGE & RETRIEVAL SYSTEM ACTUAL STORAGE 15,051 SQ. FT. (61' x 246.75') WITH 4 ROWS (ONE AISLE & TWO ROWS OF RACKS EACH) & 47 PALLETS LONG PER RACK. EACH RACK IS 6 HIGH TO YIELD 2256 PALLETS.

Figure 6.7-12 Hanford Reservation Boundary Map

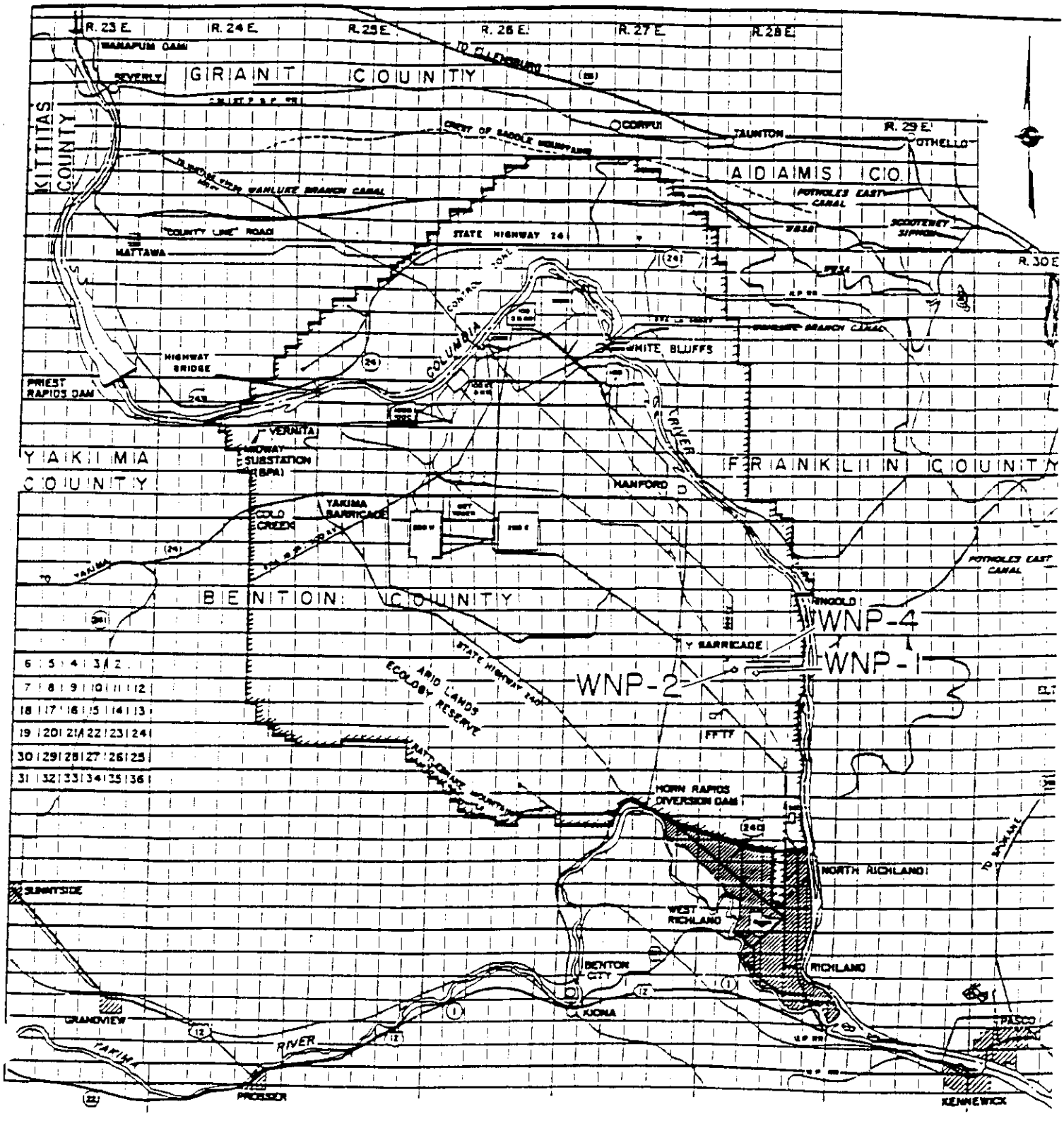


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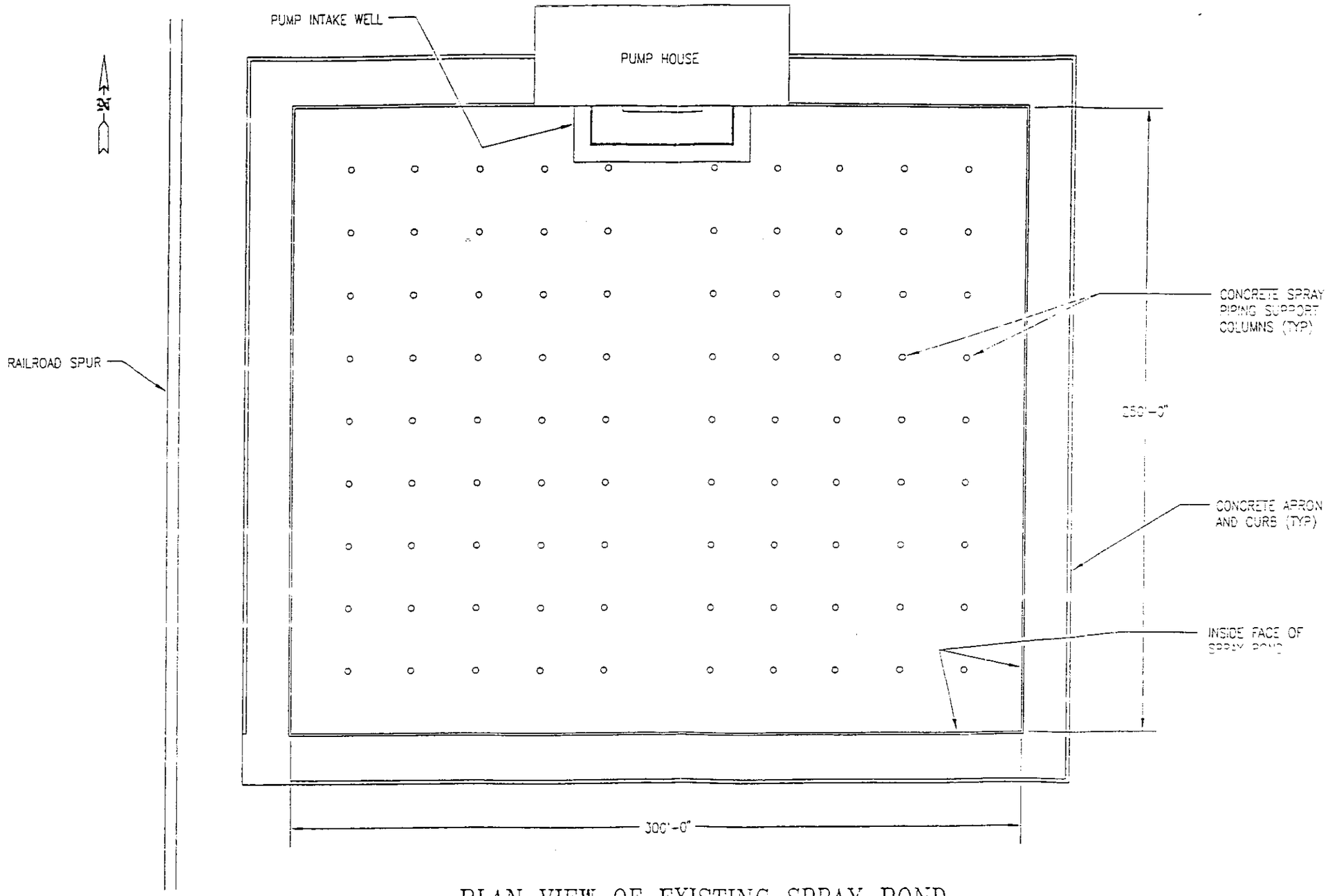
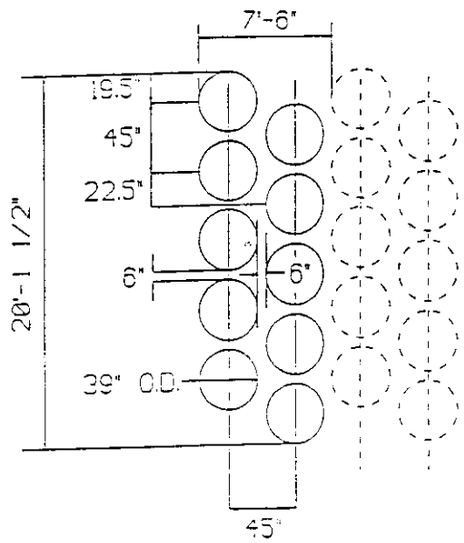
Figure 6.7-10 Plan View Of Existing Spray Pond

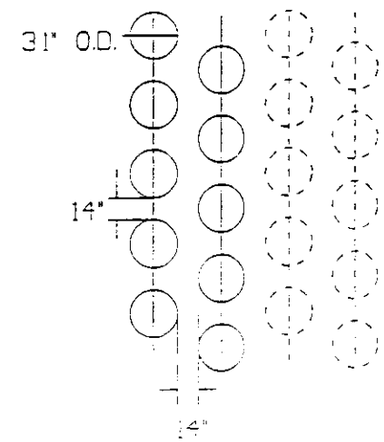


PLAN VIEW OF EXISTING SPRAY POND

SCALE: 1"=40'

Figure 6.7-14 Proposed Canister Storage Tube Arrangement





PLAN AT OPERATING FLOOR

(O.D. = 39", SPACING = 6")

10 CANS/7.5 LF
280 LF/7.5 LF = 37 SETS
37 SETS(10 CANS/SET) = 370 CANS/BAY
370 CANS/BAY(10 BAYS) = 3700 CANS/LIFT
2 LIFTS(3700 CANS/LIFT) = 7400 CANS TOTAL
7400 > 6800 OK

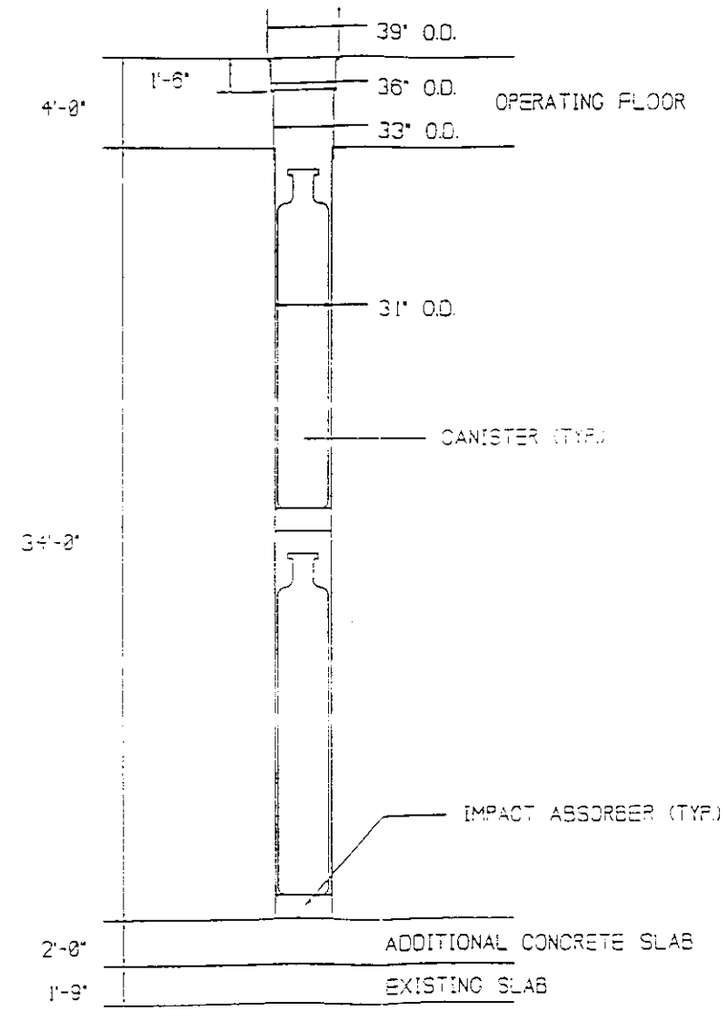
PLAN AT BASE SLAB

(O.D. = 31", SPACING = 14")

PROPOSED CANISTER STORAGE TUBE ARRANGEMENT

(NOT TO SCALE)

Figure 6.7-15 Typical Canister Storage Tube

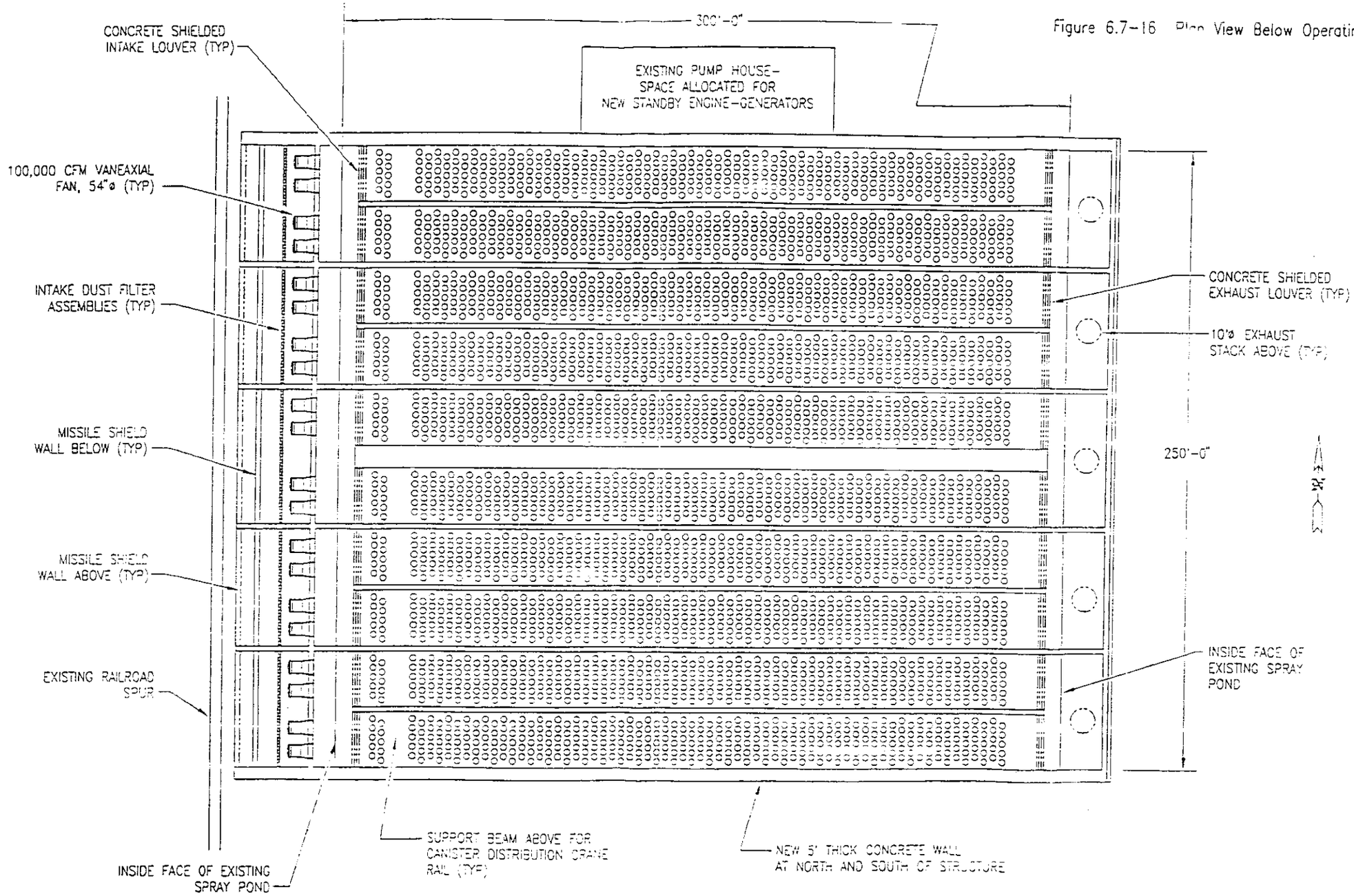


TYPICAL CANISTER STORAGE TUBE

27" DIA. X 15' LONG CANISTERS STACKED TWO HIGH

(NOT TO SCALE)

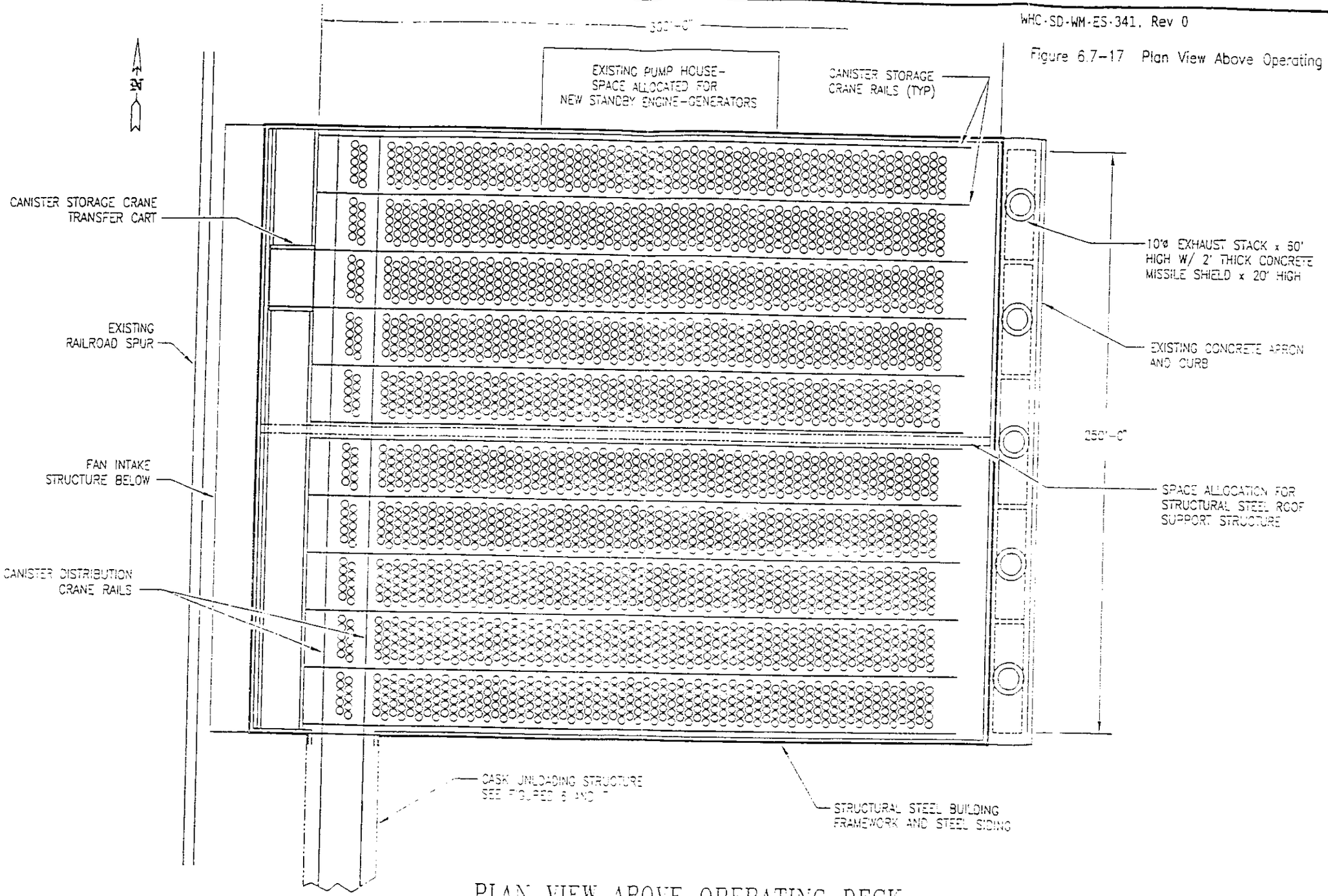
Figure 6.7-16 Plan View Below Operating Deck



PLAN VIEW BELOW OPERATING DECK

SCALE 1"=40'

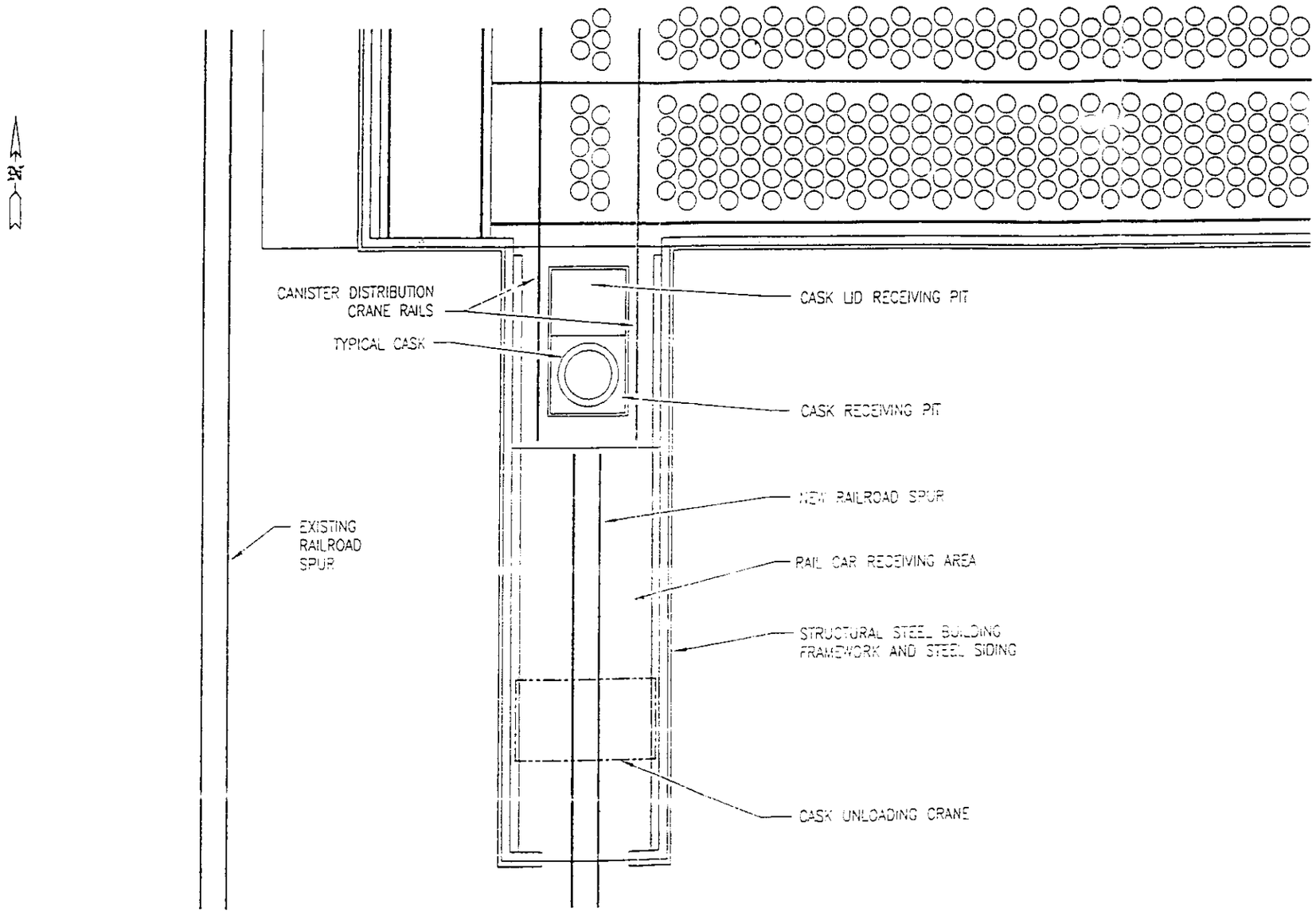
Figure 6.7-17 Plan View Above Operating Deck



PLAN VIEW ABOVE OPERATING DECK

SCALE 1"=40'

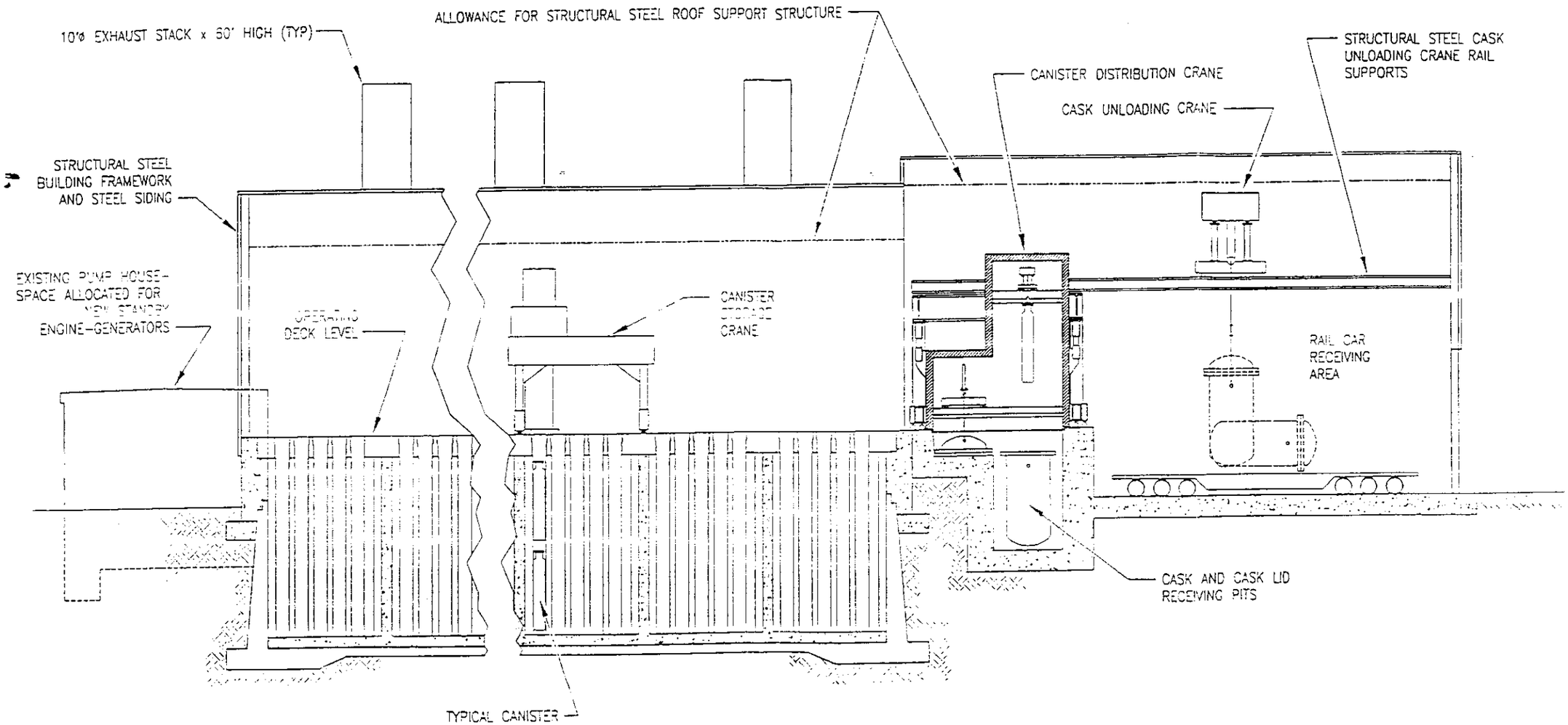
Figure 6.7-18 Plan View – Cask Unloading Area



PLAN VIEW-CASK UNLOADING AREA

SCALE: 1"=20'

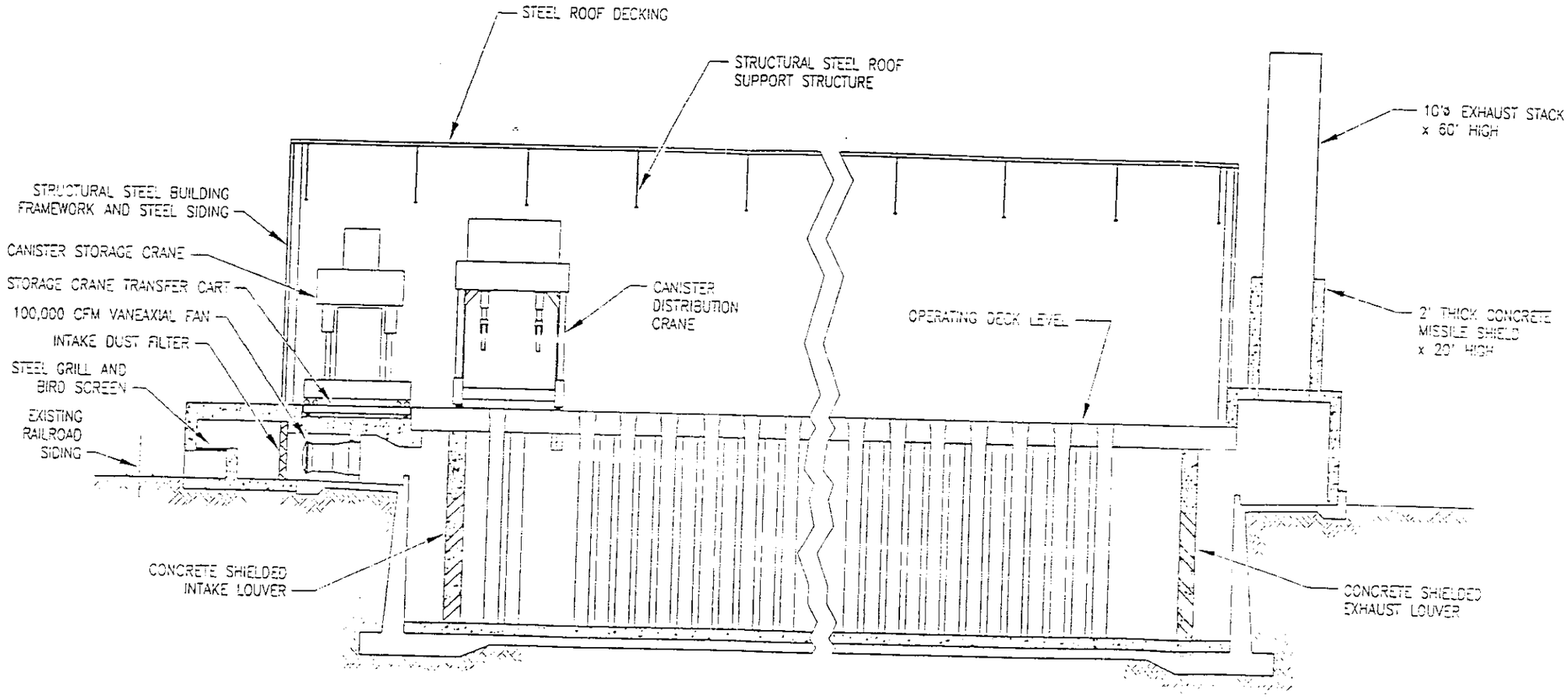
Figure 6.7-19 Transverse Section Looking East



TRANSVERSE SECTION LOOKING EAST

SCALE: 1" = 20'

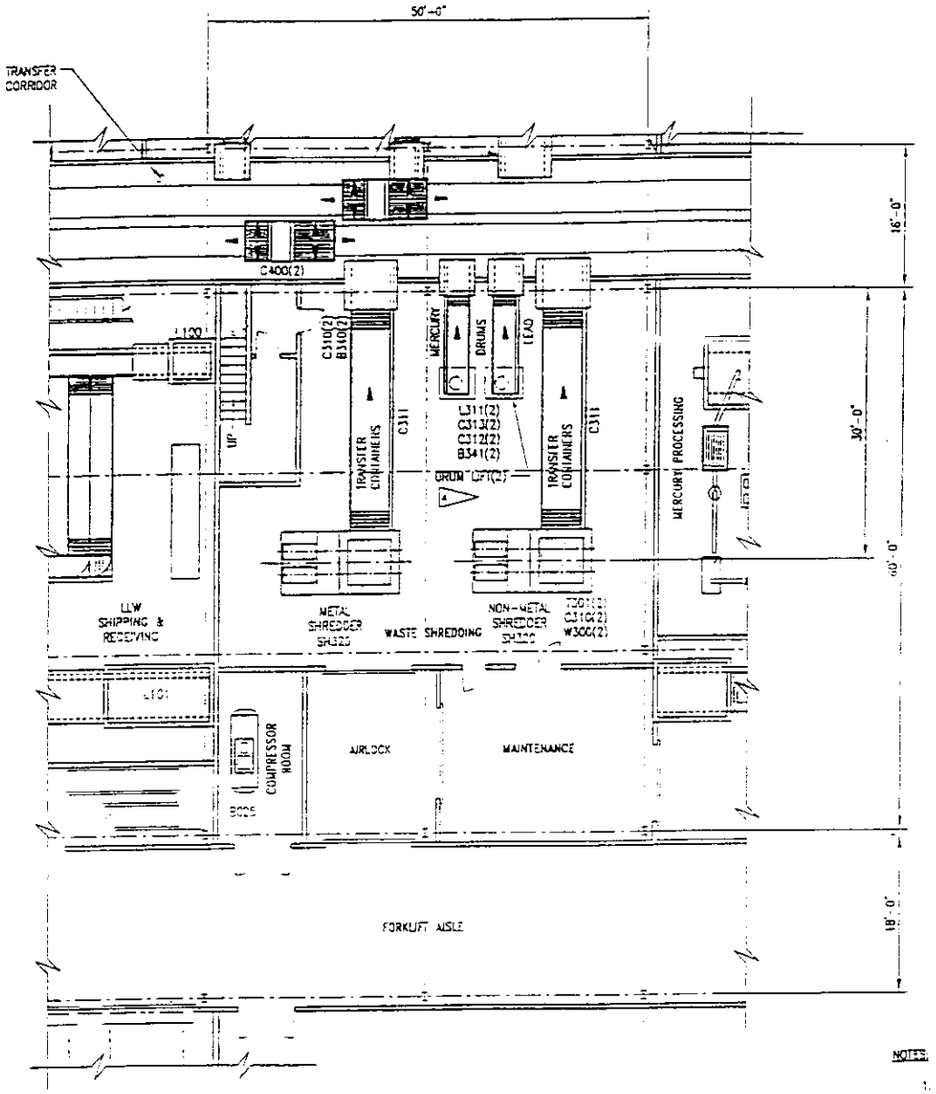
Figure 6.7-20 Longitudinal Section Looking North



LONGITUDINAL SECTION LOOKING NORTH

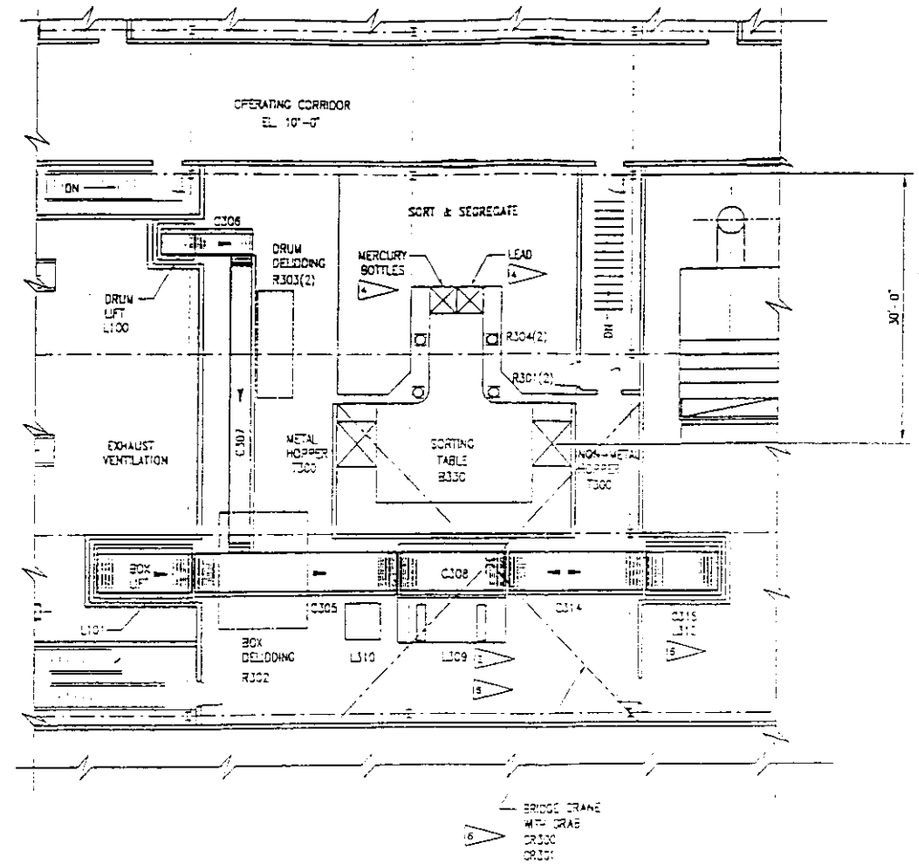
SCALE: 1"=20'

Figure 6.7-21 Typical Process Plan - Shredding, Sort, & Segregate



PLAN - SHREDDING (TYPICAL)

(BELOW SORT & SEGREGATE)



PLAN - SORT & SEGREGATE (TYPICAL)

NOTES:

1. SEE EQUIPMENT LIST FOR DESCRIPTIONS OF ITEMS WITH TAG NUMBERS.

2. TIPPER (L309) CAN TIP ONE BOX OR 5 DRUMS AT A TIME.

3. LLW WILL BE SORTED AT THE RATE OF 200 DRUM EQUIVALENTS PER DAY (5 DAYS A WEEK, 3 SHIFTS PER DAY, OR 1.04 FT^3 PER HOUR.

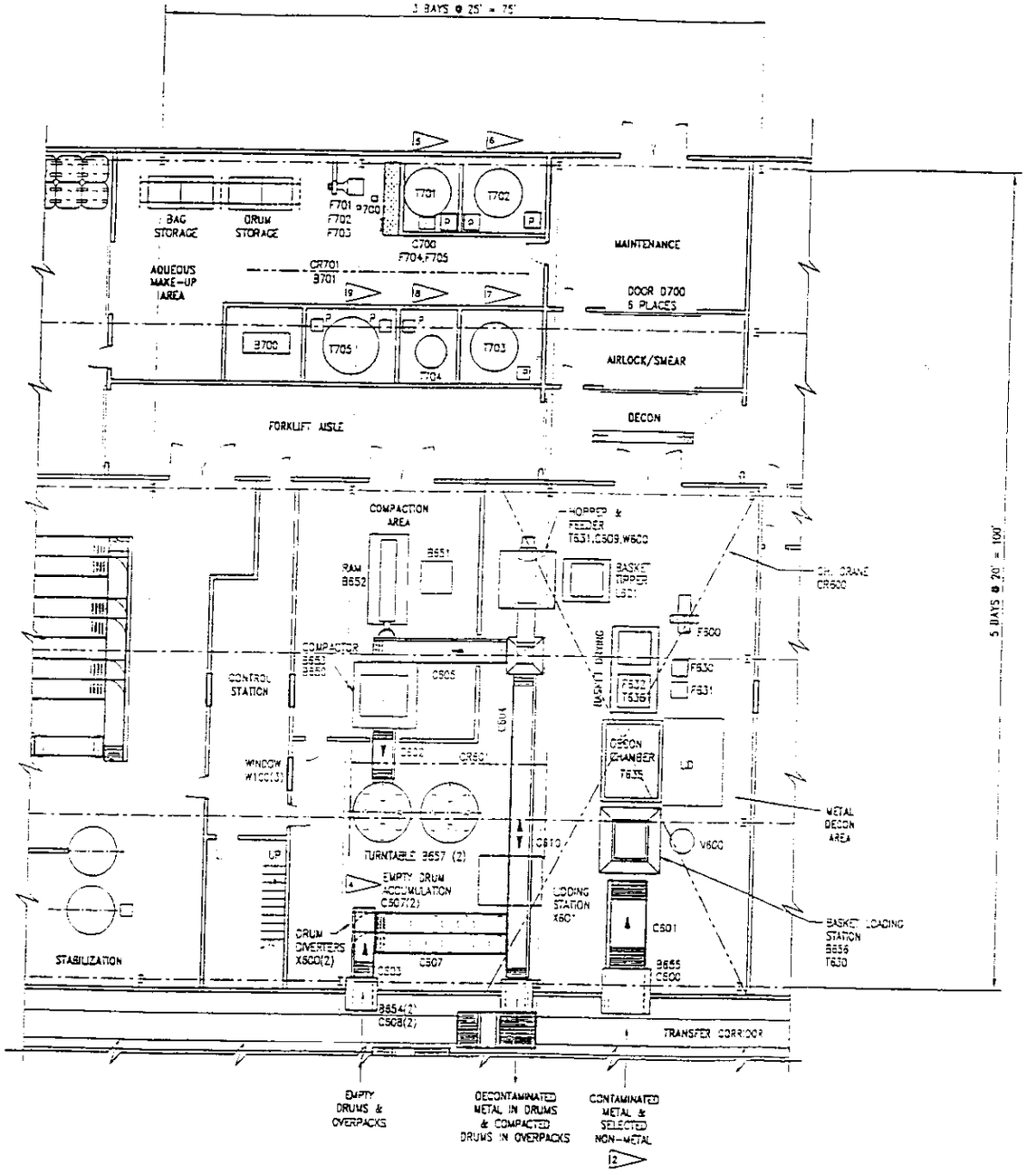
14. LEAD AND BOTTLES OF MERCURY AND LEAD WILL BE PLACED IN HALF DRUMS BY MANIPULATORS. HALF DRUMS WILL BE LOWERED TO THE FIRST FLOOR VIA DRUM LIFTS (1000 LBS. LIMIT).

5. TRANSFER CONTAINERS ARE 4'x4'x4' DRUMS ARE 7.5 FT^3

15. REJECTED WASTE LOADED INTO B-25 CONTAINERS WITH OVERHEAD BRIDGE CRANE WITH GRAB. B-25 CONTAINER STORED ON LIFT UNTILL READY FOR LOADING. THEN CONVEYED TO THE TIPPER FOR WASTE LOADING. THIS POSITION WILL YIELD THE LEAST WASTE SPILLAGE.

6.7-81 6.7-82

Figure 6.7-22 Typical Process Plan - Metal Decontamination, Compaction, & Aqueous Make-Up

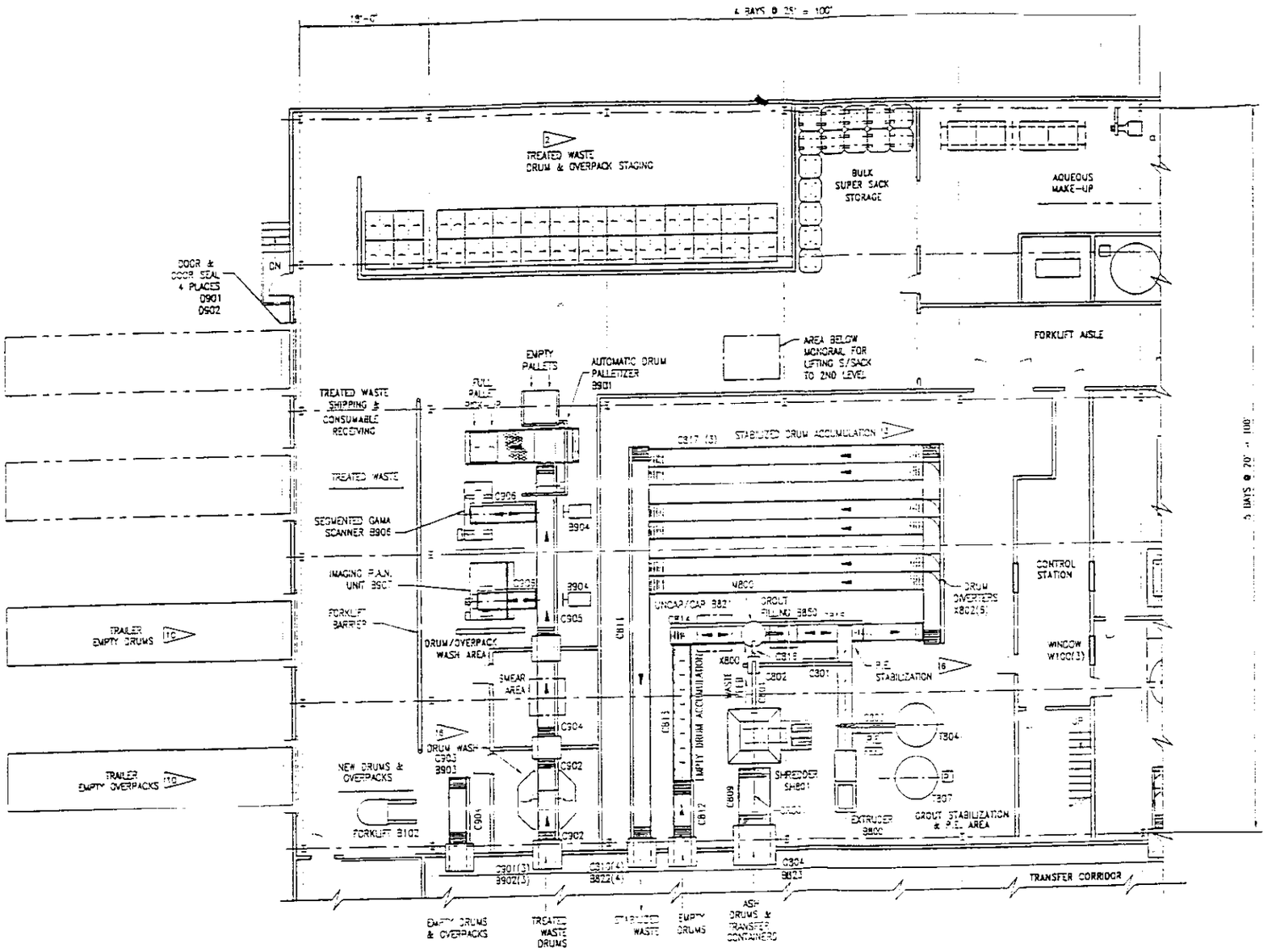


PLAN – METAL DECONTAMINATION, COMPACTION, & AQUEOUS MAKE-UP (TYP)

NOTES:

1. SEE EQUIPMENT LIST FOR DESCRIPTIONS OF ITEMS WITH TAG NUMBERS.
2. SHREDDED CONTAMINATED METAL & NON-METAL TRANSFER CONTAINER FROM SORTING TABLE 62.5 FT³/HR MAXIMUM (1 TRANSFER CONTAINER)
3. DRUMS FILLED TO 1000#.
4. EMPTY DRUM & OVERPACK ACCUMULATION FOR FILLING, COMPACTING & LOADING WILL BE 16 TOTAL FOR DRUMS OR OVERPACKS OR A COMBINATION OF BOTH.
5. 1 1/2 DAY = 1500 GAL
6. 1500 GAL
7. 110% LARGEST TANK
8. 500 GAL
9. 4 WEEKS @ 5 DAYS/WEEK = 1 MONTH 2100 GAL

Figure 6.7-23 Typical Process Plan - Treated Drum Wash, Staging & Shipping, Bulk S/Sack Storage, Consumable Receiving, Stabilization

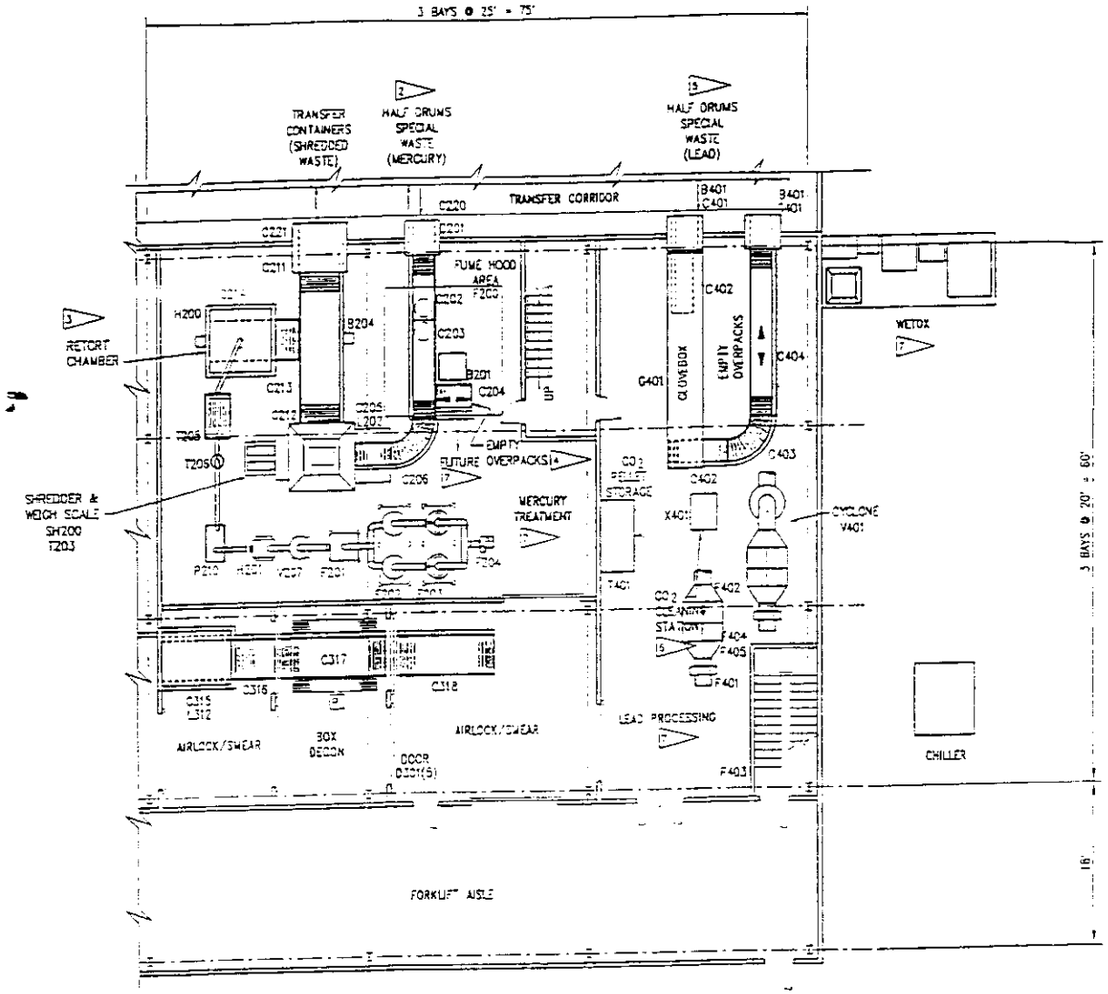


NOTES:

1. SEE EQUIPMENT LIST FOR DESCRIPTIONS OF ITEMS WITH TAG NUMBERS.
2. 4.7 DAYS FULL DRUM & OVERPACK STAGING ON PALLETS THREE HIGH. (336 DRUMS, 1000# EACH)
3. TWO GROUT DRUMS PER HOUR FROM STABILIZATION 48 HOURS STABILIZED DRUM CURING OR COOLING = 96 DRUM ACCUMULATION
4. ONE DRUM PER HOUR
5. EMPTY DRUM & OVERPACK BULK STORAGE WILL BE ON TRAILERS
6. POLYETHYLENE STABILIZATION IS A FUTURE INSTALLATION

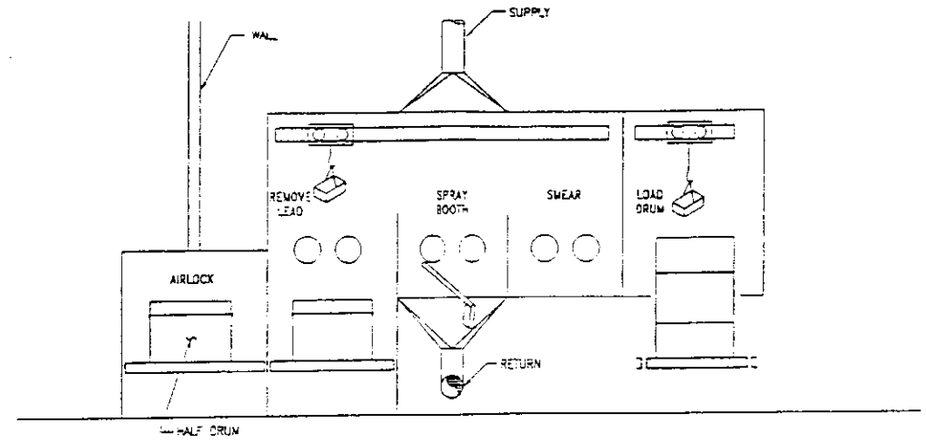
PLAN - TREATED WASTE DRUM WASH, STAGING & SHIPPING, BULK S/SACK STORAGE, CONSUMABLE RECEIVING, STABILIZATION (TYP)

Figure 6.7-24 Typical Process Plan - Mercury Treatment & Lead Processing, Box Decontamination



PLAN - MERCURY TREATMENT & LEAD PROCESSING.

BOX DECONTAMINATION (TYPICAL)



LEAD GLOVEBOX SCHEMATIC (TYPICAL)

NTS

NOTES

1. SEE EQUIPMENT LIST FOR DESCRIPTIONS OF ITEMS WITH TAG NUMBERS.

12 3.4 DRUM EQUIVALENTS PER WEEK (AVERAGE) INPUT = OUTPUT

13 3 DAY RETORT CYCLE

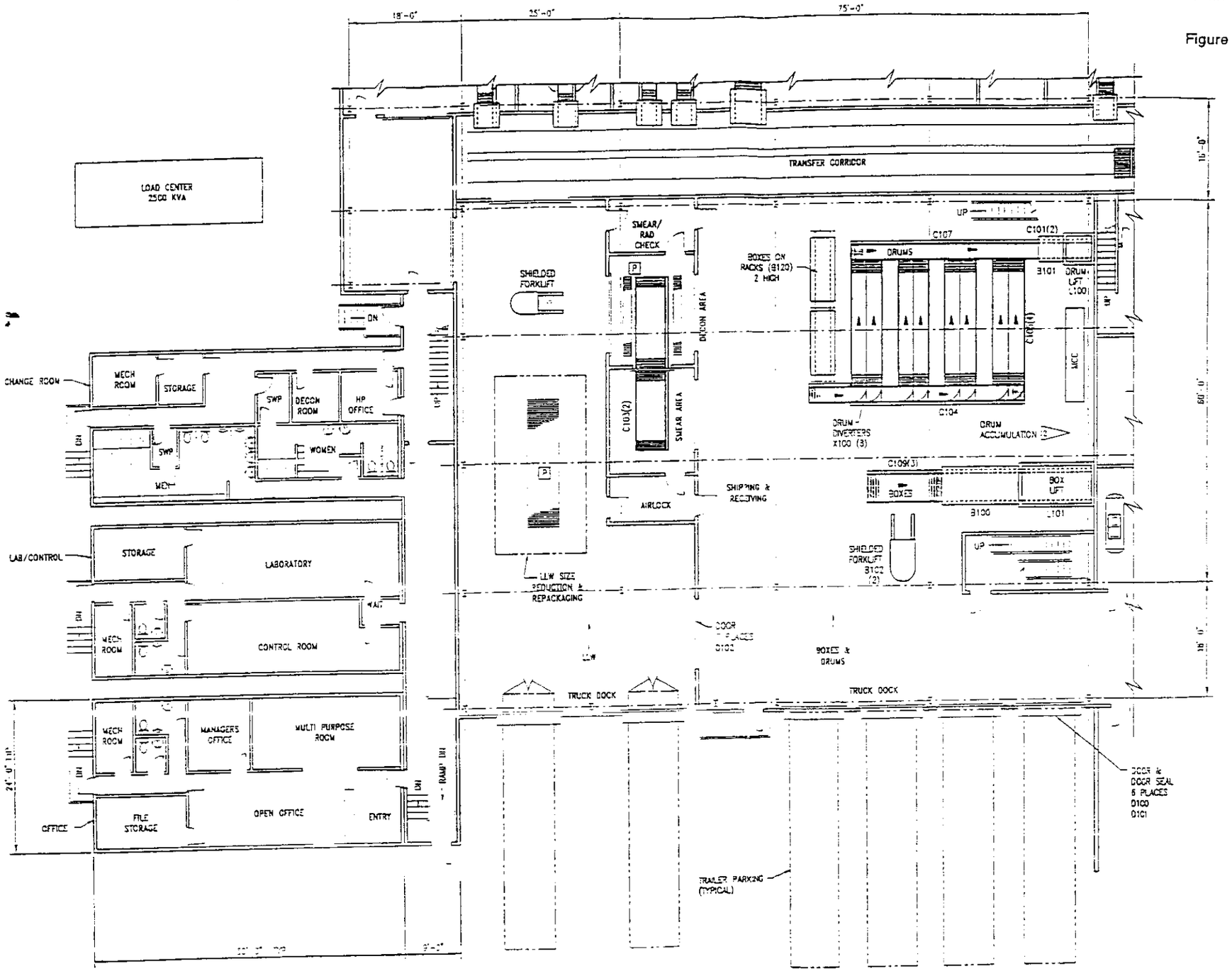
14 ONE DRUM BOTTLED MERCURY IN OVERPACK IN 16 WEEKS

15 4000#/WEEK (AVERAGE) IN 1000# HALF DRUMS INPUT = OUTPUT

16 1000#/SHIFT

17 MERCURY RETORT AND OFF-GAS TREATMENT, LEAD PROCESSING, & WETOX EQUIPMENT ARE FUTURE INSTALLATIONS.

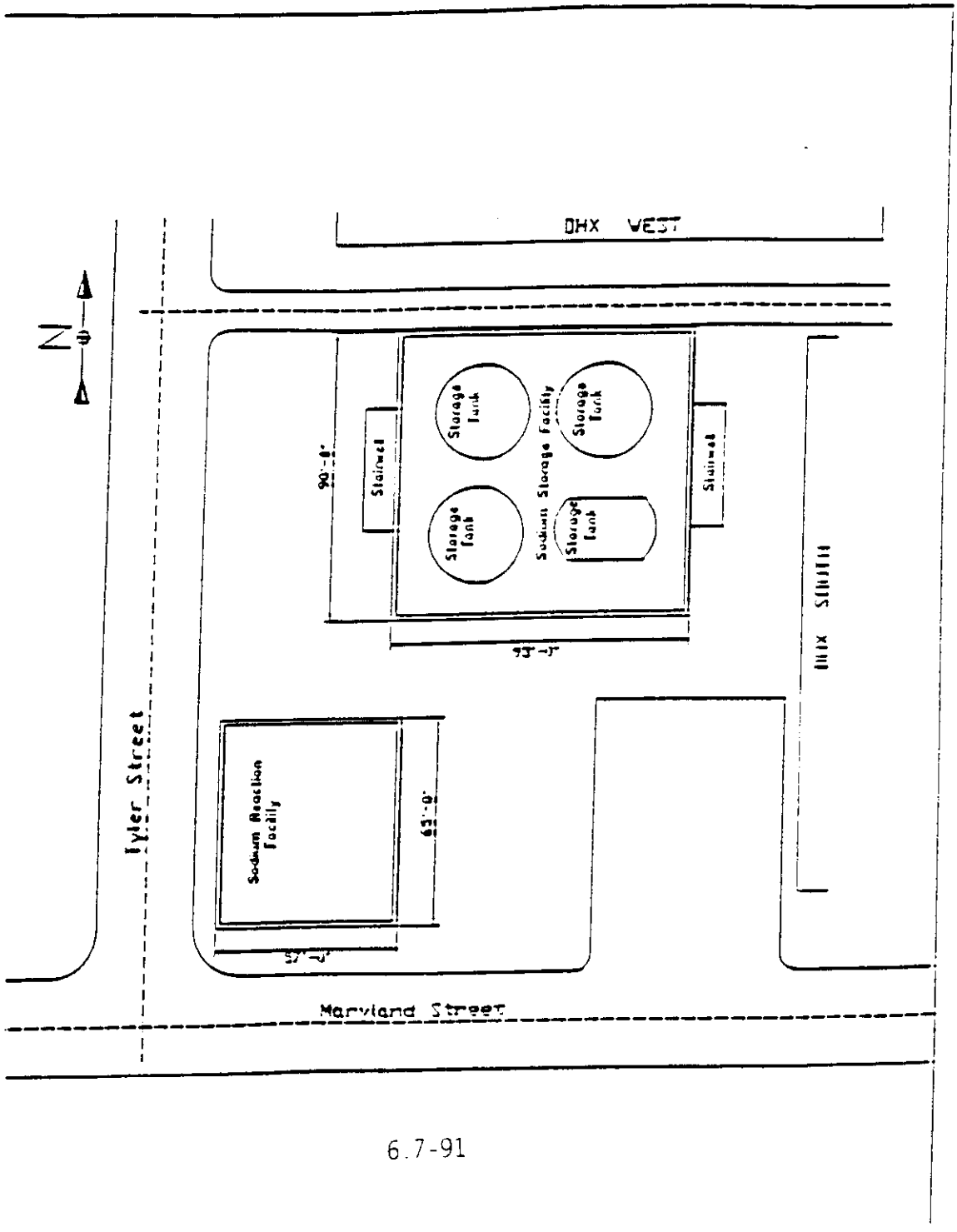
Figure 6.7-25 Typical Process Plan - LLW Shipping & Receiving & Personnel Trailers



NOTES:
1. SEE EQUIPMENT LIST FOR DESCRIPTIONS OF ITEMS WITH TAG NUMBERS.
2. LLW DRUM ACCUMULATION (1) SHIFT IS 73 DRUMS MINIMUM.
3. MIXED LLW WILL BE RECEIVED BY TRUCK AT 220 DRUM EQUIVALENTS PER DAY - 5 DAYS PER WEEK.
4. INCOMING MLLW:
   DRUM=2000# EACH
   BOX=12,000# EACH.

PLAN - LLW SHIPPING & RECEIVING & PERSONNEL TRAILERS (TYP)

Figure 6.7-26 Typical Sodium Storage & Processing Facility



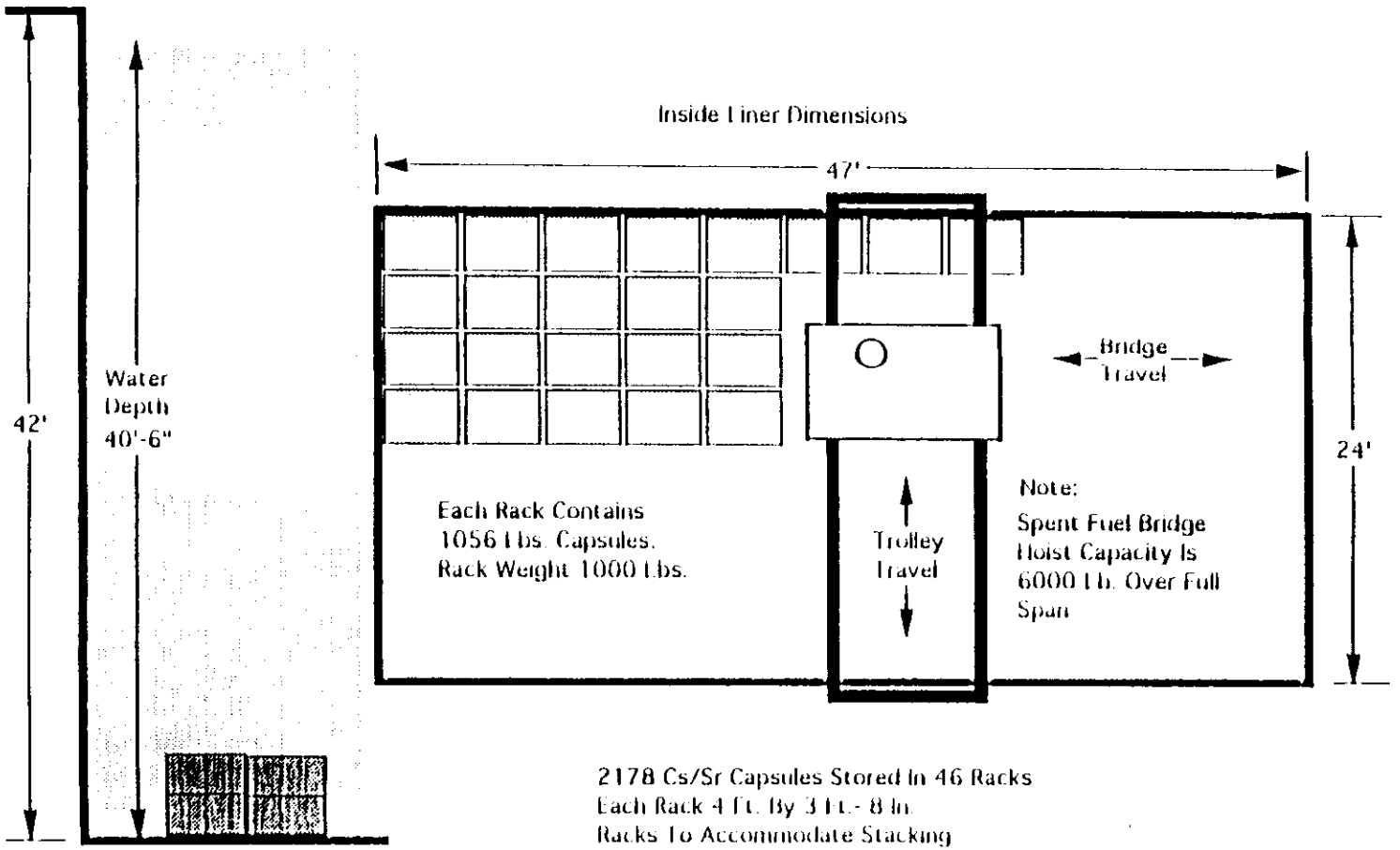


Figure 6.7-27 Spent Fuel Pool Storage Of Cs/Sr Capsules

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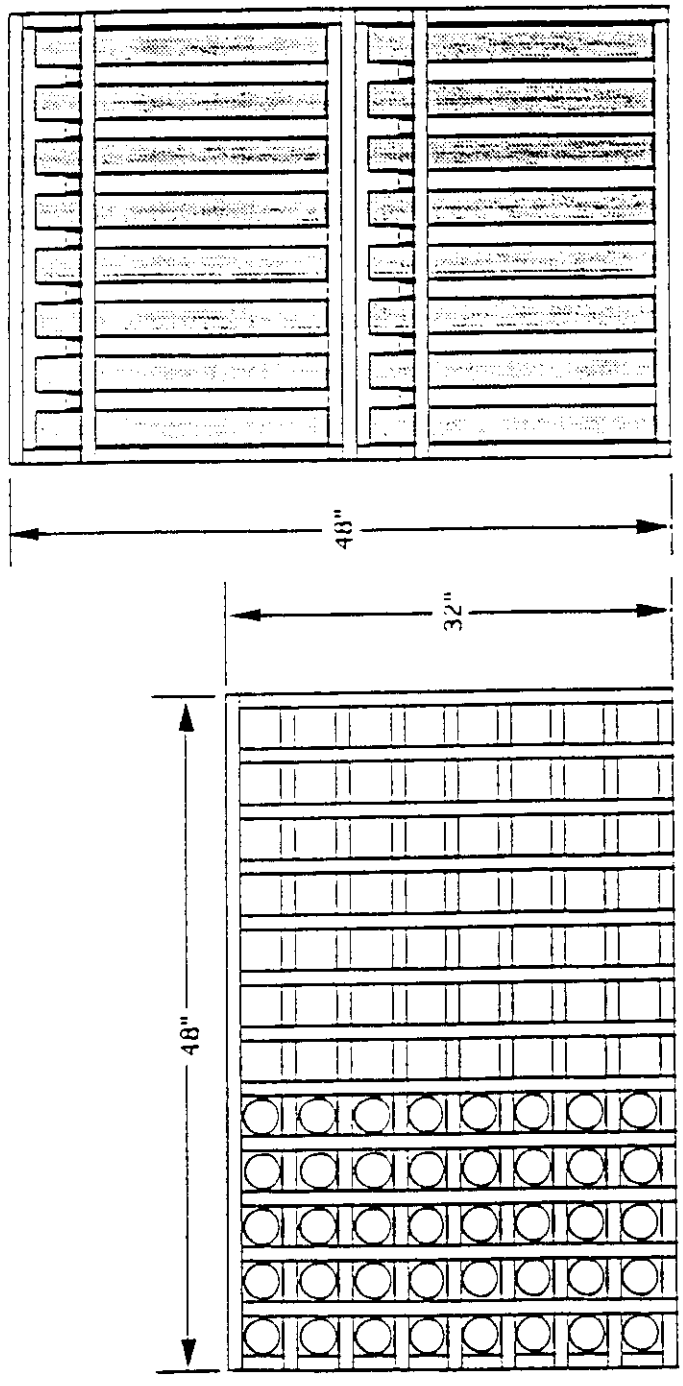
Figure 6.7-28 Cs/Sr Capsule Storage Interlocking/Stacked Racks



8 X 12 Storage In Double Or Triple
High "Egg Crate" Provides 192 To
288 Capsules Per 10.66 Square Feet

Figure 6.7-29. Alternative 4 Schedule.

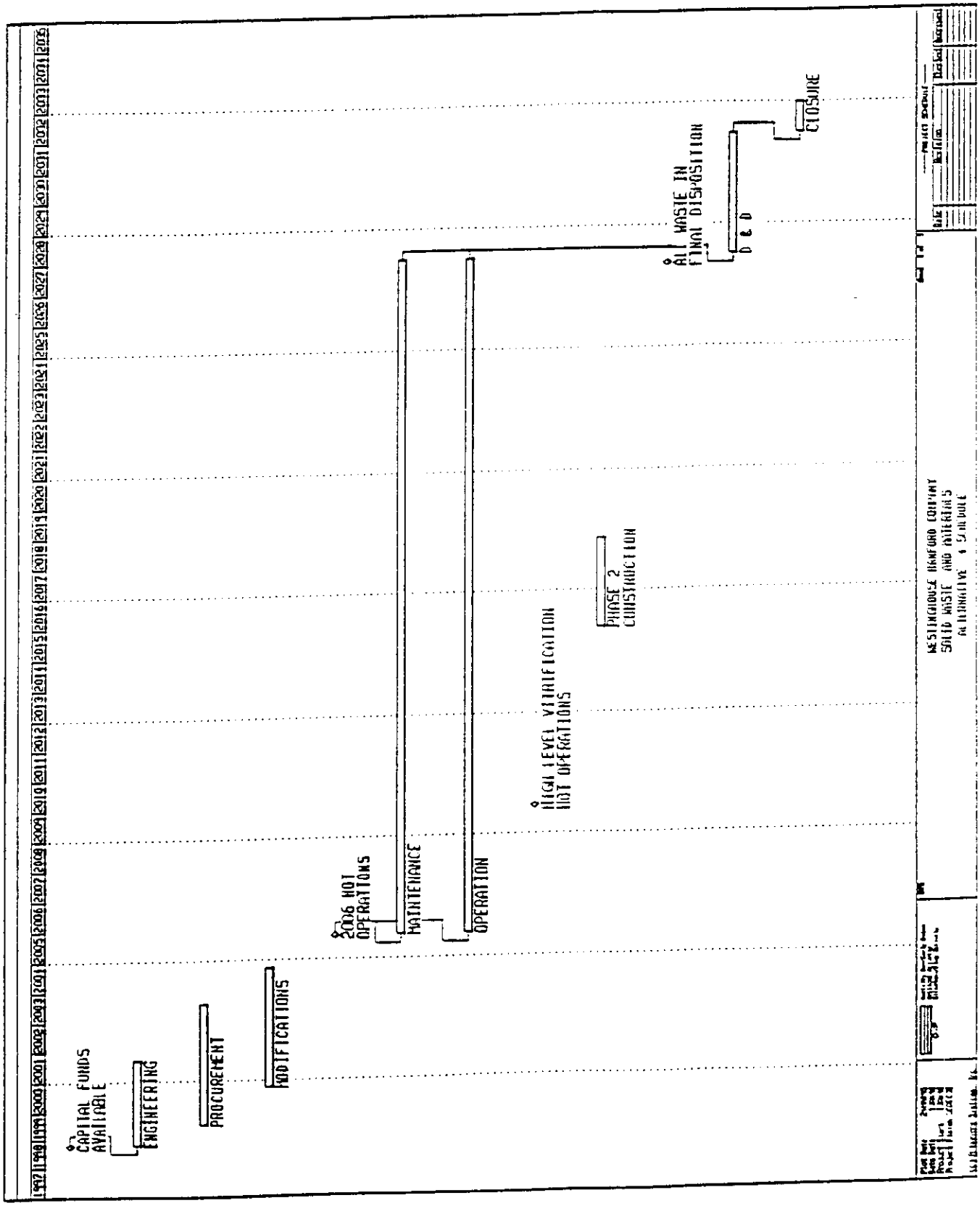
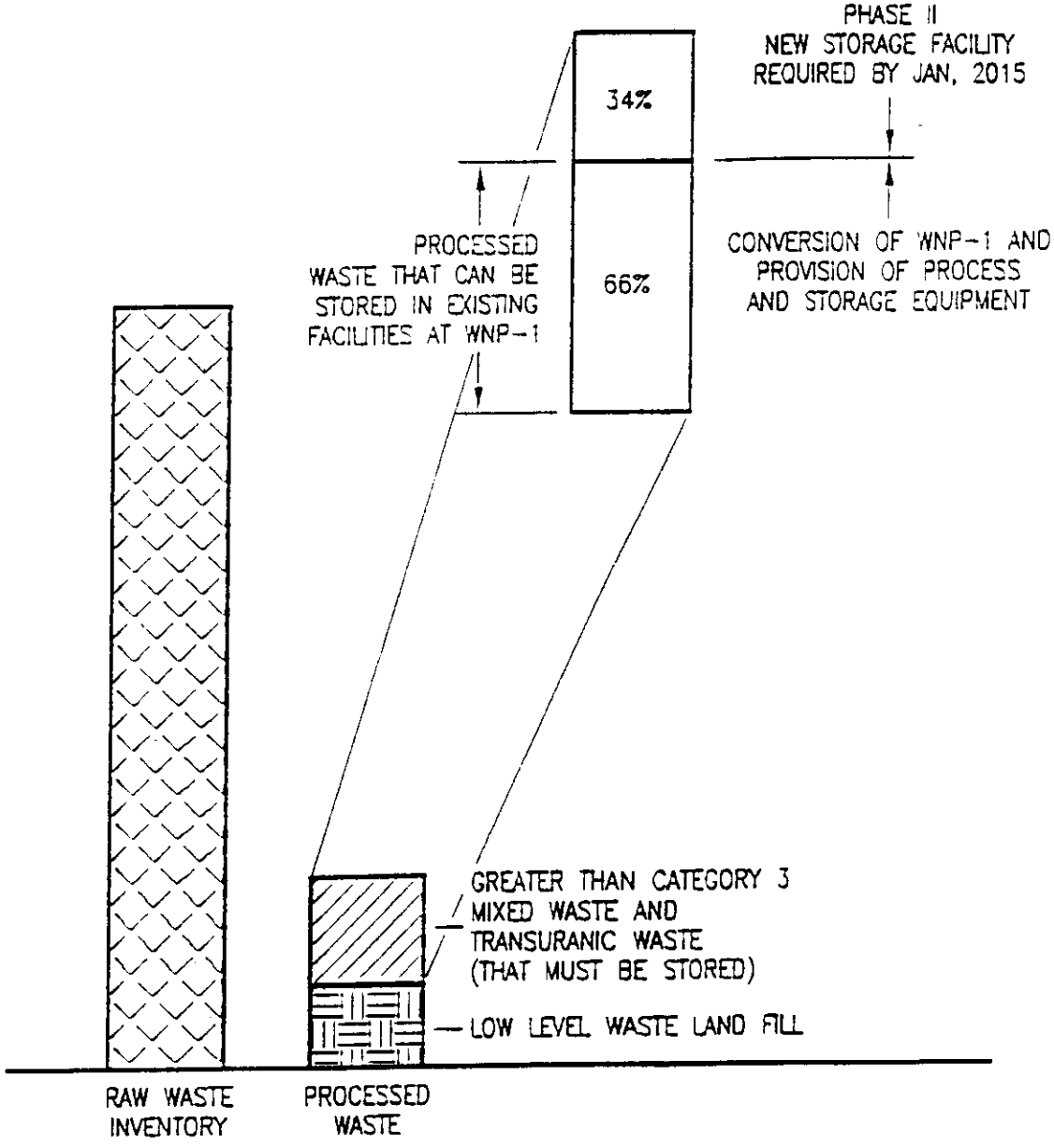


Figure 6.7-30. Waste Stream Storage Analysis.



WASTE STREAMS 3-19

Table 6.7-1 Annual Reactor Coolant Source Term (Selected Isotopes)
(Note: Licensing Basis 0.25% Failed Fuel)

Isotope*	Half Life	Coolant Specific Activity (micro Ci/gm)	Total Annual Coolant Activity (Ci)	Average Gamma Energy Release (kev)	Equiv. WESF Cs Capsules**
Ba 140	12 d	2.02E-03	4.67E+05	1.83E+02	<1
Ce 144	284 d	1.81E-04	4.18E+04	1.92E+01	<1
Pr 144	7.2 m	1.81E-04	4.18E+04	1.21E+01	<1
Co 60	5.26 y	3.90E-03	9.01E+05	2.50E+03	<1
Cs 136	12.9 d	2.84E-02	6.56E+06	2.17E+03	1
Cs 137	30 y	1.29E-01	2.98E+07	5.66E+02	662
I 129	1.6E7 y	2.62E-08	6.05E+00	2.48E+01	<1
I 130	12.36 h	2.85E-03	6.58E+05	2.14E+03	<1
I 131	8.06 d	1.36E+00	3.14E+08	3.82E+02	7
I 133	21 h	1.34E+00	3.10E+08	6.07E+02	11
La 140	40.2 h	8.49E-04	1.96E+05	2.32E+03	<1
Mo 99	67 h	3.10E-01	7.16E+07	2.72E+02	1
Ru 106	1.0 y	6.17E-05	1.43E+04	2.06E+02	<1
Xe 131M	12 d	5.80E-01	1.34E+08	2.05E+01	<1
Xe 133	5.27 d	8.33E+01	1.92E+10	4.59E+01	52
Xe 133M	2.3 d	8.99E-01	2.08E+08	4.14E+01	1
Y 91	58 d	2.56E-04	5.91E+04	3.60E+00	<1
				Total	735

* Selected gamma emitting isotopes with half life greater than 10 hours.
** Based on isotope specific activity and average gamma energy per disintegration.

Table 6.7-2 Summary Data For WNP-1 HVAC & Air Cleanup Systems

System Acronym	System Name	Seismic Category	Quality Class	Redundant Trains	System Flow Rate (cfm)	Quantity Air Handling Units	Each AHU Capacity (%)	Chilled Air or Evap. Cooling	Quantity Air Cleanup Trains	Each ACI Capacity (%)	Roughing Filters	HEPA Filters	Zoned dP Control
GENERAL SERVICES BLDG. SYSTEMS													
HPA	Primary Aux. Area	II	G	N	117,500	2	50	E	4	25	Y	Y	Y
HPA	Decon. Room	II	G	N	10,150	1	100	E	1	100	Y	Y	Y
HSG	Safeguards Area	I	1	Y	71,250	2	100	E	6	34	Y	Y	Y
HDG	Diesel Generator	I	1	Y	75,000	2	100	E	na	na	Y	N	Y
HCL	Control & Aux. Equip. Areas	I	1	Y	36,000	2	100	C	2	100	Y	Y	Y
HSF	Spent Fuel Storage Area	I	1	Y	80,000	4	50	C	2	50	Y	Y	Y
HFS	Radioactive Equip. Maint. & Test Area	II	G	Y	23,000	1	100	E	1	100	Y	Y	Y
HPT	Electrical & Piping Tunnels	I	1	Y	47,500	2	100	E	1	100	Y	Y	Y
HRW	Waste Treatment Area	II	G	N	54,000	1	100	E	1	100	Y	N	Y
HSC	Switchgear, Battery & Spreading Rms.	I	1	Y	95,500	2	100	E	0	na	Y	Y	Y
HCH	Non-Contaminated Service Area	II	G	N	35,000	1	100	E	na	100	Y	N	Y
HDI	Contaminated Service Area	II	G	N	21,000	1	100	E	2	100	Y	Y	Y
HCA	Component Cooling & Make-Up Pump Area	I	1	Y	57,500	2	100	E	2	100	Y	Y	Y
MER	Equipment Rooms HVAC	I	1	Y	60,000	2	100	E	na	na	Y	N	Y
MER	Mechanical Equipment Room HVAC	II	G	N	18,200	1	100	E	na	na	Y	N	Y
TURBINE GENERATOR BLDG. SYSTEMS													
HTA	Turbine Generator Area	II	G	N	182,000	2	50	E	na	na	Y	N	N
HTA	Water Treatment Area	II	G	N	33,000	1	100	E	na	na	Y	N	N
HIA	Main Steam & Feedwater Isolation Bldg.	I	1	Y	22,000	2	100	E	na	na	Y	N	N
CONTAINMENT BUILDING SYSTEMS													
CFC	Containment Recirculation	I	G	Y	400,000	4	50	C	na	na	na	na	N
CPP	Containment Purge	I	G	N	27,000	1	100	na	2	100	na	Y	N
PUMP HOUSE													
HSP	Spray Pond Pump House HVAC	I	1	Y	4,000	2	100	E	na	na	Y	N	N

Table 6.7-3 WNP-1 Liquid Radioactive Waste Processing Capability

Reactor Coolant Evaporator (BRS)

Forced Circulation Evaporators	
Number	2 Fully Redundant
Type	Forced Circulation
Flow Rate Each, gpm	20
Design Pressure, psig	150
Design Temperature, F	200
Material of Construction	SS
Steam Demand (lb/hr each)	12,920

Liquid Radioactive Waste System (RSW)

Forced Circulation Evaporators	
Number	2 Fully Redundant
Type	Forced Circulation
Flow Rate Each, gpm	10
Design Pressure, psig	50 (Vapor Body)
Design Temperature, F	250 (Vapor Body)
Material of Construction	Incoloy 825 (Vapor Body)
Steam Demand (lb/hr each)	6,000

Evaporator Bottoms Transfer To Collection Tank A	
Number	1
Type	Vertical
Volume, gal	2,400
Design Pressure	Atmospheric
Design Temperature, F	200
Material Of Construction	SA 304 SS
Special Characteristics	Heat Traced, Sparged

Auxiliary Boiler System (ABS)

Table 6.7-4

CONSTRUCTION STATUS BY DISCIPLINE

DISCIPLINE	PERCENT INSTALLED
OVERALL PROJECT CONSTRUCTION STATUS	65
Civil/Structural	94
Mechanical	60
Electrical	48
HVAC	67

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Table 6.7-5

CONSTRUCTION STATUS BY COMMODITY

COMMODITY	PERCENT INSTALLED
Concrete	99
Structural Steel	90
Large Bore Pipe	88
Large Bore Hangers	65
Small Bore Pipe	32
Electrical Cable Tray	90
Electrical Conduit	43
Electrical Cable	17
HVAC Ductwork	75
Large Bore Fire Protection Piping	22

Table 6.7-6

DESIGN BASIS DOCUMENTATION OVERVIEW

DOCUMENT TYPE	ACTUAL REQUIRED	ACTUAL REMAINING
SPECIFICATIONS	197	7
SYSTEM DESCRIPTIONS	125	9
DRAWINGS		
Structural/Civil	963	14
Structural/Rebar Detail	896	0
Mechanical	290	0
Electrical	3,778	212
Instrumentation & Control	1,336	1,060
Nuclear	699	7
Mechanical Services	178	3
Fire Protection	426	266
Wiring Packages	15,300	1,788
Pipe Isometrics	1,204	47
Large Bore Fabrication & Installation	1,130	615
Small Bore Fabrication & Installation		
Nuclear Hanger Details	7,667	609
Non-Nuclear Hanger Details	14,770	3,265

Table 6.7-7 Summary of Unirradiated Uranium Waste Streams-Source

STREAM NUMBER	WASTE FORM	WEIGHT (MTU)	WEIGHT (lb)	STORAGE CONTAINER	SIZE	QUANTITY	LOCATION	SPACE REQUIREMENTS (SPECIFIED)
UU-1	Fuel Assembly	821.497	1,807,293	Wooden Boxes	6 ft X 3 ft X 5 ft	893 155 96	Bldg. 3712 Bldg. 303-A Bldg. 303-E	11,000
UU-2	Fuel Assembly	136.686	300,709	Wooden Boxes G-4214 Boxes	6 ft X 3 ft X 5 ft 6 ft X 2.5 ft X 5 ft	205 134	Bldg. 3716	3,500
UU-3	Trioxide Powder	132.910	292,400	55 Gal Drums	3 ft High X 2 ft ø	172	Bldg. 2714-U	600
UU-4	Uranium Dioxide	3.400	7,480	Cans, Pins, Drums	Varies	-	Bldg. 303-K South	525
UU-5	Thorium Oxide	0.470	1,034	Buckets	2½ Gal.	-	Bldg. 303-K South	Included with UU-4 Above
UU-6	Depleted Uranium	21.160	46,552	Wooden Boxes	5 ft X 5 ft X 1 ft	11	Bldg. 4713	100
UU-7	Trioxide Powder Hoppers	677.000	1,489,400	Hoppers	6 ft High X 5 ft ø (4" ø Base)	146	UO_3 Plant 200 West Outdoors	6,000
UU-8	Uranium Billets	695.101 133.407 111.044	1,529,222 293,495 244,297	Boxes	3 ft X 3 ft X 2.5 ft	921 178 159	Bldg. 3712 Bldg. 303-B Bldg. 303-G	6,000

Table 6.7-8 Summary of Unirradiated Uranium Waste Streams-Destination

STREAM NUMBER	WASTE FORM	SPACE REQUIREMENTS (SPECIFIED)	CONTACT AREA PER STACK(ft^2)	WEIGHT /STACK (lb)	STACK LOADING (lb/ft^2)	AREA REQUIRED (ft^2)	LOCATION
UU-1	Fuel Assembly	11,000	18	3,100 4,650	172 258	11,000	GSB
UU-2	Fuel Assembly	3,500	18 15	1,800 868	100 58	3,500	GSB
UU-3	Trioxide Powder	600	16(stack) 16(no stack)	13,600 1,700	850 425	600 1200/2400	GSB
UU-4	Uranium Dioxide	525	260	-	29	525	GSB
UU-5	Thorium Oxide	Included with UU-4 Above					GSB
UU-6	Depleted Uranium	100	8	4,232	529	200	GSB
UU-7	Trioxide Powder Hoppers	6,000	12.57	10,200	812	19,500	TGB
UU-8	Uranium Billets	6,000	9	7,030.66	781	18,750	GSB

Table 6.7-9 Spent Fuel Pool Cooling Equipment Design Data

Spent Fuel Pool Cooling Pumps:

Quantity	2
Type	Horizontal Centrifugal
Material	Type 304 SS
Design Flow	1,450 gpm
Pump Capability	1,900 gpm
Design Head	119 Ft
NPSH Required	18 Ft
NPSH Actual	21 Ft
Shutoff Head	140 Ft
Design Pressure	150 psi
Design Temperature	225 F

Spent Fuel Pool Heat Exchangers:

Quantity	2
Type	Horizontal Centrifugal
Overall Heat Transfer Coefficient	240 BTU/hr Ft^2 F
Heat Transfer Area	3,700 Ft^2
Total Heat Duty, BTU/hr (X 10^6)	17.3
Design Pressure	200 psig
Design Temperature	225 F
Material, Shell Side	SA-516 Grade 70
Material, Tube Side	SA-213 Type 304

Table 6.7-10 HSF System Parameters

Outside Air Conditions:

DB Temperature F:	110 Summer	-10 Winter
Relative Humidity %:	12 Summer	NA Winter

Inside Air Conditions:

DB Temperature F:	80 Max Summer	80 Max. Winter 55 Min. Winter

Fully Redundant Air Handling Units - 2 Trains:

System Requirements for each Air Handling Unit: 40,000 cfm
System Requirements for each Return Air Fan: 40,000 cfm
System Requirements for each Atmospheric Cleanup Train: 40,000 cfm
Rated Capacity of each Chiller: 225 Tons

Table 6.7-11 (sheet 1 of 2)

Alternative 4 TABLE 6.7-8				INVENTORY INFORMATION Table 6					WNP-1 3/23/95
Waste Category	Waste Type	Waste Stream No.	Container Type	Container Dimension (max)	Container Weight (max)	Radiation Field (max)	Tabulation Volume (m^3)	Total Waste Volume (WHC's list 3/10/95)	Remarks / Function / Method
High Level Waste	Vitrified Waste	1	Canister	27" OD x 15'	8 000 lb	Per Canister 359 000 Ci Cs - BA 13 400 Ci Sr - Y	11500 not tab-ulated	8 600 m^3 glass 11 500 m^3 (canisters) 6000 Canisters	Store canisters in spray pond No processing Remote handle Cask wt 100 ton loaded New HR Spur req'd
			Shipping Cask	no data	100 ton				Cask unload area req'd
TRU Waste	Forecast RH (High Rad)	2	Ion Exchange Column	75 ft3 (nom 4' OD x 6')	5 000 lb each	4 200 ci/m3 of 137 Cs	2210 not tab-ulated	2 210 m^3 (waste) (1 000 trips w/ Casks) (1000 columns) (Total Cask Vol incl waste is 18414m^3)	Open cask, remove column, and place in OP Store full columns on racks No processing Remote handle Decon & Re-use casks
			Shipping Cask	9 5' OD x 9 1' 1 1/2" Shielding	40 tons				Store OPs in GSB (handle remotely)
	Existing RH (High Rad)	3	Waste Overpack	26" OD x 10 1'	8 000 lb	7,000 Ci/m^3 Mixed Fission Fission Products	25 not tab-ulated	23 m^3 (35 trips w/ Casks)	Retrieve when facility comes available No interim (yard) storage No processing Store (as processed fuel) only after inspection of 'Alpha caissons', in existing overpacks These have been sent to 200 Area to be eventually retrieved and sent to WIPP
			Cask	6 3' OD x 15 7'	25 tons				Store in GSB (hi-rad) & TGB
	Forecast RH (Moderate Rad)	4	Overpack	66" OD x 70' long (61" OD x 60' waste inside) (Max) Various sizes	30,000 lb	5 000 mrem/hr contact (typ)	3 700	3,700 m^3 of waste 22 300 m^3 overpack 200 shipments	Much void space in overpacks This is retrieved oversize equipment from the tank farms (pump risers, instrument trees, etc) Size reduce, repackage Decon & re-use OP 1/6 of overpack volume is actually waste
	Existing RH (Moderate Rad)	5	Box	4' x 4' x 4'	4 000 lb	1,300 mrem/hr (contact)	150	150 m^3 of waste (now)	Waste is now in burial grounds Size reduce, repackage
	Forecast CH Large Container	6	Box	Metal, concrete, or fiberglass & misc containers			22,000	218 42 m^3	Open container, sort decon, size reduce, repackage, store in GSB
	Existing CH Large Container	7	Box	Remainder, use 4' x 4' x 8' (10) @ 8' x 17' x 16' Plywood box containing glove box	60,000 lb	200 mrem/hr	7 300	7299 m^3	Count: 2,000 containers Open container, sort, decon, size reduce, repackage, store in GSB
	Forecast CH Special Waste	8	Drum	2' OD x 3'	1000#/drum max	200 mrem/hr Known 5 mR avg	1,900	1892 m^3	40,000 containers total, 38,000 drums Now in burial ground May have criticality concerns Soils, particulates, reactive chemicals 1240 classified drums (12) high PU drums (653) drums contain soil Also, nitrate shipping containers (R - Reactive) Now in extended interim storage
	Existing CH	9	Drum	2' OD x 3'	1,000 lb	200 mrem/hr	500	492 m^3	Open, sort, remove free liquids, stabilize reactive chemicals, shred, compact and repackage in drums Shred and compact used drums Store full drums on pallets in GSB
Page 1/2	SpecialWaste								

Table 6.7-11 (sheet 2 of 2)

Alternative 4
TABLE 6.7-8

INVENTORY INFORMATION
Draft 6

WNP-1
3/23/95

Waste Category	Waste Type	Waste Stream No	Container Type	Container Dimension (max)	Container Weight (max)	Radiation Field (max)	Tabulation Volume (m^3)	Total Waste Volume (WHC's List 3/10/95)	Remarks / Function / Method
Low Level Mixed Waste	Forecast RH (High Rad)	10	Cask	4' x 4' x 4'		A small qty of items will be high Rad	3 700	3658 m^3 (2016 casks)	Open, cutup, size reduce, repackage waste Store in GSB (hi-rad) & TGB (low)
	Existing RH (High Rad)	11					2 856	8 659 m^3 per AL T 1 Function Diagram	Waste volume is 1/3 OP volume Open, cutup, size reduce, repackage waste
	Forecast RH (Moderate Rad)	12	Overpack (part of this is long length equip) Overpack container provides some shielding dbl annulus filled w/ lead shot)	66" OD x 70' long (61" ID x 60' waste inside) Cut up to meet debris rule or encapsulate Requires storage "undercover	30 000 lb	5 000 r/hr Max	15,500	15 440 m^3 of waste 92 643 m^3 overpack	There are 2000 large containers 90% are LLMW 10% are TRU (listed above) Open, cutup, size reduce, repackage waste Decon & re-use overpack (shipping tube) Store LLMW in drums in Turbine Bldg on stacker/retriever rack system
	Existing RH (Moderate Rad)	13	LL Overpack (assumed)				8 227	(per AL T 1 Function diagram)	Less than forecast, no data Some LLMW drums will be generated and can be stored in Turbine Bldg
Misc Debris	Forecast CH Large Container	14	Overpack	66" OD x 70' long (61" OD x 60' waste inside)	30 000 lb	100 mrem/hr	1 000	838	Open, cutup, size reduce, repackage waste Decon & re-use overpack (shipping tube) Store LLMW in drums in Turbine Bldg
	Existing CH Large Container	15	Boxes	10' x 12' x 23' quantity (6 8)	34,500 kg 76 000 lb		6,000	5824 m^3	Open, cutup, size reduce, repackage waste Shred & compact used containers Store LLMW in drums in Turbine Bldg
GTC3 LLW (Greater Than Category 3 LLW)	Forecast RH LLW	16	Similar to RH Cask	16 lg X 6' dia TRU PAC			41 035 (per WHC comment)	(42 589 on AL T 1 Function Diagram)	Repackage and store Class C waste Assume SWB's and Drums See 'generator questionnaires' Store in GSB (hi-rad) & TGB (low)
	Forecast RH LLMW	17					1,550		Open, cutup, size reduce, repackage waste Shred & compact used containers Some LLMW drums will be generated Store in GSB (hi-rad) & TGB (low)
	Forecast CH LLW	18					42 300		Store special waste in TGB, ship out LLW
	Forecast CH LLMW	19					4 375		Open, cutup, size reduce, repackage waste Shred & compact used containers Store LLMW drums in GSB, TGB and W'lises
Misc	Sodium	20	Tanks and Drums	(3) 80,000 gal + (1) 52,000 gal tanks at LFTF (5) 15,000 gal tanks and 15d drums in 200 West		120 Ci 22Na		1,160 m^3	Requires new building to accomodate Volume not included in tabulation
	Uranium	21	Wooden boxes or T-hoppers	2741 boxes of metal & fuel Nom 1' X 1' X 1' 146 T-hoppers (6' OD x 5')				145	No processing Volume not tabulated Store in GSB and TGB
	Sources	22	Cask					60	Storage Only No processing Volume not tabulated
Cesium / Strontium Capsules	Cs Capsules	23	Capsule	2 6" OD x 20 8"	22 lb	300 000 R/hr emissions (45,000 Ci/capsule) gamma		1577 capsules	Water cooling pool storage req'd No Processing Volume not tabulated
			Cask	54" OD x 49"	32 900 lb				GSB Spent Fuel Pool
	Sr Capsules	24	Capsule	2 6" OD x 20 8"	22 lb	55 000 Ci/capsule		601 capsules	Water cooling pool storage req'd Volume not tabulated
Page 2/2			Cask	54" OD x 49"	32 900 lb				GSB Spent Fuel Pool No processing

Notes
RH – Remote Handled
Spent Fuels not included
Waste Stream No does not correspond to Other documents
CH – Contact Handled
Contaminated soils not included

Tabulation Total
162 093 m^3
5 724 272 ft^3 (raw waste)
204438 drums of repackaged waste @ 4 1 vol reduction

Table 6.7-12 (sheet 1 of 2)

Alternative 4 — **STORAGE AND PROCESS INFORMATION** — **WNP-1**

TABLE 6.7-9 — DRAFT 6 — 3/23/95

Waste Category	Waste Type	Waste Stream No (As Rcvd)	Tab'ln Volume (m^3)	Process (Y/N)	Volume Reduct (%)	Treated Volume (ft^3)	Number of Drums *	Storage Pkg Type	Pkg Qty	Loc'n of Storage	Insp Aisles Req	Sort	Comp pact	Stree	Stabil ize	Remarks
High Level Waste	Vitrified Waste	1	11,500	N	0	–	–	HLW Canister	6,800 Canister	Spray Pond	N					Canister – 27" OD x 15' Lg
TRU Waste	Forecast RH (High Rad)	2 IX col	2,210	N	0	–	–	OPed Column	1,000 OP Col	GSB	Y					OP Columns = 5' OD x 7' Lg Sp. – 6'x6' w/ 6' Insp. aisles
	Existing RH (High Rad)	3 OP	25	N	0	–	–	Existing OP	35 Pallets	GSB	N					Decon OP prior to storage OP (max) = 26" x 10'
	Forecast RH (Mod. Rad)	4 LEC	3,700	Y	75 (4:1)	32,666	4,667	Pallet (Drums)	1,167 Pallets	GSB & TGB	N	X	X	X	X	repackage waste into drums
	Existing RH (Mod. Rad)	5 Box	150	Y	75 (4:1)	1,324	189	Pallet (Drums)	47 Pallets	GSB & TGB	N	X	X	X	X	repackage waste into drums
	Forecast CH Large Contr	6 Lg Box	22,000	Y	75 (4:1)	194,231	27,747	Pallet (Drums)	6,937 Pallets	GSB & TGB	N	X	X	X	X	repackage waste into drums
	Existing CH Large Contr	7 Box	7,300	Y	75 (4:1)	64,449	9,207	Pallet (Drums)	2,302 Pallets	GSB & TGB	N	X	X	X	X	repackage waste into drums
	Forecast CH Special Waste	8 Drum	1,900	Y	75 (4:1)	16,774	2,396	Pallet (Drums)	599 Pallets	GSB & TGB	Y (10%)	X	X	X	X	repackage waste into drums
	Existing CH SpecialWaste	9 Drum	500	Y	75 (4:1)	4,414	631	Pallet (Drums)	158 Pallets	GSB & TGB	Y (10%)	X	X	X	X	repackage waste into drums

Pg 1/2

Table 6.7-12 (sheet 2 of 2)

Alternative 4 — STORAGE AND PROCESS INFORMATION — WNP-1

TABLE 6.7-9 — DRAFT 6 — 3/23/95

Waste Category	Waste Type	Waste Stream No (As Rcvd)	Tot'l'n Volume (m^3)	Process (Y/N)	Volume Reduct (%)	Treated Volume (ft^3)	Number of Drums *	Storage Pkg Type	Pkg Qty	Loc'n of Storage	Insp Aisles Req	Sort	Com pact	Stren	Stabil ize	Remarks
Low Level Mixed Waste	Forecast RH (High Rad)	10 4x4x4	3,700	Y	75 (4:1)	32,666	4,667	Pallet (Drums)	1,167 Pallets	GSB	N	X	X		X	repackage waste into drums
	Existing RH (High Rad)	11 LEC?	2,856	Y	75 (4:1)	25,218	3,603	Pallet (Drums)	901 Pallets	GSB	N	X	X		X	repackage waste into drums
	Forecast RH (Mod Rad)	12 LEC	15,400	Y	75 (4:1)	135,961	19,423	Pallet (Drums)	4,856 Pallets	GSB & TGB	N	X	X		X	Decon & reuse shipping Tube; repackage waste into drums
	Existing RH (Mod Rad)	13 LEC?	8,227	Y	75 (4:1)	72,633	10,376	Pallet (Drums)	2,594 Pallets	GSB & TGB	N	X	X		X	NO DATA; repackage waste into drums
Misc. Debris	Forecast CH Large Contin	14 LEC	1,000	Y	75 (4:1)	8,829	1,261	Pallet (Drums)	315 Pallets	GSB & TGB	N	X	X	X	X	Decon & reuse shipping Tube; repackage waste into drums
	Existing CH Large Contin	15 Box	6,000	Y	75 (4:1)	52,972	7,567	Pallet (Drums)	1,892 Pallets	GSB & TGB	N	X	X	X	X	repackage waste into drums
GTC3 LLW	Forecast RH LLW	16 TRU PAC	41,035	Y	75 (4:1)	362,284	51,755	Pallet (Drums)	12,939 Pallets	GSB & TGB	N	X	X		X	SWB = 4' x 4' x 4'; repackage waste into drums
	Forecast RH LLMW	17 ?	1,550	Y	75 (4:1)	13,684	1,955	Pallet (Drums)	489 Pallets	turb bldg & trench	N	X	X		X	repackage waste into drums
	Forecast CH LLW	18 ?	42,300	Y	75 (4:1)	373,453	53,350	Pallet (Drums)	13,338 Pallets	turb bldg & trench	N	X	X	X	X	repackage waste into drums
	Forecast CH LLMW	19 ?	4,375	Y	75 (4:1)	38,625	5,518	Pallet (Drums)	1,379 Pallets	turb bldg & trench	N	X	X	X	X	repackage waste into drums
Misc	Sodium	20	–	–	–	–	–	–	–	–	–	–	–	–	–	
	Uranium	21	145	N				as is		GSB	Y					
	Sources	22	60	N				cask		GSB	Y					
Cesium / Sr. Capsls	Cs Capsules	23		N				capsules		GSB Fuel Pool	Y					
	Sr Capsules	24		N				capsules		GSB Fuel Pool	Y					

Notes: * – 66 gallon drums = 7 cubic feet storage capacity

Pg 2/2 Waste stream numbers refer to Alternate 4 - Inventory Information Table

Table 6.7-13
Waste Processing Rates

WASTE PROCESSING RATES		
AREA / FUNCTION	RATE	REMARKS
OPERATIONAL BASIS	220 days (5,280 hours) per year 100 DE per day average 200 DE per day peak	24 hours per day (peak)
RECEIVING AREA	100 DE per day	
PROCESS EQUIPMENT	200 DE per day	
REMOTE HANDLING	150 DE per day	
CONTACT HANDLING	100 DE per day	
REMOTE SORTING AND SEGREGATION	200 DE per day	includes container opening
CONTACT SORTING AND SEGREGATION	200 DE per day	includes container opening
WASTE SHREDDING	200 DE per day	Contact only
REMOTE DECONTAMINATION	1,400 ft^3/day(39.7 m^3/day)	200 DE per day
CONTACT DECONTAMINATION	1,400 ft^3/day (39.7 m^3/day)	200 DE per day
COMPACTION	8 DE per hour	75% (4:1) size reduction (average)
SPECIAL MATERIAL PROCESSING	2 DE per hour	
STABILIZATION		HLW, TRU, sodium, acid, reactive chemicals, debris, and Hg are not grouted
DRUM/OVERPACK WASH	2 drums or overpack drums per hour	

Table 6.7-14
Treated Waste Storage Volume Availability Within WNP-1

WASTE TYPE	STREAM No.	RAW WASTE VOLUME	STORAGE VOLUME AVAILABLE for PROCESSED WASTE*	LOCATION
HLW Canister	1	6800 Canisters	ALL	Spray Pond
IX Column	2	1000 Overpacks	ALL	GSB
RH TRU	3	35 Overpacks	ALL	GSB
RH TRU	4	3,700 m^3	ALL	GSB/TGB
RH TRU Existing	5	150 m^3	ALL	GSB/TGB
CH TRU	6	22,000 m^3	ALL	GSB/TGB
CH TRU	7	7,300 m^3	ALL	GSB/TGB
CH Special TRU	8	1,900 m^3	ALL	GSB
CH Special TRU	9	500 m^3	ALL	GSB
RH LLMW	10	3,700 m^3	ALL	GSB/TGB
RH LLMW Existing	11	2,856 m^3	ALL	GSB/TGB
RH LLMW Med.Rad.	12	15,500 m^3	ALL	GSB/TGB
RH LLMW Med.Rad. Existing	13	8,227 m^3	ALL	GSB/TGB
CH Debris	14	838 m^3	ALL	TGB
Large CH Debris	15	5824 m^3	ALL	TGB
GTC3 LLW RH	16	41,035 m^3	PARTIAL	TGB
GTC3 LLMW RH	17	1,550 m^3	ALL	GSB/TGB
GTC3 LLW	18	42,300 m^3	PARTIAL	TGB
GTC3 LLMW	19	4,375 m^3	ALL	TGB
Uranium	21	145 m^3	ALL	GSB
Sources	22	60 m^3	ALL	GSB
Cs Capsules	23	1,577 capsules	ALL	GSB
Sr Capsules	24	601 capsules	ALL	GSB
GTC3 LLW	16, 18	(see above)	REMAINDER	WAREHOUSE (Existing and New)

* Storage volume available at WNP-1. Assumes 57% of waste stream is transferred to landfill following treatment (per PNL Storage graphs dated 3/9/95).

Table 6.7-15

WNP-1 PROCESSING AREAS					
AREA / FUNCTION	APPROXIMATE AREA REQUIRED (ft^2)		AREA AVAILABLE (ft^2)	PLANT AREA DESIGNATOR	REMARKS
RECEIVING AREA		220 ft X 1000 ft	220,000	Yard	100 DE/day for 1 year
WASTE STAGING		180 ft X 100 ft	18,000	Yard	100 DE/day for 1 month
SHIPPING AND RECEIVING		200 ft X 60 ft	10,425	GSB EL 455	10 Dock Spaces, Contact and RH
CONTACT HANDLING	Open container:	60 ft X 40 ft	2,400	GSB EL 455	
	Dump, sort and segregate:	60 ft X 45 ft	2,700	GSB EL 455	
	Shredding	400 (20 ft X 20 ft) (2 required)	800	GSB EL 421	
	Treat/repackage:	200 ft X 120 ft	24,000	GSB EL 421	
REMOTE HANDLING	Open container:	80 ft X 40 ft	3,200	GSB EL 455	
	Dump, sort and segregate:	60 ft X 60 ft	3,600	GSB EL 455	
	Treat/repackage:	200 ft X 160 ft	32,000	GSB EL 421	
	Overpack:	50 ft X 50 ft	2,500	GSB EL 421	overpack IX columns

Table 6.7-16

WNP-1 STORAGE AREAS				
AREA / FUNCTION	AREA REQUIRED (ft^2)	AREA AVAILABLE (ft^2)	PLANT AREA DESIGNATOR	REMARKS
TREATED WASTE STORAGE (TGB)	EL 452: 54,700 EL 476: 24,700 EL 476: 15,300 EL 508: 33,000	65,000 24,700 21,000 44,000	TGB EL 452 TGB EL 476 TGB EL 476 Turbine Deck	Pallet rack storage Pallet rack storage ASRS Pallet rack storage ASRS Pallet rack storage
TREATED WASTE STORAGE (GSB)	EL 455 ft: 0	47,852	GSB EL 455	Grade level: no waste storage
	EL 479 ft: 7,000	22,000	GSB EL 479	Upstairs, with personnel area and control room
	EL 395 ft: 50,000	50,000	GSB EL 395	Below Grade: entire level designated as storage
	EL 421 ft: 20,000	20,200	GSB EL 421	Below Grade, with RH and CH Treat and repackage
HLW CANISTERS	Spray Pond 75,000	75,000	Spray Pond	HLW Canister Storage (in Racks)
CONSUMABLE STORAGE	GSB Storage EL 455: 8,000 (72 ft X 109 ft)	7,800	GSB Tank Vault	Grade Level

Table 6.7-17 Alternative 4 Cost Summary

Waste Stream Description	Construction/Modification Cost in Million $ (Escalated with Contingency
HLW Canister Storage	271.3
TRU Process & Storage	42.0
LLMW/GTC III Process & Storage	113.0
Uranium Storage	2.0
Cs/Sr Capsule Storage	3.6
Common Usage Area Construction/Modification	1.8
Sub-Total, Capital Cost	433.7

Cost Line Item Description	Other Cost in Million $ (Escalated with Contingency
Construction/Modification	433.7
Engineering Title I	21.9
Engineering Title II	54.7
Engineering Inspection Title III	36.1
Construction Management	40.1
Project Management & Integration	54.4
Other Project Costs	66.8
Grand Total Cost	707.7

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6.8.1 Process Logic

The process flowsheet for the planning baseline is shown in Figure 6.8.1-1. The flowsheet is constructed similarly to Alternatives 1 through 4 flowsheets: processing activities are in the center, and disposal or offsite removal activities are at right in the figure. The waste streams and materials are identical to those used for Alternatives 1 through 4.

A summary of the facilities assumed as the baseline is provided below. A detailed discussion of these facilities is provided in Section 6.8.2.

The storage facilities are as follows:

- Central Waste Complex (CWC) (Phase-I through IV);
- 2727-W Building;
- Waste Encapsulation and Storage Facility (WESF)
- UO_2 Plant;
- 200 Area Hallam and Sodium Reaction Experiment (SRE) Sodium Storage;
- CWC Phase V, W-112 (planned);
- Nonhazardous Special-Case Waste Storage, W-272 (planned);
- Hazardous Special-Case Waste Storage, W-349 (planned); and
- HLW Modular Storage Facility (planned).

The processing facilities are as follows:

- Waste Receiving and Processing (WRAP) 2B (planned)
- Cs/Sr Overpack Facility (planned)
- WRAP-1
- WRAP-2A or Privatized Mixed Waste Treatment
- Commercial Thermal Treatment Facility (CTTF)

The disposal facilities are as follows:

- Mixed Waste Disposal Trench
- Waste Isolation Pilot Plant (planned)
- High-Level Waste Geologic Respiratory (planned)
- GTC-3 LLW Intermediate Depth Disposal Facility (not yet planned)

Planning assumptions for Alternative 5 are outlined in Table 6.8-1 Small-Container CH Wastes and the facilities that provide assay/certification and other processing functions for this waste, including WRAP-1, WRAP-2A and CTTF, are not within the scope of the M-33 Milestone. The operation schedule for the storage facilities will be for the entire time period under consideration for this study (35 years). The processing start-up dates range from the year 2006 (WRAP Module 2B) to the year 2008 (contaminated sodium processing), with all processing operations completed by the year 2023. The table also indicated the waste streams and materials managed by each facility.

6.8.1.1 High-Level Radioactive Waste Canisters. Waste from Double Shell Tanks (DST) and Single Shell Tanks (SST) will be retrieved to the extent necessary for closure. The waste will be separated into high-level and low-level fractions so that most of the radionuclides are in the HLW fractions. The HLW stream volume will be reduced for cost effectiveness of further waste management activities and of acceptability to the HLW Geologic Repository

program. The waste will be vitrified and placed in canisters. The vitrified waste and canisters will meet the waste acceptance criteria of the HLW Geologic Repository.

Subsequent to vitrification and emplacement in canisters, the HLW will be stored onsite, until offsite shipment to the repository occurs. The Planning Baseline assumes construction of a modular Storage Facility at a location in the 200 Areas, with cask shipping/receiving capabilities.

6.8.1.2 Transuranic Waste. Transuranic waste flow is divided initially into two categories: existing and forecast waste. The baseline assumption is that any waste now existing can be shipped directly from its current storage location to processing in WRAP-2B. The current storage is primarily in Low-Level Burial Ground trenches, the 200 Area Tank Farms, or in 300 Area laboratories. Forecast waste to be generated in the future is assumed to be shipped from the point of generation to new storage in the Central Waste Complex provided by Project W-112 for Small-Container CH waste and future projects (not currently planned) for RH and Large-Container CH waste.

Transuranic waste includes RH waste containers; CH or RH containers larger that 200 liter drums; large, failed equipment; and, Special-Case CH waste. Waste for the Planning Baseline includes all streams identified as WRAP-2B feed in WHC-SD-W255-TI-001, Rev. 1. Reactor irradiated nuclear materials and high-Pu_{238} content waste from the 300 Areas is addressed as "Miscellaneous Sources" in Section 6.8.1.5.

Processing for all TRU waste within the scope of this Alternative was planned to be handled by the WRAP-2B project. Processing steps will be: receiving, size-reduction, sorting, packaging, certification, and shipping. Treatment to meet subsequent facility acceptance criteria (such as WIPP) will also be necessary for some waste. A small quantity of highly radioactive material (Miscellaneous Sources) requires a highly shielded, small hot-cell for processing. The nominal radiation level expected for these Miscellaneous Sources is 2000 R/hr. A large hot-cell with moderate shielding for fields up to 100 R/hr will be provided for all other RH and Large-Container CH TRU and LLMW boxes and failed equipment.

Smaller glovebox processing lines will be provided for Special-Case CH waste. These waste forms will be received from storage in small drums and boxes. The TRU and LLW steams will be segregated to avoid cross-contamination.

After processing, packaging, and certification, CH TRU will be shipped to the CWC for storage prior to offsite disposal at WIPP. The RH TRU waste will be sent to Special-Case Waste Storage prior to WIPP disposal.

Buried Pre-1970 TRU waste, contaminated soils, FFTF sodium and Spent Nuclear Fuel (SNF) are outside the scope of the M-33 Milestone.

6.8.1.3 Low-Level Radioactive Mixed Waste. Existing RH LLMW will be shipped to the CWC, with appropriate shielding to achieve contact-handled radiation fields, prior to availability to Hazardous Special-Case Waste Storage, Project

W-349. Subsequently, such waste and all forecast RH LLMW will be sent to Project W-349.

Processing of RH (including large containers) LLMW with moderate radiation fields (nominally up to 100 R/hr) will take place in the WRAP-2B facility. Retrieved boxes of waste and large failed equipment will use a relatively large hot cell concept where packaged waste can be received, unloaded, sorted and size reduced, treated to meet Land Deposit Restriction(s) (LDR) as necessary. The LDR treated waste will be transferred to smaller cells for processing. Processing of TRU and LLMW will be segregated to avoid cross-contamination. The CH large containers of LLMW will be received and stored at the CWC.

Processing of CH LLMW will consist solely of large containers that can not be shipped to commercial facilities because of container size constraints. Large containers of CH LLMW will use the same relatively large, moderately shielded hot cell concept used for RH wastes up to 100 R/hr. The waste will be received, unloaded, sorted and size-reduced, sent to smaller cells for further processing, packaged and shipped to storage in the CWC. Waste requiring treatment for LDR restrictions will be then sent to WRAP-2A.

Disposal of RH LLMW will be directly from WRAP-2B to the Mixed Waste Disposal Trenches. Disposal of CH LLMW will be directly to the Mixed Waste Disposal Trenches or from WRAP-2A after treatment for LDR restrictions. The LLMW streams resulting from TRU processing within WRAP-2B will be managed similarly to newly generated or existing LLMW.

6.8.1.4 Greater-Than-Category 3 Waste. Remote-handled GTC3 waste will be shipped to the appropriate Special-Case Waste Storage Facility, W-272 or W-349, depending on the presence or absence of hazardous components. Contact-handled GTC3 will be stored in the CWC Phase V, W-112.

Further disposition of this waste will depend on decisions made at the national level. Disposal of such waste requires a specific performance assessment. Storage in Special-Case Waste Storage or the CWC will continue until a path for disposal is chosen.

6.8.1.5 Miscellaneous Materials. Miscellaneous materials consist of items that have not been declared waste and may be reused onsite or offsite.

The present path being pursued for Hallam and SRE sodium processing involves commercial processing and subsequent commercial use of the product material. A Request for Proposal (RFP) has been issued and bids are being evaluated. This processing option would require allocation of funds to pay a commercial vendor for the difference between the processing cost and the value of the product material to be generated. The second option evaluates potential on site uses and the final option for processing the Hallam and SRE Na is to add these materials to the feedstream for the 400 Area Sodium Reaction Facility.

Unirradiated Uranium (UU) consists of depleted uranium, normal uranium, and low enrichment uranium. The material is stored onsite in the UO_3 Plant, in the 300 Area, (303 Building Complex, 3712, and 3716) and in the 400 Area in the 4713 Building. The baseline for this material will be continued storage while pursuing offsite reuse.

Miscellaneous sources consist of primarily high radioactive material waste in various buildings and facilities onsite. Principally laboratories such as the 324 and 325 Buildings. Material will be stored in current locations until it can be shipped to the CWC or the Canister Storage Building (planned). Requirements for processing and final disposal for these materials have not been established.

6.8.1.6 Cesium and Strontium Capsules. The capsules will continue to be stored in the WESF. The baseline assumes that overpacking in a new facility will meet repository acceptance criteria. The overpacked capsules will be shipped to the HLW Geologic Repository.

6.8.2 Facility Descriptions

The descriptions of the process facilities within the existing baseline are organized by waste stream/material in the same order as presented in Table 6.8-1 and in the following:

1. HLW;
2. TRU Waste;
3. LLMW;
4. GTC-3 Waste;
5. Hallam and Sodium Reactor Experiment (SRE) Material;
6. Unirradiated Uranium;
7. Miscellaneous Sources;
8. Strontium and Cesium Capsules;
9. Other Waste Streams/Materials to be addressed under other TPA Milestones:
   a. FFTF Sodium;
   b. Spent Nuclear Fuel.

The process facility descriptions are followed by a discussion of storage requirements and the planned activities under the *Solid Waste Program Technical Baseline*. Recommendations for modifying the existing baseline plans to provide for future storage are also included.

6.8.2.1 High-Level Radioactive Waste Canister Storage. The HLW is the product of the vitrification processes for the high-level and low-level components of the waste stored in the DST. The HLW component is to be stabilized by a HLW Vitrification Process beginning in the year 2010. This process will generate approximately 450 m^3 of high-level stabilized waste in canisters each year from 2010 through 2028. The low-level component of the Tank Farm waste processing operations will be stabilized by a Low-Level Waste Vitrification Process, generating an unspecified volume of low-level waste in canisters. The low-level fraction is out of the scope of the M-33 study and is not addressed in this volume.

The existing baseline documents describe a vitrification plant for processing high-level waste. The TWRS Baseline flowsheet projects approximately 6,800 canisters of glass will be produced.

6.8.2.1.1 **Modular Vault Dry Storage Facility Description.** The MVDS would use natural air convection to cool stored high-level waste canisters, thereby minimizing the amount of equipment requiring maintenance. The modular design would allow for expansion of the storage area to accommodate more HLW canisters beyond those which were projected at the time. Construction of the facility could be phased according to the storage required. Phased construction of additional modules would allow lower annual construction budgets and accommodate the adjustment of future budgets to reflect the need for storage.

The storage building proposed for the MVDS would consist of a number of storage modules, with a transport cask reception/dispatch facility located at the center. Figure 6.8.2-1 is an elementary plan view of the MVDS Complex. Each storage module consists of two storage racks arranged back-to-back against a central air duct outlet. The canisters would be housed in the storage vaults within individual storage tubes. Each storage tube would house two vertically stacked canisters.

Each storage module would have an operating level and a storage level. Access to the storage level would be through shielded plugs in the operating level's floor (charge face). A canister-handling machine would provide remote handling of canisters, retrieval of canisters for inspection, and if necessary, retrieval of failed canisters for overpacking. A shielded shipping cask permanently mounted on a rail flatcar would be used to transport canisters two-at-a-time (or one overpacked canister-at-a-time) from the processing facility to the MVDS. After the cask railcar has arrived at the MVDS, the canister-handling machine would lift a shielded plug from the charge face, deposit a canister into the storage tube, and replace the shielded plug. Eventual shipment of canisters to an offsite disposal facility will require the addition of a canister load-out facility not provided in the current storage facility design.

The facility would be capable of monitoring the cooling air temperature. Canisters would be inspected by withdrawing them from their storage tubes, using the canister-handling machine. Sensing equipment in the storage arrays would detect failed canisters.

This facility would meet the requirements of a licensed nuclear waste storage facility. It was approved by U.S. Nuclear Regulatory Commission in March 1988 for this purpose.

6.8.2.1.2 **Facility-Specific Assumptions.**

1. The storage facility must meet Safety Class II Criteria. The building structure will meet seismic qualifications for Safety Class II, nuclear nonreactor facilities. The Heating, Ventilation and Air-Conditioning (HVAC) system and its electrical, control, and instrumentation systems will meet Safety Class II seismic qualifications for all components and emergency electrical power;

2. The facility will meet current DOE, Federal and Washington State

Department of Ecology criteria for nuclear waste storage facilities. Canister inspection requirements are anticipated to be modified to allow alternative leak detecting methods in lieu of direct on-line visual imaging or non-destructive examination;

3. The facility will have the capabilities to remotely handle, place, and retrieve individual canisters;

4. The facility will ensure that any canister centerline temperature does not exceed the glass transition temperature during storage and handling of canisters;

5. The facility will be capable of monitoring canister cooling air temperature and for potential contamination of the cooling air. (monitoring of the canister cooling air is anticipated to be adequate in lieu of individual canister monitoring);

6. The facility will be capable of inspecting canisters;

7. The facility will be capable of detecting and recovering failed canisters;

8. Facility capacity will be 6,802 canisters, based on a HLW volume of 8,569 m^3, developed in the TPA M-33 Milestone inventory volume, revised February 17, 1995;

9. Canisters will have the following physical properties:

   (a) Dimensions: 0.69 m dia. x 4.6 m tall;
   (b) Weight: 3,318 kg;
   (c) Heat generation: 77 Watts (not adjusted for decay);

10. Canister surface contamination and contact radiation level limits are as follows:

    (a) 220-dpm alpha/sq. cm
    (b) 2,200-dpm beta-gamma/sq. cm
    (c) Greater than 11,000 rads/hr (11,000 rads/hr was given in the *HWVP Solid Waste Handling Alternatives Evaluation* for a 0.6 m dia. x 3 m ht. canister); and

11. The Functional Design Criteria do not include a canister load-out facility.

6.8.2.1.3 Uncertainties.

1. Changes in environmental regulations that affect permitting requirements for new facilities may impact the siting, schedule, and cost of MVDS and other alternative storage options.

2. The MVDS was evaluated for storage of 2000 canisters, whereas the current waste volume projection is for 6,802 canisters. It is not clear to what extent the previous construction estimates for the MVDS would be valid, or how they should be modified to accommodate the new waste volume projections. Alternative 2 of the M-33 study evaluated a new

modular storage facility for the HLW canisters, the cost estimate from Alternative 2 is used in this report as the basis for the cost estimate for the "current baseline".

6.8.2.1.4 References.

Engineering Study, Hanford Waste Vitrification Plant Project, Interim Storage Facility for Hanford Waste Vitrification Plant Canisters. Kaiser Engineers Hanford, June 1990.

Hanford Waste Vitrification Plant, Solid Waste Handling Alternatives Evaluation, March 31, 1993, WHC-SD-HWV-ES-045, Rev. 0.

6.8.2.2 Transuranic Waste Processing. Transuranic (TRU) waste is divided into three major processing categories. The three categories are Remote-Handled; Large Container and Special Case Contact-Handled; and Small Container Contact-Handled. There were facilities designed for these processing operations: The WRAP-1, and WRAP-2 (the latter split into WRAP-2A and WRAP-2B). The WRAP-1 is currently funded and under construction. The WRAP-2A was intended only for Small Container Contact Handled LLMW processing. The WRAP-2B was intended for RH, Large Container CH, and Special Case CH TRU as well as RH and Large-Container CH LLMW. The WRAP-2B facility has been canceled. For completeness, descriptions for the WRAP-1 and WRAP-2B modules have been needed.

6.8.2.2.1 Facility Descriptions.

WRAP Facility Module 1. The WRAP-1 will process only Small Container CH TRU waste that can be handled without radiation shielding. The WRAP-1 was a 1992 Line Item (definitive design began in January 1992 and was completed in the year 1993). Construction began in the year 1994 and is to be completed in the year 1996. Operation is planned for the year 1997. The WRAP-1 is located in the 200 West Area; it is designed as a 4,808 m^2 structure with 4,116 m^2 of space on the first floor and 691 m^2 on the second floor. There are four primary areas within the building: Shipping and Receiving, Nondestructive Assay/Nondestructive examination (NDA/NDE), Process, and Administration. The second floor contains the Plant Control Room, Computer Room, and some of the HVAC equipment. There are three zones of HVAC confinement in the processing areas provided, with progressive negative pressures to assure air flow from potentially lower contamination locations to potentially higher contamination locations. Design life of the facility is 30 years. The WRAP-1 is designated a radioactive solid waste facility, and is classified as Hazard Class 3 facility in accordance with DOE-STD-1027-92, JDO.

WRAP Facility Module 2B. The WRAP-2B project has been canceled. For completeness a discussion of the facility is including herein, as if it were currently planned and budgeted. This section is strictly for reference only, any project costs and dates are described as they were planned prior to canceling this project. The functions for the previously planned WRAP-2B must be reassigned to existing facilities or alternative new facilities.

The primary activities that would have taken place at the WRAP-2B were waste sorting, processing, repackaging, and final certification. In addition, the facility would have been capable of size-reducing very large and/or heavy items. A large hot cell with moderate shielding was planned

because of the large amount and deteriorating condition of oversize CH and RH boxes.

The WRAP-2B was planned to consist of 10 buildings that would treat both Large-Container CH and RH TRU as well as LLMW. Waste would have been received in large boxes. Any RH waste received would have been packaged with appropriate shielding so that it would have been contact-handled on entering the facility.

The following waste would have been accepted at the facility:

1. Retrieved suspect CH TRU waste in drums that are unacceptable at WRAP-1, and in oversize boxes.
2. Newly generated CH TRU waste in drums that are unacceptable at the WRAP-1, and in oversize boxes;
3. Newly generated CH LLMW waste packaged in oversize boxes;
4. Retrieved RH TRU and LLMW waste from caissons and trenches; and
5. Newly generated RH TRU and RH LLMW waste.

The WRAP-2B facility would have been capable of assaying and repackaging Large Container CH TRU and LLMW, some limited quantities of RH TRU and LLMW, and drummed waste that would not be accepted at the WRAP-1. All waste would be subject to a final assay before exiting the facility. The CH TRU waste would have then been returned to the planned Enhanced Radioactive and Mixed-Waste Storage Facility, Phase V, for head gas testing (WIPP Waste Acceptance Criteria (WAC) compliance) prior to packaging in TRUPACT containers at the WRAP-1. The RH TRU waste would have been shipped directly to an appropriate disposal site such as the WIPP. The RH LLMW would have been shipped directly to the Mixed-Waste Disposal Trench. The CH LLMW (and any CH LLW) would have been returned to storage, prior to additional processing or disposal.

6.8.2.2.2 **Facility Specific Assumptions.** The WIPP will receive a resolution to the "no-migration" petition to allow disposal of TRU mixed waste.

6.8.2.2.3 **Uncertainties.**

1. The WIPP's capability to demonstrate adequate containment of radioactive and hazardous constituents of the buried waste is being questioned. In accordance with the Hanford Federal Facility Agreement and Consent Order Change Form M-19-91-1, WRAP-2B work is to be delayed until resolution of the aforementioned WIPP uncertainties. Because resolution of the WIPP uncertainties is likely to take a significant amount of time, the resultant WRAP-2B programmatic impacts would become unacceptable (i.e., TRU waste processing must occur in a timely manner to allow shipment to the WIPP during its operational period).

2. Current, land disposal restriction treatment criteria do not apply to Transuranic mixed TRUM waste; however this position may be reversed depending on the outcome of the "no-migration" petition at the WIPP. In this case, the baseline WRAP-2B must incorporate a sorting step to divert this waste category to storage until final disposition of this waste category has been determined.

3. Considerable uncertainties exist in the projected waste volumes and

characteristics for both waste generated at the Hanford Site, and waste generated at other sites that are shipped to the Hanford Site, that are planned to be received at the WRAP-2B.

6.8.2.2.4 References.

Waste Receiving and Processing (WRAP), Module 2B Strategy Assessment, T. J. Venetz, Laws, R. B., C. L. Anderson, WHC-SD-W255-TI-001, Rev. , February 24, 1993.

1993 Baseline Solid Waste Management System Description, L. L. Armacost, Fowler R. A., Konynenbelt, H. S., PNL 8990, February 1994.

Solid Waste Program Technical Baseline Description, A.B. Carlson et al., WHC-SD-WM-RPT-060, Rev. 0, March, 1994.

6.8.2.3 TRU Storage. The existing baseline does not provide for storage of RH and Large-Container TRU. Project W-112 (Phase V CWC expansion) is currently planned to accommodate a portion of the Small Container CH TRU.

6.8.2.3.1 Facility Description.

CWC - Phase V (Project W-112). As of April 28, 1995, the Project W-112's scope has been reduced to building three 2,420 m^2 structures. Each structure will be able to accommodate approximately 5,000 drum equivalents of contact-handled waste. The current budget for Project W-112 is $ 25 Million. The following discussion describes CWC phase V as it was originally conceived and is presented for reference only to demonstrate of some of the storage capabilities that will still be necessary after Phase V.

The Solid Waste Operations Complex (SWOC) is designed to have a 30-year operating life and will receive waste from onsite operating facilities, offsite operating facilities, and environmental restoration and remediation activities. Some facilities will provice treatment or disposal of waste.

The CWC consists of several existing waste storage facilities and additional planned waste storage facilities all within the SWOC. Existing facilities include the 13 small 2402-W series Radioactive Mixed-Waste (RMW) Storage Buildings, and the four larger 2403-W series Mixed-Waste Storage, Phase I through IV buildings. The RMW Storage Buildings and the Mixed-Waste Storage (Phase I through IV) buildings floor area is 18,950 m^2.

The Phase V (Enhanced Radioactive Mixed Waste Storage) building was originally planned facility that will provide Resource Conservation Recovery Act (RCRA)-compliant, permitted storage for newly generated waste, existing waste from storage buildings, and existing waste retrieved from alpha caissons. It will provide primary inventory control and waste batching capabilities for the Hanford Site solid waste management system. Acceptable waste classes include the following:

1. LLW;
2. LLMW (including ignitable and potentially ignitable waste);
3. TRU waste;
4. TRU Mixed waste; and
5. GTC-3 Waste.

Primary operational areas planned for the Phase V storage facility include storage for 55-gal drums and overpacked drums, ignitable and potentially ignitable drum storage, box storage, three shipping/receiving modules, and container head-gas testing. Existing Phase I-IV storage capacity is 52,000-drum equivalents with annual receipts of 5,000 drums. Phase V storage capacity was originally designed for 27,000-drum equivalents, this design has been downsized to 15,000-drum equivalents.

The Phase V buildings design floor area is 15,610 m^2, with an additional 7,710 m^2 of dedicated support area. Storage areas will be distributed into three, long-term drum storage buildings (5,000 drums each), one box storage building (4,000-drum equivalents), a smaller storage building (1,000-drum equivalents), and a six-tier rack-storage building (7,000-drum equivalents). The rack-storage building will be equipped with an automated stacker/retriever system (AS/RS). Support facilities will be provided by an operations and support building for the WRAP-1 and a maintenance building for the CWC.

6.8.2.3.2 **Facility-Specific Assumptions.**

1. All waste received at the Phase V storage facility will be packaged in acceptable containers such that no additional packaging will be required; and

2. Phase V will be the only facility that will ship CH LLW and CH LLMW to onsite disposal facilities.

6.8.2.3.3 **Uncertainties.**

1. The future generated waste volume projections, particularly for the RH component originating from the Long-Length Contaminated Equipment, are highly variable;

2. The current technical baseline does not provide for storage of RH and Large-Container CH TRU (and LLMW).

6.8.2.3.4 **References.**

1993 Baseline Solid Waste Management System Description, L. L. Armacost, Fowler R. A., Konynenbelt, H. S., PNL 8990, February 1994.

U.S. Department of Energy, Review for Key Decision 1, Approval of New Start, Solid Waste Operations Complex, Major System Acquisition (94-D-411), presentation materials, May 9, 1994.

Telephone conversation, March 13, 1995, H. A. Heidkamp - Parsons Engineering Science, Inc. to E. Erpenbeck - Westinghouse Hanford Corporation.

6.8.2.4 Low-Level Mixed Waste Processing. The LLMW is divided into three major processing categories. The three categories are: Remote-Handled, Large Container CH, and Small Container CH. The types of treatment required prior to disposal have been grouped into two (2) categories: An easy to process group, the CH LLMW; and a hard to process group, remote-handled and large container CH LLMW category.

The WRAP-2B was being designed to accommodate the difficult to process

LLMW, the RH and the Large-Container CH wastes. Section 6.8.2.2.3 describes the previously planned WRAP-2B module.

The current baseline planning documents show all Small-Container LLMW, being processed by the WRAP-2A module. WRAP-2A has recently been placed on hold and the new plan is to send Small-Container CH LLMW to Commercial Processing. The Request For Proposal (RFP) for this privatized activity is due out in June 1995. Organic and other wastes requiring thermal treatment are to be segregated during the processing operations at the RH and Large-Container Processing Facility. These wastes requiring thermal treatment are also now planned to be shipped offsite for commercial processing.

6.8.2.4.1 **WRAP Module-2A Facility Description.** The WRAP facilities provide characterization, treatment, and repackaging of radioactive solid waste at the Hanford Site. The primary functions of the WRAP-2A included processing, packaging, and certification of retrieved and newly generated CH LLMW. All activities associated with the WRAP-2A were put on hold in December 1994. Engineering and design for WRAP-2A was scheduled to be complete in the year 1996, with construction occurring in the year 1996 through the year 1998. The WRAP-2A would also have been located in the 200 West Area and was designated as a 4,180 m^2 structure, with external storage provided for new drums entering the process, and for the bulk materials of the cement grout and polymer encapsulation processes. The facility would have performed the tasks of waste characterization, waste storage, waste sorting, waste treatment (non-thermal treatment, primarily immobilization or encapsulation), waste packaging, and NDA/NDE. The design life of the facility was to be 30 years.

Commercial Thermal Treatment Facility. The CTTF provides treatment for the low-level and TRUM waste that will require incineration as the technology-based standard for treatment. Both CH and RH will be treated on segregated process lines in the CTTF. Current process logic identifies that the CH and RH will be segregated prior to delivery to the CTTF. Upon completion of treatment, the residue and ash will be delivered to the WRAP facilities for further treatment.

Current plans are to privatize the design, construction, and operation of the CTTF, and pay for the services provided on a unit/rate basis. Residue and ash will be treated at the WRAP facilities.

6.8.2.4.2 **Facility-Specific Assumptions.** The WRAP-2A and CTTF facilities will only accommodate Small-Container CH LLMW.

6.8.2.4.3 **Uncertainties.** The WRAP-2A facility may not be constructed as planned. Alternative, privatized LLMW processing options are being evaluated. Initial procurement activities for the privatization option are in progress and a Request for Proposal is due out in June 1995.

6.8.2.4.4 References.

Solid Waste Program Technical Baseline Description, A.B. Carlson et al., WHC-SD-WM-RPT-060, Rev 0, March 1994.

Hallis, Statement of Work, Rev 2, November 28, 1994.

6.8.2.5 Low-Level Mixed Waste Storage. All relevant baseline information regarding LLMW storage facility is included in section 6.8.2.3. The baseline for storage does not address the need for a remote-handled storage facility. At present remote-handled waste is stored in specialty designed, shielded storage containers to reduce the radiation levels down to contact-handled levels. The cost and technical difficulties for design and fabrication of these special shielded containers makes this approach ineffective in meeting future storage needs. Additional storage facilities (not currently planned) must be constructed to accommodate the remote-handled and some large-container contact handled waste which can not be stored in the existing baseline facilities.

6.8.2.6 Greater Than Category III Low-Level Waste Storage. To date, there is not an accepted method of treating or disposing of GTC-3 LLW. Stabilization of this waste stream in preparation for disposal is not currently being pursued. GTC-3 Waste will be stored until disposal methods and processing requirements have been established. A detailed description of GTC-3 LLW storage requirements is discussed in section 6.8.3.7.

The maximum waste volume for post processing storage in any given year is a function of the waste generation and processing rates for the present and prior years. The maximum volume of waste to be stored at any time, occurs in the year 2023. The total volume to be stored by the year 2023 is 89,292 m^3. Of this, 42,589 m^3 is RH and 46,703 m^3 is CH.

The storage space in square feet can be calculated from the waste volumes if the container types are known. For purposes of this summary, all CH waste was assumed to be in 200 liter drums and all RH waste was assumed to be in 1.5 m x 1.5 m x 2.7 m. metal boxes. Drums are stacked three high and metal boxes are stacked two high, with a 1 m. aisle between rows, as required by Washington Administration Code (WAC) 173-303. The calculated storage areas are then 50,620 m^2 for CH wastes and 19,670 m^2 for RH Wastes. CWC phases I through IV provide 26,010 m^2 of CH waste storage space thus reducing the new construction CH storage space requirements to 24,610 m^2. All of the RH storage space will have to be provided by new construction.

6.8.2.7 Hallam and Sodium Reactor Experiment (SRE) Material Processing. The contaminated metallic sodium inventory consists of quantities from the Hallam Nuclear Power Facility (HNPF) and from the Sodium Reactor Experiment (SRE) (Jacobson 1993). The sodium was originally brought to the site for use at the Fast Flux Test Facility, however the sodium was not used for that purpose. Subsequent to that time the sodium has been stored awaiting beneficial use. The sodium is currently being held in Sodium Storage Buildings 2727W and the Alkali Metal Storage Modules at the Central Waste Complex. The HNPF and SRE material was placed into storage April 1977 and December 1967, respectively.

There are five 56,780 liter tanks at 2727-W that contain metallic sodium from the HNPF. Two of these tanks are full, one is approximately half full

and the other two are empty with the exception of their residual heels. These tanks do not provide RCRA compliant storage for reactive metals since the maximum Resource Conservation and Recovery Act (RCRA) Single-Container volume for this type of hazardous material is 1,890 liters. There are 158 overpacked 200 L drums of metallic sodium from the SRE, currently stored at the CWC. The total volumes of sodium in these categories are 140 m^3 HNPF and 33 m^3 SRE.

The present path being pursued for Hallam and SRE sodium processing involves commercial processing and subsequent commercial use of the product material. A Request for Expression of Interest has been issued to identify potential vendors. This processing option would require allocation of funds to pay a commercial vendor for the difference between the processing cost and the value of the product material to be generated. The second option evaluates potential on site uses and the final option for processing the Hallam and SRE sodium is to add these materials to the feedstream for the 400 Area Sodium Reaction Facility. Although the Sodium Reaction Facility is planned to process the sodium materials at the FFTF, it could also accommodate the Hallam and SRE sodium without any change to the processing facility design. This option would require continued storage of the Hallam and SRE sodium until the Sodium Reaction Facility becomes operational. Once processed, the sodium will be used as product by Tank Waste Remediation System in treatment of Hanford's tank waste.

6.8.2.7.1 **Facility Description**. Treatment of the Hallam and SRE sodium by a commercial vendor would be outside of the scope of this study. The required processing operations and the facilities to be used would be at the vendor's discretion. The planned 400 Area Sodium Reaction Facility is described in detail in Section 6.8.2.12.3.

6.8.2.7.2 **Facility Specific Assumptions**. It is assumed that continued storage of the Hallam sodium in the 2727-W Building will be acceptable to the regulatory agencies, until a processing option can be executed.

6.8.2.7.3 **Uncertainties**. Vendor bids for commercial processing have not yet been evaluated, and the cost of this option are not known. Continued storage of the Hallam sodium at 2727-W may not be acceptable to the Washington State Department of Ecology if the material is ever declared waste because the facility would not comply with RCRA regulations. If the material is declared a waste a RCRA permit waiver will be required to support the continued storage until the year 2008. If a permit waiver couldn't be obtained, the material would have to be moved or 2727-W would have to be upgraded with a new concrete RCRA compliant floor, and smaller or possibly compartmentalized tanks.

6.8.2.7.4 **References**

Contaminated Hallam and Sodium Reactor Experiment Sodium WHC-SD-WM-ES-431, Rev 0, Section 4.5.1, Westinghouse Hanford Company, Richland, Washington.

Telephone conversation , May 1, 1995, J. D. Osterloh - Parsons Engineering Science to T. L. Erickson - Westinghouse Hanford Company, Richland, Washington.

Fast Flux Test Facility Transition Project Plan WHC-SD-FF-SSP-004, Rev 1, Westinghouse Hanford Company, Richland, Washington.

6.8.2.8 Hallam and Sodium Reactor Experimental Material Storage. Current Hallam and SRE sodium storage facilities are the 2727-W and the Central Waste Complex, both in the 200 West Area. The Sodium Storage Facility, which is planned for the storage of the FFTF sodium, is not currently planned to be used to store the Hallam or SRE sodium.

If the preferred commercial use of the Hallam and SRE sodium discussed in section 6.8.2.7 is not achievable, then continued storage of the Hallam sodium at 2727-W and Central Waste Complex will be required. Storage will be necessary until the material is transferred to another program for beneficial use or to the FFTF for conversion to sodium hydroxide for use by TWRS.

6.8.2.8.1 Facility Descriptions. The SRE sodium is in 208-liter drums in RCRA compliant storage at the CWC. The Hallam sodium is stored in five 56,780 liter storage tanks in the 2727-W Building in the 200 West Area. The 2727-W Building is similar to a Butler Building design and does not RCRA compliant secondary containment.

6.8.2.9 Unirradiated Uranium Storage. Unirradiated uranium is presently stored on the Hanford Site in the 400, 300 and 200 West Areas. Approximately 143 m^3 of unirradiated uranium fuel assemblies and elements are stored in wooden boxes in six buildings in the 300 Area (past fuel fabrication facilities). Depleted uranium trioxide is stored in 200 liter drums at the UO_3 facility in the 200-West Area. Depleted uranium metal slabs are stored in metal or wooden boxes in the 400 area and uranium dioxide powder and pellets are stored in cans; pins; assemblies and drums in the 300 Area. The total volume occupied by the unirradiated uranium is approximately 177 m^3.

6.8.2.9.1 Facility Descriptions. There are no current baseline planning documents that specify the long-term storage or disposal for the unirradiated uranium. It is assumed that this material will continue to be stored until it is sold commercially, or a decision has been made to proceed with disposal. Some of the unirradiated uranium containers may require repackaging prior to shipment. The repackaging operations are also assumed to be performed in the facilities where the material is presently being stored.

Fuel assembly inventory consists of 1,144 boxes of finished fuel assemblies and 339 boxes of unfinished fuel. Unfinished fuel exists in various stages of the fabrication cycle--as a co-extruded billet; as clad tubing, cut to fuel element length, but without cladding on the ends; or as a completely clad fuel tube. The fuel assembly boxes are stacked two high, with the exception of 155 boxes, which are stacked three high. Fuel assembly boxes can be loaded with no more than four layers of nine assemblies each.

The depleted uranium trioxide powder (0.27-0.30% U-235) is stored at the UO_3 Plant, 2714-U Building, in 172-200 liter drums. The drums are stored four to a pallet and two pallets high. Storage of this material requires approximately 60 m^2 of space. Each of the drums contain what is considered to be excessive weight 680 to 860 kgs and are judged unacceptable for shipment. The present facility requires only routine and electrical maintenance, and operational surveillance.

Approximately 3.4 MTU of unirradiated uranium in the form of uranium dioxide pellets, powder, fuel pins, and fuel assemblies are stored in the 300 Area, 303-K South Building. All of the materials, with the exception of the fuel pins and fuel assemblies, are packaged in taped slip lid cans, 3.5 to 20 liter buckets, or cans within 200 liter drums. The fuel pellets within the pins and assemblies are encapsulated within stainless-steel cladding. Also stored in this building is 0.47 MT of unirradiated thorium oxide. Approximately 50 m^2 of storage space is required for this material. Approximately 21.16 MTU of depleted uranium (DU) metal in the form of 11 solid slabs 1.5 m x 1.5 m x 0.2 m stored in the 400 Area, 4713 Building. The slabs are contained in 10 metal and 1 wooden containers. The required storage area for this material is 9.3 m^2.

A sales agreement is being negotiated for the sale of approximately 940 MTU of uranium metal billets and approximately 677 MTU of low-enriched uranium trioxide powder. The metal billets currently are stored in shipping boxes in Buildings 3712, 303-B and 303-G in the 300 Area. The uranium trioxide powder is stored in 146 T-hoppers at the UO_3 Plant in the 200 West Area.

6.8.2.9.2 **Facility Specific Assumptions**. The inventories indicated are based on that quantity of unirradiated uranium that will remain on the Hanford Site after the proposed sale of uranium billets and uranium trioxide.

6.8.2.9.3 **Uncertainties**. It is not known if the commercial sale(s) pending will proceed as planned. A final decision on ultimate use, or disposal of this material as LLW, will be required.

6.8.2.9.4 **References.**

Fast Flux Test Facility Transition Project Plan WHC-SD-CP-ES-163, *Fast Flux Test Facility Transition Project Plan* April 1994, and references from this report.

6.8.2.10 **Miscellaneous Source Storage**. Special-Case Mixed-Waste (SCMW) has been assumed to be RH high-activity waste that primarily consists of those waste that have limited or no disposal options. The SCMW includes mixed-waste types currently maintained at various Hanford Site facilities, but primarily at the 300 Area Radiochemical Engineering Cells (RECs).

Special-Case Waste (SCW) has been broadly defined as non-RCRA hazardous and RCRA hazardous RH high-activity waste that primarily consists of waste with limited or no disposal options. The SCW includes, but is not limited to, the following waste groups:

1. The WIPP noncertifiable defense TRU waste ;
2. The DOE-held commercial LLW that potentially may be classified as GTC-3, per 10 CFR 61;
3. The LLW that exceeds site-specific performance assessment limits (e.g. GTC-3, per WHC-EP-0063-4); and
4. Vitrified Waste.

Waste from groups 1 through 4 (above) currently reside in one of the Radiochemical Engineering Cells (B-Cell) in 324 Building. Waste from group 5 (above) is currently stored in the T Plant. Waste consisting of all the GTC-3 group and RH TRU waste will establish the baseline storage requirements for this facility. The remaining waste from the groups above are planned as optional scopes of work.

The DOE/RL Pacific Northwest Laboratory (PNL) is scheduling a variety of research and development (R&D) activities to support work that meets TPA Milestones. The waste in 324 Building B-Cell must be removed for PNL to support these scheduled R&D activities. In addition, there exists an inventory of 1.5-million Curies of dispensable fine dust that has accumulated on the B-Cell floor that requires collection and containment. This dust inventory is not in the scope of this project, but drives the removal of the B-Cell SCW so that the dust hazards can be mitigated.

6.8.2.10.1 Facility Description.

Special-Case Mixed-Waste Interim Storage Facility (Project W-349). The W-349 project will provide capabilities to transport the SCMW inventory within the 324 Building RECs and store them in the SCMW Interim Storage Facility.

It is anticipated that the SCMW Interim Storage Facility will be similar in design as the planned Special-Case Waste Interim Storage Facility.

The storage system may be a horizontal or vertical system that meets the requirements of all functional design criteria. The storage system will be constructed on a reinforced concrete pad capable of housing the solid waste overpacks. The cask/module arrangement will be passively cooled by natural convection through ventilation. Storage system design will include provisions for future retrieval of any solid waste overpack containing SCMW. Retrieval operation will either be the reverse of the loading operation or some other operation that is approved by Westinghouse Hanford Company (WHC). The solid waste overpacks will serve as the primary confinement. The storage system will be designed such that a secondary level of confinement is provided. The secondary level of confinement will be equipped with a lake-detection system capable of monitoring the individual solid waste overpacks.

There are two types of transport and storage systems that may be used. The first would include a cask that would be used for both waste transport and waste storage; and the second would use a transfer cask provided by a transportation service to move the waste to the storage facility, at which point the waste would be transferred to permanent storage modules/casks. This project will not construct the storage modules/casks, but will procure the required storage units (and transportation services) on an as-needed basis.

Special-Case Waste Interim Storage Facility (Project W-272). This planned project will provide the capabilities to transport the SCW inventories within the 324 Building B-Cell to the Special-Case Waste Interim Storage Facility where it will be stored.

The storage system may be a horizontal or vertical system that meets the requirements of all functional design criteria. The storage system will be constructed on a reinforced concrete pad, capable of housing the solid waste overpacks. The cask/module arrangement will be passively cooled by natural

convection through ventilation. The storage system design will include provisions for future retrieval of solid waste overpacks containing SCW or irradiated fuel. The retrieval operation will either be the reverse of the loading operation or some other operation that is approved by WHC. The solid waste overpacks will serve as the primary confinement. The storage system will be designed to provide secondary containment. The secondary level of confinement will contain a leak-detection system, capable of monitoring individual solid waste overpacks.

There are two types of transport and storage systems that may be used. The first type would include a cask that would be used for both waste transport and waste storage. The second type would use a transfer cask provided by a transportation service to move the waste to the storage facility, at which point, the waste would be transferred to permanent storage modules/casks. This project will not construct the storage modules/casks, but will procure the required storage units (and transportation services) on an as-needed basis.

6.8.2.10.2 **Facility Specific Assumptions**. It is assumed that the irradiated fuel will be shipped to the Canister Storage Building (CSB) after the facility has been constructed. The CSB design must to be modified to accommodate this new waste stream. The high-activity, TRU and TRUM materials must be heavily shielded to allow storage at the CWC. The curie content and heat generation from these containers will also require further evaluation to allow storage at the CWC.

6.8.2.10.3 **References.**

Functional Design Criteria for the Special Case Waste Interim Storage Facility (Project W-272), Draft (unissued), WHC-SD-W272-FDC-001, Rev. 1, Westinghouse Hanford Company, March 1995.

Telephone conversation, March 13, 1995, H. A. Heidkamp - Parsons Engineering Science, Inc. to W. J. Guether - Westinghouse Hanford Corporation.

6.8.2.11 **Strontium and Cesium (Sr/Cs) Capsule Processing and Storage**. The existing baseline documentation for long-term storage and processing (overpacking) of the capsules for disposal in a offsite repository, describes a number of options but does not provide a clear path forward. The options that have been described in various documents include storage and processing at WESF, the Canister Storage Building, and a new Sr/Cs overpack facility. All of these options are discussed herein.

The current capsule inventory is as follows:

1. 1,577 Cs-137 (Cs-137) capsules were fabricated at the WESF.
2. 640 Sr capsules were fabricated at the WESF. Currently, 601 Sr capsules (23.23 MCi, decayed to October 15, 1994) are stored in the WESF pool cells; four Sr capsules (0.32 MCi) are located offsite (Nevada), and five Sr capsules (2.36 MCi) have been cut or destroyed.

The capsules are currently stored in pools of demineralized water in the WESF, except those that are in commercial use or stored elsewhere.

The inner and outer portions of the Sr-90 source capsules are constructed of stainless steel. The projected Sr-90 loading of each capsule is 90 KCi. Both the inner and outer portions of the Cs-137 source capsule are constructed of stainless-steel. The projected Cs-137 loading of each capsule is 70 KCi. The inner container was filled to approximately 80% of volume with the molten CsCl or compacted granules of SrF_2 and sealed with a welded cap. After passing leak checks and other inspections, the container was decontaminated by electropolishing and placed into an outer container. The inner container was then sealed in the outer container by welding a cap onto the open end of the outer container.

The process to be used in overpacking the capsules consists of several steps. First, the capsules will be removed from the water pools in the WESF and loaded into an overpack container suitable for disposal at the offsite repository. The overpack container will then be placed into a cask for shipment.

The general requirements for a capsule overpack facility include the following:

1. A receiving area for the capsules that arrive by truck in shielded casks;
2. A shielded receiving cell where the capsules are remotely unloaded from the shielded casks and placed on a transfer mechanism;
3. A shielded packing and welding hot cell where the capsules are placed into stainless steel canisters, and the canisters seal welded;
4. A load-out area where the sealed canisters are placed into a shipment casks; and
5. A storage area/pad for the casks awaiting shipment to the offsite repository.

Several facility options are available for the capsule overpacking operations. The WESF could be modified to add a hot cell for overpacking the capsules. Other options being considered include shipment to the Canister Storage Building (CSB). The CSB could then be used for interim storage of the capsules and for the overpacking operations.

6.8.2.11.1 Facility Descriptions.

Waste Encapsulation Storage Facility. The primary mission of the WESF was conversion of the liquid Sr and Cesium in B Plant to stable solid forms (strontium fluoride in the form of a compact powder and Cesium chloride as cast metal); encapsulation of the resulting solidified materials; and storage of the strontium and Cs capsules. The Cs salts and Sr salts were a result of a separation process for purifying these isotopes from aqueous tank waste.

The WESF consists of the cells, support facilities, and water basins used to store the Cs and Sr capsules. The adjacent B Plant provides WESF with the capabilities for liquid radioactive aqueous transfer, liquid effluent treatment and disposal, solid waste handling, and lag storage for the processed capsule contents. The G Cell at WESF is a key facility in handling the Cs and Sr capsules as they are inspected or loaded into casks for shipment from the facility.

Raw water provides once-through cooling for the WESF pool cells and the hot cell heat exchanger system (inactive). Currently, the cooling water effluent is routed to B Pond for disposal. A closed-loop cooling system for the WESF pool cell and hot cell areas is currently being installed. The new closed-loop cooling system will eliminate the current cooling water waste effluent stream.

The WESF has 11 pool cell areas, five of which contain Cs and Sr capsules. Shielding is provided by 4.3 m of water and a media of heat exchange for the capsules. The present plan is for Cs and Sr capsules to be stored in the WESF pool system for the short term until a decision is made on longer term onsite storage and over packing. Offsite capsules will be returned and remain in storage in the pool cell facility for 10 to 15 years.

The WESF currently depends on the adjacent B Plant for liquid radioactive waste transfer and liquid effluent treatment and disposal. As long as the Cs and Sr capsules are stored underwater at the WESF, waste-handling facilities must be maintained. Work is being initiated to "decouple" WESF from B Plant so that it will not rely on B Plant for these capabilities.

Sr/Cs Overpack Facility. Several options are available for capsule overpack. The WESF can be modified to add hot cell handling capabilities for overpacking operations. The disassembly and processing represents a mission change for WESF and may require significant upgrades to meet regulatory requirements. Another option is to construct a new facility near WESF to provide overpacking operations.

The capsule overpack facility would require a transfer mechanism from the cooling cells to the overpack process area. This area would be a shielded hot cell to pack the capsules into welded steel canisters. The overpacks would be transferred to a loadout area specifically designed for placement into a transport vehicle.

The entire process would require an offgas system and provisions for airborne contamination that would be generated.

Canister Storage Building (CSB). Some baseline documents state that commercially available modular vaults or the CSB will be used for Sr/Cs capsule storage. The *Multipurpose Storage Complex Description* indicates that the capsules will be stored initially in the CSB. The CSB was originally designed for HLW canisters, but is now planned to be used for storage of the Spent Nuclear Fuel. The CSB design must be modified to provide either wet or dry storage of the Cs/Sr capsules.

6.8.2.11.2 **Facility-Specific Assumptions**. The WESF would continue to store the Cs and Sr capsules until a decision is made for longer term onsite storage and overpacking.

6.8.2.11.3 **Uncertainties**. Modifications are needed for both the WESF and the B Plant to meet the present environmental and safety regulations. The

cost estimates for these modifications range from $30 million to more than $100 million.

Technical uncertainties associated with dry storage of the Cs/Sr capsules have not been resolved.

6.8.2.11.4 References.

Quarterly Report - Location of WESF Cs Capsules, WHC Internal Memo #16800-94-KPB-007, Cs Capsule Return Program to E. D. Robbins, October 20, 1994.

Revision of Project W-252 Heat Load Requirements, WHC Internal Memo #16610-94-JFB-051, B Plant Environmental Engineering to P.C. Sato, July 26, 1994.

Fax to J. Kasper, from J. Sabin, March 7, 1995.

Engineering Study for the Transfer and Storage of Cs and Sr Capsules, WHC-SD-HWV-ES-044, Rev. OE, Predecisional Draft.

Telephone conversation, March 13, 1995, H. A. Heidkamp; Parsons Engineering Science, Inc. to W. J. Guether; Westinghouse Hanford Corporation.

6.8.2.12 Other Waste Streams/Materials to be Addressed Under Other TPA Milestones.

6.8.2.12.1 **Spent Nuclear Fuel**. The storage of SNF on the Hanford Site has been consolidated under the responsibility of the Hanford Spent Fuel Project. The mission of this project is to retrieve SNF from the current locations (i.e., K Basins for N Reactor fuel, T Plant for Shippingport Fuel, and the 300 Area Laboratories), package, treat if required, and provide long-term (40-year) safe storage until a high-level waste repository can receive SNF for permanent disposal. Because the storage of SNF is to be handled by this single-project structure, the alternatives evaluated under the Solid Waste Program M-33 Milestone have not considered building new facilities or modifying existing facilities for storage of SNF. However, due to the potential for alternative uses of the CSB, Spent Fuel currently stored at T Plant, SNF was considered as interface for the M-33 Milestone.

6.8.2.12.1.1 Facility/Project Description. The Hanford Spent Nuclear Fuel Project has committed to an accelerated schedule for removing SNF from the K Basins to a storage facility in the 200 Areas CSB. The process includes retrieval of fuel canisters , SNF cleaning, loading into MCOs, and loading of the Multi Canister Overpack (MCO)s into a cask for rail transfer to the interim storage facility. Sludge remaining on the basin floor of the K-East Basin will be accumulated and packaged, then loaded into a similar overpack for transfer to the storage facility.

The interim storage system would first be used as temporary lag storage for fuel and sludge packages removed from the K Basins. The storage facility would also provide a staging area for fuel and sludge for the fuel stabilization process. The objective of the Fuel Stabilization Facility is to passivate the fuel to allow safe long term dry storage.

Current plans for storage of the K Basins SNF is to use a CSB to be constructed in the 200 East Area. The CSB was originally designed as part of the storage complex for storing vitrified HLW canisters from the HWVP. The CSB design is now being used for the storage of SNF, saving time in designing, siting, and constructing a new SNF storage facility. The CSB will be used for storage of the MCOs following shipment to the facility from K Basins. The CSB will also provide the staging area for preparing the SNF for shipment to the stabilization facility and will receive the stabilized fuel for long-term storage until disposal at the HLW repository is available.

The stabilization facility will be sited immediately adjacent to the CSB (or incorporated within the CSB) to improve logistics. The precise configuration and processes involved in the stabilization facility are still under development. It is currently planned to use the same MCOs and Shipping Casks for all stages of the SNF shipping, treatment, and storage operations.

Other SNF onsite (such as the Shippingport fuel at T Plant) do not have the same immediate priority for removal as the K Basin SNF; however, it is anticipated that future retrieval and storage of other Hanford Site SNF would use the same facilities as the K Basin fuels. These facilities may have to be modified or expanded to accommodate the additional SNF.

6.8.2.12.1.2 Facility Specific Assumptions. The sludge in the K Basins is considered to be SNF and will be retrieved. Storage and stabilization of the

sludge is assumed to occur in the same facilities to be used for the SNF fuel canisters. New facilities will meet U.S. Nuclear Regulatory Commission (NRC) licensing requirements. Interim storage must be provided for 40 years. Fuel will be stored wet, until it is treated in the Stabilization Facility.

6.8.2.12.1.3 Uncertainties. Safety Analysis and Environmental Impact activities are ongoing , and it is assumed that the results will not change the path forward. A stabilization process briefing paper will be issued to provide more detail on the risks associated with the stabilization process.

6.8.2.12.1.4 References.

Hanford Spent Nuclear Fuel Project Recommended Path Forward, WHC-EP-830, October 1994, Westinghouse Hanford Company, Richland, Washington.

Multi-Canister Overpack Concept Trade Study For Spent Nuclear Fuel Removal From The K Basins, Spent Nuclear Fuel Project M-379954, Task.

6.8.2.12.2 **FFTF Sodium Storage Facility.** Sodium storage and processing is outside the scope of M-33. However, the current baseline is to store the FFTF sodium at the FFTF Sodium Storage Facility, process it at a proposed 400 Area Sodium Reaction Facility, and use the resulting Sodium Hydroxide product in the processing of single-shell and double-shell tank waste. The following discussion is for information only as it is outside the scope of the M-33 study.

The FFTF is to be deactivated, and eventually decommissioned. Deactivation of the FFTF will include the construction of a sodium storage facility to support the draining of the sodium from the plant systems; accommodation of the sodium residuals remaining in the plant systems following the sodium drain; and possible construction of a sodium reaction facility to convert the sodium to a stable form. Transition to shutdown requires the removal and storage of the bulk sodium coolant contained within the various systems throughout the FFTF. The new sodium storage facility will be constructed close to the FFTF complex in order to support the sodium drain evolution. The proposed Sodium Storage Facility is planned to be constructed in the area between the south and west Dump Heat Exchanges. The sodium will be drained into tanks located in this facility by pressure transfer from the plant. Two secondary loops will be drained first to provide personnel with experience in the sodium transfer process, prior to draining the more challenging radioactive primary sodium systems. The remaining secondary loop will be drained last. Several other liquid-metal systems, including the Interim Decay Storage and Fuel Storage Facility vessels, will be drained after the fuel is removed.

6.8.2.12.2.1 References.

Fast Flux Test Facility RL-W94-029, USDOE, Richland Operations Office, August 1994.

Fast Flux Test Facility Transition Project Plan WHC-SD-FF-SSP-004, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

6.8.2.12.3 Sodium Reaction Facility at the FFTF. There is currently no facility at Hanford that can convert the bulk FFTF sodium to a suitable form for final disposition. Therefore, a reaction facility for conversion of the sodium to a stable form may be constructed adjacent to the Sodium Storage Facility. The current plan is that the sodium reaction process used by Argonne National Laboratory-West will form the basis for the FFTF Sodium Reaction Facility. Pending the operational verification of the Idaho unit, the same processing facility could then be constructed at the FFTF, thus negating any development or design costs.

The Baseline plan makes the assumption that the sodium will be converted to hydroxide product for use in processing the tank waste on the Hanford Site. The Hanford TWRS baseline process for waste tank sludge disposal includes using a sodium hydroxide solution in a pretreatment process of the feed stream going to the HLW Vitrification Facility. The sodium hydroxide produced from the FFTF bulk sodium could produce as much as 20% of that required for the TWRS. Although a final decision on the pretreatment process is not anticipated until 1998, onsite usage of the FFTF sodium is considered highly likely and is included in the TWRS technical baseline. It is therefore prudent to delay any action on the final sodium disposition until this, decision is made.

6.8.2.12.3.1 References.

Fast Flux Test Facility, RL-W94-029, USDOE, Richland Operation Office, August 1994.

Fast Flux Test Facility Transition Project Plan, WHC-SD-FF-SSP-004, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

6.8.2.12.4 **Mixed-Waste Disposal Trench.** A RCRA-compliant MW disposal trench was built in 1994 to accommodate disposal of low-level mixed waste. This facility will be able to dispose of the mixed waste currently in storage, as well as the projected mixed-waste volumes. The TRU and GTC-3 waste cannot be disposed of in this facility. The document, WHC-EP-0063-4, provides the waste acceptance criteria for the mixed-waste disposal trench. The trench is double lined and includes a leachate collection system in each of the liners to prevent any liquid may leak into the disposed waste from reaching the surrounding environment. The trench is located in the northwest corner of the 200 West Area. The facility measures approximately 140 m x 90 m with a depth ranging from 7.5 m at the east end to nearly 11 m at the west end. A 32-year facility life has been listed.

6.8.3 Cost Summary

Existing baseline documents have been examined if an effort to obtain cost data for each of the projects described in Alternative 5. In some cases, the existing baseline does not specifically identify a project(s) or a path forward for certain waste streams and material processing or treatment. In these cases, assumptions have been made regarding current plans and costs. A summary of the existing baseline costs is provided in Table 6.8.3-1.

6.8.3.1 High-Level Waste Canister Storage. A "turn-key facility" estimate for this project, provided by Foster-Wheeler Energy Corporation, was $61,300,000, in 1990 dollars. The estimate was for storage of 2,000 HLW canisters, and included costs for a canister-shipping cask and a cask-loading facility.

The Foster-Wheeler Energy Corporation estimate was based on the waste stream feed projected in 1990, and assumed that the facility would provide storage capacity for only 2,000 canisters that are physically smaller than the currently proposed canister size. Current waste stream projections show 6,800 HLW canisters being generated by the HLW Vitrification Process. It is not possible to accurately extrapolate the cost of a storage facility for the current number and size of canisters from the Foster-Wheeler estimate.

As part of Alternative 2 of the M-33 study, Kaiser Engineers Hanford (Kaiser) prepared an estimate for the construction of a modular storage facility of a different design other than the Foster-Wheeler design. The Kaiser estimate for a new HLW canister storage facility is $320 Million.

6.8.3.2 RH and Large Container CH-TRU and LLMW Processing. The WRAP-2B module was intended to provide processing for the TRU and LLMW streams that could not be accepted by WRAP-1 or WRAP-2A. Design and construction cost for the WRAP-2B Facility was estimated at $202 Million. This cost was derived from the cost estimates for the WRAP-2 complex and the WRAP-2A Facility, detailed in WHC-SD-W100-CDR-001 (1991), and TVW-SVV-364152 (1994).

The total design and construction costs estimated for the WRAP-2 Complex were $300 Million. The estimated design and construction costs of WRAP-2A totaled $139.9 Million. Assuming a 30% redundancy or overlap in functions between WRAP-2A and WRAP-2B, the WRAP-2B cost was estimated by subtracting 70% of the WRAP-2A costs from the total WRAP-2 CDR cost.

Annual operation and maintenance costs for this facility alternative were estimated at $48 Million.

6.8.3.3 RH and Large Container CH-TRU and LLMW Storage. At present, there are no facilities planned that will accommodate these waste streams. If facilities were constructed to store the projected volume of GTC-3 waste, then the surge capacity needed for pre- and post-processing storage at the RH and Large Container LLMW could be accommodated as well. Section 6.8.3.4 provides a discussion of the GTC-3 storage costs.

6.8.3.4 Greater Than Category 3 Low-Level Waste Storage. The required storage space for pre- and post-processing storage in any given year is a function of the waste generation and processing rates for the present and prior years. The maximum volume of waste to be stored occurs in the year 2023. All GTC-3 waste will require storage at that time. The total volume to be stored is 89.292 m^3. Of this, 42.589 m^3 is Remote-Handled and 46.703 m^3 is Contact-Handled.

The storage space in square feet can be calculated from the waste volumes if the container types are known. For purposes of this summary, all CH wastes were assumed to be in 200 liters drums and all RH wastes were assumed to be in 1.5 m x 1.5 m x 2.7 m metal boxes. Drums are stacked three high and metal boxes are stacked two high, with a 3-ft. aisle between rows, as required by WAC 173-303. The calculated storage areas are then 50.620 m^2 for CH wastes and 19.670 m^2 for RH wastes. The CWC phases I through V provide 26.010 m^2 of CH waste storage space, thus reducing the new construction CH storage requirements to 26.610 m^2. All RH storage space must be provided by new construction.

The total new construction costs for future CWC expansion are projected to be $55 Million for CH storage and $272 Million for RH storage. The costs for CWC Phase V, $26 Million, should be added to these totals.

To accommodate both pre- and post-processing storage requirements of other waste streams, it is recommended that the additional GTC-3 floor space be phased in ahead of the forecasted GTC-3 storage requirements curve. By using this type of storage strategy, the DOE could employ a single storage facility to store TRU (or any of the other waste streams with an identified final disposal option), before and after processing, and to store GTC-3 waste after the year 2023. In this manner, the whole storage complex could be constructed and filled gradually, over time, with a decreasing fraction of rotating inventory and an increasing fraction of GTC-3 waste, becoming filled to capacity in the year 2023 with GTC-3 waste. The following assumptions were made to arrive at the facility sizes and costs mentioned herein:

- Processed TRU waste will be shipped to WIPP beginning in the year 2002;
- LLMW will be disposed of in the Radioactive Mixed Waste RMW trench immediately after processing;
- Existing and planned CWC structures can be used to provide both pre- and post-storage functions for all waste streams;
- GTC III waste is the only waste stream which will require long term interim storage;
- Project W-112's (CWC Phase V) current budget of $25 Million is a good cost estimate for bringing a 7,250 m^2 CH storage facility through design, construction, and operational readiness phases; and
- Remote-Handled waste storage space will cost four times as much per square foot to design, construct, and make operational.

Contact-Handled GTC-3 Waste Storage:

- All Contact-Handled waste is in 200 liters drums;
- Array length is length of building (assume 60 m for calculation purposes);
- Array is comprised solely of drums and is 1.2 m wide;
- Drums are stacked 3 high as they are now at CWC; and
- Aisles are 1 m wide.

Calculations:

- Drum area = 6.1 m x 1.2 m =73 m^2;
- Matrix area = 61 m x 2.1 m = 128 m^2;
- Storage matrix floor efficiency = 73 m/128 m = 57%; and
- Matrix volume = 61 m. x (1 pallet / 1.2 m) x (4 drums / pallet) x 3 high x (0.2 m^3 / drum) = 120 m^3 / matrix

Floor Space required = 64,000 m^3 CH waste x (1 array / 120 m^3) x (128 m^2/array) = 68,300 m^2.

Remote-Handled GTC-3 Waste Storage:

- All Remote-Handled waste is in 1.5 m x 1.5 m 2.7 m boxes;
- Assume array is comprised of 16 boxes, stacked two high, 4 end-to-end, 2 back-to-back; and
- Aisles are 1 m wide.

Calculations:

- Box Area = (4 boxes long) x (2.7 m / box) x (2 boxes wide) x (1.5 m / box) =32.4 m^2;
- Matrix Area = 12 m x 4 m = 48 m^2;
- Storage Matrix floor efficiency = 32.4 m/48 m = 67.5%; and
- Matrix volume = 48 m^2 x (1.5 m box height) x (2 boxes high) = 144 m^3.
- Floor Space required = 43,000 m^3 RH waste x (1 array / 144 m^3) x (48 m^3 / matrix) = 14,350 m^2.

6.8.3.6 Hallam and SRE Sodium Storage Cost. The current path forward for disposing the Hallam and SRE sodium is to process the material at a commercial facility. The vendor would utilize the product material(s) for other commercial use. This option will require DOE funding since the processing costs will exceed the commercial value of the product materia (s). Because the vendor bids have not been evaluated, the cost for the commercial processing option is not known.

6.8.3.7 Unirradiated Uranium Storage. Modifications required to bring existing storage facilities into compliance are estimated at $400,000. Annual operating costs for the existing storage facilities are currently approximately $1.1 million.

6.8.3.8 Miscellaneous Source Storage. Storage of miscellaneous source inventories will be accomplished by two facilities. Project W-272 will provide the capabilities to store Special Case Waste (SCW) inventories within the 324 Building B-Cell in the Special-Case Waste Interim Storage Facility. The storage system may be a horizontal or vertical system that meets the requirements of all functional design criteria. The storage system will be constructed on a reinforced concrete pad capable of housing the solid waste overpacks. The cask/module arrangement will be passively cooled by natural convection through ventilation. The storage system design will include provisions for future retrieval of solid waste overpacks containing SCW or irradiated fuel. The total estimated cost of Project W-272 is $6,250,000, including escalation and contingency. The project assumes expense costs of transportation services and capital costs of modules are assessed to the waste generator.

Project W-349 will provide the capabilities to transport the Special-Case Mixed Waste (SCMW) inventory within the 324 Building Radiochemical Engineering Cells (RECs) and store them in the SCMW Interim Storage Facility. The SCMW includes RCRA, hazardous, remote-handled high-activity waste that primarily consists of those wastes that have limited or no disposal options. It is anticipated that the SCMW Interim Storage Facility will be similar in design to the planned Special Case Waste Storage Facility addressed by Project W-272.

Budgetary estimates show an estimated facility cost of $5,400,000 distributed from 1996 through 2000. The project assumes expense costs of transportation services and capital costs of modules are assessed to the waste generator.

6.8.3.9 Strontium and Cesium Capsule Storage Costs. The baseline documentation identifies a number of on-site storage and canister overpacking options, including the WESF and the Canister Storage Building (CSB). Although future plans for canister storage and overpacking are not clear at present, the WESF is used for comparison purposes. Operating costs associated with B Plant/WESF were $30 million in fiscal year 1993. Roughly $10 million of this is for WESF support. The upgrades costs for WESF to provide safe long-term storage of the Cs/Sr capsules were estimated by the WESF staff at $30 Million. Other rough estimates documented in previous reports range higher than $100 Million. Estimated life-cycle cost, based on $10 million annual operating cost and $30 million in upgrades, is $360 million.

In the Record Of Decision (ROD) Implementation Plan, for new Storage/Overpack Facility, the estimated cost for the overpacking, storage and disposal of the capsules is $210 Million. It is now assumed that this estimate will be exceeded, based on the delay in the opening of the high-level waste repository.

6.8.4 Schedule Summary

6.8.4.1 High-Level Waste Canister Storage. A High-Level Waste (HLW) Canister Storage Facility must be operational before the HLW Vitrification Process is initiated. The HLW vitrification Process will begin by December, 2009 as required by TPA Milestone M-55-03.

6.8.4.2 RH and Large-Container CH-TRU and LLMW Processing. The WRAP-2B project was intended to provide these functions. The WRAP-2B has been canceled. The M-33 Milestone is intended to identify the plans to construct new facilities or modify existing facilities to provide for treatment of the TRU and LLMW streams.

6.8.4.3 RH and Large Container CH-TRU and LLMW Storage. The CWC Phase V expansion, Project W-112 will provide storage space for approximately 15,000-drum equivalents of CH waste. It will be possible to store the fraction of the RH, TRU and LLMW that is practical to shield down to CH levels (<200 mr/hr.). However, additional storage facilities must be constructed to accommodate the remainder of the RH, Large-Container, CH, TRU, and LLMW. The existing solid waste baseline documents do not describe these additional storage facilities or their schedules.

6.8.4.4 Greater Than Category III Low-Level Mixed Waste. The CWC Phase V expansion, Project W-112, will provide storage space for approximately 15,000-drum equivalents of CH waste. It will be possible to store the CH GTC-3 waste as well as the fraction of RH GTC-3 waste, that is practical to shield to CH levels (<200 mr/hr.). However, additional storage facilities must be constructed accommodate the remainder of the GTC III waste. The existing solid waste baseline documents do not describe these additional storage facilities or their schedules.

6.8.4.5 Hallam and SRE Sodium Processing at the Sodium Reaction Facility Cost. The current baseline assumes that the Sodium Reaction Facility is assumed to be operational by the year 2008. It is anticipated that the operating lifetime of this facility will be approximately two (2) years. An alternative option for commercial processing of the Hallam and SRE Sodium is being pursued. Procurement activities for this option are in progress.

8.6.4.6 Hallam and SRE Sodium Storage Cost. The Hallam and SRE Sodium is presently being stored in the 2727-W Building, and the CWC. This material is assumed to remain in these locations until a processing option can be executed.

8.6.4.7 Unirradiated Uranium Storage. The Unirradiated Uranium (UU) is presently being stored in various facilities on the Hanford Site. The baseline documents do not identify any plans to move this material, until a decision is made regarding sale or disposal.

6.8.4.8 Miscellaneous Source Storage. Facility construction for Project W-272 is scheduled to begin February 1997. Transfer of the SCW to the new facility is scheduled to begin March 1998.

Facility construction for Project W-349 is scheduled to begin October 1998. Transfer of the SCMW to the new facility is scheduled to begin in January 2001.

6.8.4.9 Strontium and Cesium Storage. Currently, it is assumed that there is approximately a 30-year storage availability for capsule containment at the WESF. The TPA calls for the removal and permanent disposal of HLW stored at the Hanford Site and the record of decision (ROD) for the Hanford Defense Waste, Environmental Impact Study (HDW-EIS) requires the disposal of the capsules.

The dry storage CSB was originally scheduled for completion in 1996. Although the original project has been canceled, the CSB will be made operational by December 1997 to support retrieval of the K Basin Spent Fuel.

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Figure 6.8.1-1. Alternative 5 Flow Schematic.

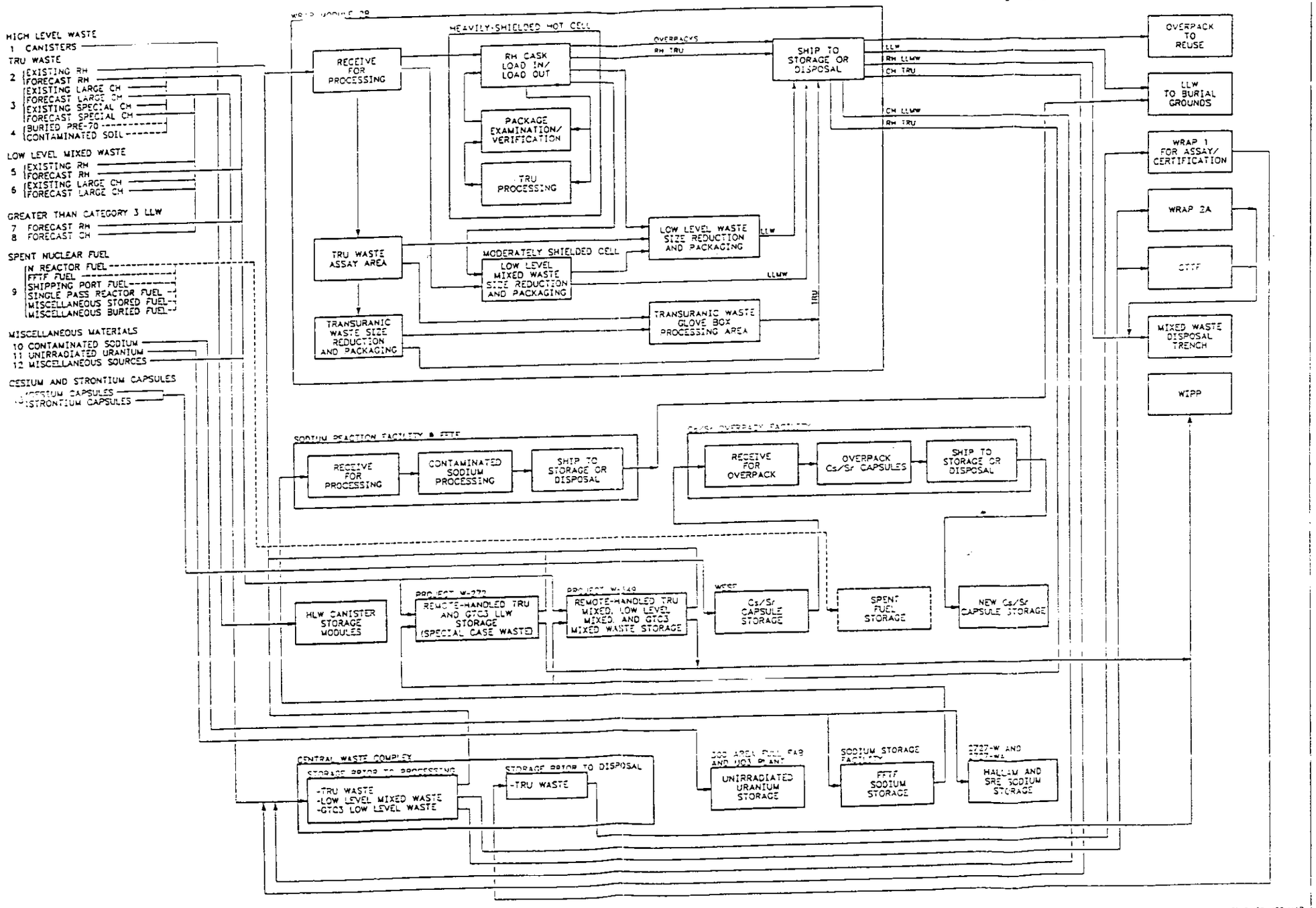

Figure 6.8.2-1. Modular Vault Dry Storage Schematic.

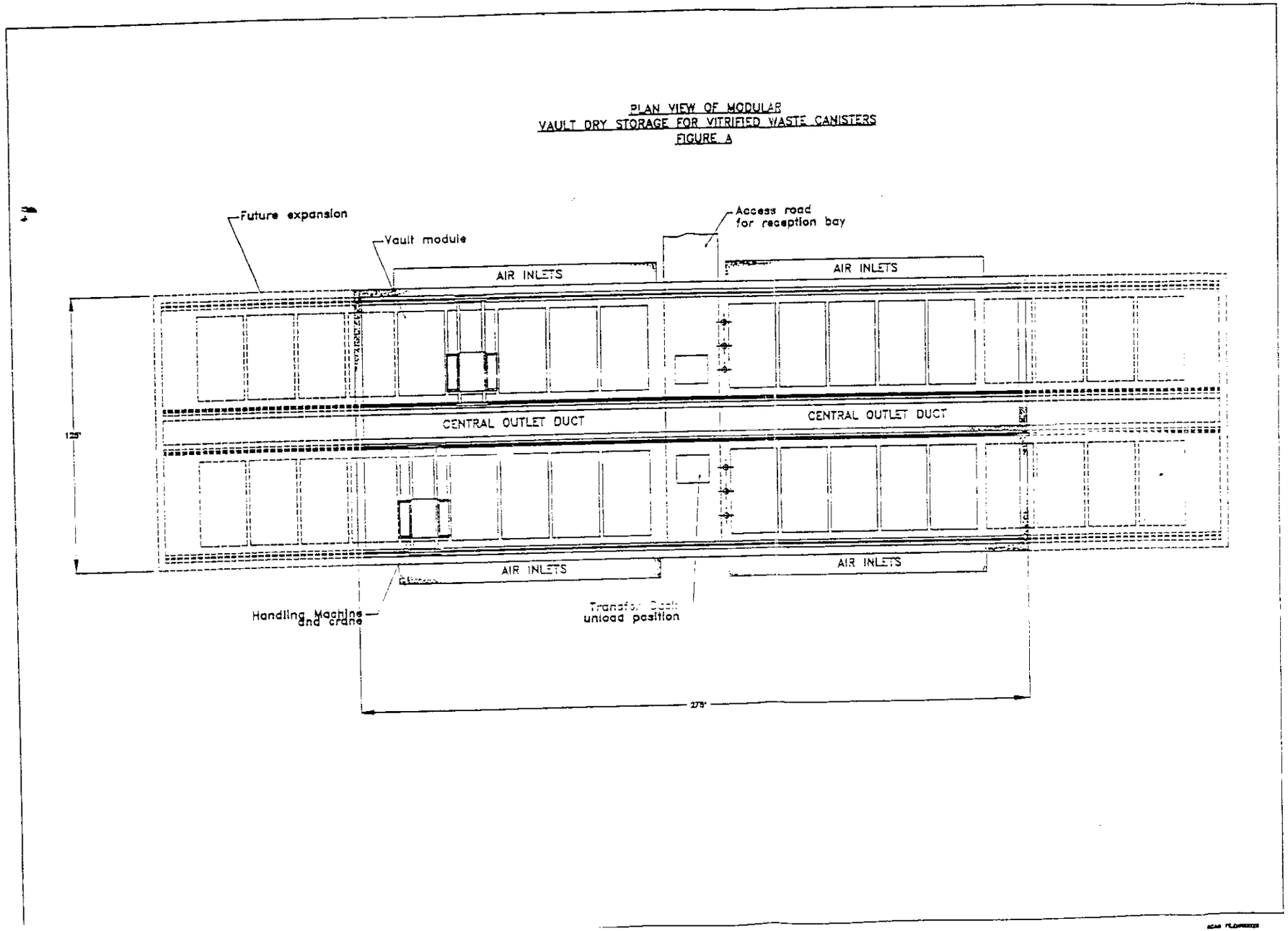

Table 6.8.3-1. Technical Baseline Cost Comparison.

WASTE STREAM/FUNCTION	FACILITY	CONSTRUCTION COST	OPERATING COST	LIFE-CYCLE COST	SOURCE
HLW Canister Storage	New Modular Storage Facility	$320 M	Not Available	Not Available	Kaiser Estimate for Alternative 2
RH and Large-Container CH TRU and LLMW Processing	WRAP-2B	$202 M	$48 M/YR	Not Available	Total WRAP-2 CDR estimate, less WRAP-2A cost.
RH and Large-Container CH TRU and LLMW Storage	CWC Expansion	(1)			
GTC3, RH Waste Storage	CWC Expansion	$272 M (1)	Not Available	Not Available	Estimate based on projected storage required and average cost per square foot.
GTC3, CH Waste Storage	CWC Expansion	$55 M (1)	Not Available	Not Available	Estimate based on projected storage required and average cost per square foot.
Hallam and SRE Sodium Processing	FFTF Sodium Reaction Facility	$30 M	Not Available	Not Available	Obtained from cost estimates for 2002 start date, converted to 1995 dollars.
Hallam and SRE Sodium Storage	2727 W Building and CWC	Not Applicable	Not Available	Not Available	
Unirradiated Uranium Storage	Existing 200 and 300 Area Facilities	Not Available	Not Available	Not Available	
Miscellaneous Source Storage	Interim Storage Facility (W-272)	$6 M	Not Available	Not Available	Project W-272 documentation.
	Interim Storage Facility (W-349)	$5 M	$1 M/YR	Not Available	Project W-349 documentation.
Cesium and Strontium Capsule Storage	WESF	$30 M	$10 M/YR	$360 M	Construction estimate from WESF staff. Operating cost estimated.

(1) Cost of GTC III storage includes cost of RH and Large Container CH TRU and LLMW storage.

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7.0 ALTERNATIVE COMPARISON, ANALYSIS, AND EVALUATION

This section presents an analysis of the impact of solid waste technical options on values and objectives that are important to the public. Described are the values that were identified, the major programmatic risks, how the impacts were measured, the performance of alternatives, the methodology used for the analysis, the results of the analysis, and the implications of the results.

7.1 INTRODUCTION

Decision analysis was used to guide the collection and analysis of data and the logic of the evaluation. Decision analysis is a structured process for the analysis and evaluation of alternatives. It is theoretically grounded in a set of axioms that capture the basic principles of decision making (von Neuman and Morgenstern 1947). Decision analysis objectively specifies what factors are to be considered, how they are to be measured and evaluated, and their relative importance. The result is an analysis in which the underlying rationale or logic upon which the decision is based is made explicit. This makes possible open discussion of the decision basis in which facts and values are clearly distinguished, resulting in a well-documented decision that can be clearly explained and justified.

The strategy of decision analysis is to analyze the various components relevant to the decision separately and then integrate the individual judgments to arrive at an overall decision. This assures that all the relevant factors are identified and their relative importance is considered. The procedure for obtaining the individual judgments, and the decision rules, for combining them and evaluating alternatives, have both theoretical and empirical foundation in mathematics, economics, and psychology.

Decision analysis makes use of numbers rather than qualitative expressions to construct scales, represent preferences, and express uncertainties. The relationship between qualitative preference structures and quantitative scales is given a precise and rigorous description in the discipline of measurement theory (Krantz et al. 1971), which is part of the theoretical foundation of decision analysis. An understanding of the logic of these relationships is especially important when there are multiple, possibly conflicting, objectives to be considered in the analysis. The standard reference for multiattribute decision analysis is Keeney and Raiffa (1976). Decision analysis also has formal procedures for considering uncertainty in the analysis. This makes it possible to evaluate the risks associated with each of the alternatives.

The steps in the decision analysis process are as follows:

1. Describe Decision
2. Identify Alternatives
3. Identify Objectives and Criteria and their Relationships
4. Evaluate Alternatives
5. Perform Sensitivity Analysis
6. Select/Implement Alternative.

This is an iterative process in which some of the steps are interactive. The general framework holds whether one carries out a few simple calculations or an extremely complex and detailed analysis. The extent of the analysis is guided by the stakes involved and the difficulty of the decision. Time is also an important consideration. The objective of any analysis is to specify the decision basis and arrive at a clear course of action. A sound strategy is to error initially on the side of simplicity and extend the complexity of the analysis as necessary.

7.2 BASIS OF ANALYSIS

This section describes the various components that formed the basis of the analysis presented in this chapter.

7.2.1 Alternatives

The alternatives chosen for this initial analysis are ones that bound the space of those available on the most salient dimensions. This initial selection of alternatives is designed to analyze strengths and weaknesses of alternatives and thus to exemplify the major tradeoffs. Alternatives interior to this space that are combinations of these can be evaluated in more detail at a later time.

The two major dimensions that this initial analysis focuses on are whether to emphasize the use of existing facilities or build new facilities, and whether the various processes should be combined in a single or common facility or a whether to use a modular approach in which the different processes are located in different buildings. Also included in the analysis is the Programs baseline. The specific realization of the combinations chosen for analysis are given detailed descriptions in Chapter 6.

7.2.2 Public Values

Public values are the statements of what we want to achieve. Figure 7-1 shows the public values or objectives that, in part, form the basis for this analysis. These values result from a literature review summarized in Armacost et al. (1994), a series of workshops with technical personnel, and a review by program management. The objectives are intended to be an inclusive set that captures all the concerns of the public stakeholders, the Department of Energy, and WHC. The values have been tailored for the specific application of the solid waste and materials facility options, and have measurable scales that clearly define the degree to which the objectives are achieved. The degree to which a technical option achieves these values is considered to measure the extent to which the solid waste and materials facility's performance is maximized for all areas of public concern.

The identified areas of public concern, as shown in Figure 7-1, consist of maximizing public and worker health and safety, minimizing impacts to the environment, minimizing costs, expediting cleanup and meeting TPA milestones, as well as a consideration of socioeconomic impacts. Additional considerations are the manageability of the system and the integration of programs so as to promote overall efficiency and cost savings.

Each of these values has been further specified to capture all aspects of interest in the value. Thus, Health and Safety has been further specified as Public and Worker. Worker Health and Safety is further specified as "minimize worker radiation exposure," "minimize worker hazardous material exposure," and "minimize worker accidents." At each level of specification the value immediately above in the hierarchy is partitioned in a way that breaks out all aspects of the value while minimizing any overlapping. The specification of values was carried out until a level was arrived at that consisted of specific criteria for which a scale could be identified for precisely measuring the performance of each alternative. For example, worker radiation exposure was further specified as chronic and acute. The respective scales were the number of radiation workers, and the maximum number of individuals that could be exposed in a single incident. Scales are further described in the next subsection.

7.2.3 Criteria/Scales

The criteria or scales are the end points in the value hierarchy and make possible well-defined measurement of the degree to which the objectives are achieved. The scales have been selected with the alternatives in mind so as to make the collection of performance data reasonable considering the time and effort available. The scales used in the analysis are shown in Table 7-1.

Several types of scales are used in the analysis. The scales may be natural or constructed, and either type may be a proxy scale that provides an indirect measure of the value of concern (Keeney 1992). Natural scales are those that have a common, well-understood interpretation, and with a unit of measurement that people naturally associate with measurement. For example, "dollars" is a natural scale for the objective to minimize cost. "Miles" is also a natural scale, and is used in the analysis as a proxy scale for public radiation exposure. The distance in miles of the facilities from major population centers serves as an indirect measure for the objective to "minimize public radiation exposure."

The objective to "expedite start schedule" is measured by a constructed scale. This consists of a series of short scenarios or descriptions that represent different levels of performance on the objective. The scale for "expedite start schedule" considers both when facilities come on line and what percentage of processing capabilities are available. The numbers ranging from 0 to 100 that are associated with the constructed scales are value functions that capture the relative importance of different levels of performance. Value functions are further described in the next section.

7.2.4 Value Functions

Value functions were assessed to measure the relative importance of different levels of performance on each of the criteria. Value functions take as their domain the various levels of performance as measured by the scales and map it onto either the unit interval or a 0-to-100 range. Value functions capture the fact that the importance of achieving different levels on an objective may not be linear with its scale. For example, the importance of distance as a measure of the potential for acute radiation exposure is not linear with distance because the dispersion of a potential release is not itself linear with distance. Value functions were developed based upon discussions among the engineers and the analyst. For criteria having constructed scales, each level of performance, as described by a scenario was assigned a number from 0 to 100 representing the relative importance of achieving that level of performance. These numbers are shown in Table 7-1. For criteria having natural scales; the value functions were judged to be linear with the measure. These were either increasing or decreasing functions depending on whether more was better or worse than less. Typical value functions are shown in Figure 7-2.

7.2.5 Uncertainties

For some objectives, alternative performance on objectives depends not only on the choice of the alternative, but on uncertainties that can not be directly controlled. Uncertainty is an important consideration in evaluating programmatic risk. Not all uncertainties warrant the same level of consideration. For much of the information, there may be uncertainty in the estimates, and if these uncertainties are symmetrically distributed, and independent of alternatives, there would not be noticeable differences if the results are based on point estimates. Uncertainties having asymmetric distributions require special consideration when estimating means. Uncertainties can be evaluated in more detail if sensitivity analysis warrants their further consideration. Of particular interest initially, are the uncertainties in which the outcome probabilities are not independent of the alternatives, and the uncertainties are thought to have a significant impact on the objectives or public values being considered in the decision.

Three such uncertainties have been identified. They are the regulatory outcome, the resolution of issues surrounding waste processing, and the feasibility of capital funding.

- Regulatory outcome refers to permitting issues, and has the potential of significant impacts on schedule and costs.

- Waste processing has unresolved issues concerning container requirements, cask requirements, and other handling criteria. The potential impact of a delay in resolving these issues is judged to be greater for a common facility than for a modular facility.

- Capital funding has a longer project cycle for larger projects and is more uncertain; consequently, alternatives using a common facility have a greater likelihood for delays in funding or not being funded at all.

These uncertainties are represented in the analysis by a decision tree shown in Figure 7-3. The tree is read from left to right. The square node on the left represents the four possible decision paths; the circles represent potential paths for the uncertainty outcomes. The tree is shown in "schematic form." There are actually 4X4X2X3 = 96 possible paths through the tree. Each of the four alternatives will result in some performance level for all the values and criteria described in preceding sections. The impact of the uncertainties on these values is primarily to cost and schedule. The probabilities for each of the uncertain variables are assumed to depend on the alternatives shown, and to be independent of each other. The impacts on cost and schedule were estimated separately for each uncertainty. These estimates are shown in Tables 7-2 through 7-4.

7.2.6 Weights

Whereas value functions capture the importance of different levels of performance on a single objective, weights capture the relative importance of the different objectives or values. For example, weights answer the question of whether the potential impacts of chronic hazardous chemical exposure are more important to consider than those from acute hazardous chemical exposure. Weights logically depend on the potential ranges over which the alternatives can vary. A common error is to specify weights in a "top down" process without considering potential ranges of impacts. The method used to develop the weights in this study tied the importance of objectives to their ranges in a "bottom up" assessment process.

The methodology used for determining the relative weights is a standard decision analysis procedure known as "swing weighting." The resulting weights reflect the tradeoffs among the objectives in their respective units. The procedure requires that the set of criteria within each category or subcategory be first ordered according to rank, and then the ratios of relative importance are determined. Evaluators are asked to consider a situation in which a hypothetical alternative would score at the worst level for all criteria within a particular category. They are then asked to imagine that if that alternative could be improved to the best level on one criterion, which criterion would be their first choice for the improvement, the second choice, etc. This provides a basis for the rankings. Ratio judgments of relative importance are then obtained. The process is repeated for each of the categories, and then extended to obtain judgements across categories. The importance ratios are then normalized so that the weights across all categories sum to one.

Weights were elicited independently from four engineers/managers who are knowledgeable about the solid waste program and are sensitive to stakeholder issues. Weights represent value judgments; consequently, there is no "correct" answer as to the relative importance that should be given to various public values. This is in contrast to estimates of performance, which while they may not be currently known, are thought to have correct answers. Consequently, performance data are generally best obtained from the appropriate technical experts, while values should come from the stakeholders.

However, some technical expertise is valuable in assessing weights because many of the scales are proxy scales, and expertise is necessary in order to consider the potential impact that these scales will have on the more fundamental objectives, which can not be measured directly. Those making the judgments attempted to adopt a public perspective rather than giving their personal opinion.

No attempt was made in the weight elicitation to trade off public values against dollar costs. The analysis will use the elicited weights to arrive at an overall public value score for each technical option and then directly compare performance on public value with cost. This method of analysis makes it possible to identify dominating options; that is, technical options that provide more value for less cost. It also keeps visible the cost-performance tradeoffs among the dominating options. Thus, the readers can judge for themselves whether the higher performing options are worth the additional cost.

The weights resulting from the elicitation are shown in Table 7-5. The first column in the table shows the major public values, in bold, along with the subcriteria. The next four columns show the weights obtained from each of the four experts. Each column shows the weights for the major public values, in bold, as well as weights for the specific subcriteria. Both the bold numbers and the non-bold numbers sum to one. Thus, the bold numbers capture the relative importance of the major criteria, and the non-bold numbers give the relative importance of specific criteria across all categories.

As can be seen in Table 7-5, three of the individuals' value weights were similar--at least for the major categories. A fourth individual brought a different value perspective, placing more weight on environmental impact and schedule and less weight on health and safety. In this person's judgment the potential impact on health and safety was not very large; consequently, less weight was placed upon it.

The last three columns in Table 7-5 are averages. Column six displays a consensus average, which is the average of the three individuals with similar weights. Column seven presents average weights for all four individuals. The last column, "Grp/Avg," shows a group average obtained at a solid waste management meeting. The weights elicited in that meeting were at the level of the major categories only--subcategories were not considered. Consequently, the weights shown are those obtained at the meeting for major categories, with the relative importance within categories being taken from the consensus average. It should also be pointed out that for the weights obtained at the management meeting, there was no attempt to consider the range of potential impacts; that is, there was no attempt to trade off specific units.

The weights used in the following analysis are the consensus average weights. However, an analysis of the options' overall rankings was also carried out using the group/average weights as well as those for the individual with a different value perspective. These analyses are discussed further in Section 7.4.

7.3 DATA

The data used to evaluate the performance of solid waste technical options are in all cases based upon best engineering judgment. For some objectives detailed analysis was carried out to generate the data, and in other cases performance estimates were based upon direct engineering judgment. The performance of alternatives on the objectives is shown in Table 7-6. This section provides an understanding of the basis for the data.

Potential for Public Exposure is based upon facility location and safety class. It is assumed that new facilities would be built to Class 3 standards. The existing WNP-1 facility was built to Class 1 standards. Public Transportation Safety is based upon the number of miles materials would be transported on public roads. This is based upon knowing facility and material locations and estimates of the number of shipments based on waste volumes.

Potential for Chronic Worker Exposure is based upon the total number of workers and the safety class. Acute exposures are based upon the number of workers located in a single facility; consequently, modular facilities score better on these measures. Worker Transportation Accidents--At Work is based upon the total number of miles for transporting materials. This is based on location of facilities and materials and estimates of number of trips. The range of 600K mi to 200K mi was estimated to correspond to a potential of 0.145 to 0.045 accidents (National Safety Council, 1986). Worker Transportation Accidents--Commuter is based upon the number of commuter miles per year from the Site boundary. Worker Industrial Accidents is the number of reportable incidents. The range of 560 to 1680 reportable incidents corresponds to a range of 5K to 15K person-years for the life of the project (National Safety Council, 1986).

The immediate risk to the environment is based upon the additional accumulation that would occur if the start is 11 years hence instead of 6 years. Short-term risk to the environment is measured by the perceived risk resulting from facilities' proximity to the Columbia River. Long-term risk to the environment is captured by number of new acres and/or sites requiring D&D.

All cost data are based upon detailed engineering analysis. System Manageability is based upon engineering judgment. Demonstrate Integration of Programs is also based upon engineering judgment, except for Minimize Cost to Interfacing Programs, which is based upon actual D&D dollars saved.

Socioeconomic Impacts to the land and making available areas of High Future Use Value are based upon actual land needs and locations. Future Facility Use is based on engineering judgment of which facilities would have potential for commercial use at the end of project life. Economic Stability is based on planned times for construction and production estimates. Capture Economic Opportunities Locally is based upon engineering judgment.

7.4 ANALYSIS

The data shown in Table 7.6 represent the facts used in the analysis of the solid waste technical options. No option scored best on all of the criteria; consequently, additional analysis is needed that considers costs and benefits and the judgments of tradeoffs among values. The following subsections analyze the strengths and weaknesses of the solid waste technical options.

Included are the results of the analysis of solid waste technical options' overall performance on public values. Performance on public values is considered from three different value perspectives. An analysis is presented of the cost-benefit tradeoffs, which reveals that three of the options are dominated; that is, other options provide more value for less cost. A detailed analysis is presented showing which specific criteria are driving the overall performance of the technical options on public value, and which criteria are the tradeoffs. An analysis is then presented that shows how robust each technical option's overall performance on public value is when changes are made in the relative importance assigned to major categories of public value. Lastly, a risk analysis is presented that examines the risk to cost and schedule caused by regulatory uncertainty, by the need to resolve waste-processing issues, and by funding uncertainties.

7.4.1 Overall Performance on Public Values

Figure 7-4 shows the overall scores for Maximizing Public Value for each of the five technical options. As can be seen in Figure 7-4, Existing Modular scored highest. New Modular and New Common were nearly tied for second, and the Program Baseline scored last. The overall scores were arrived at by taking the raw scores on each of the criteria and transforming them into a value from zero to one using the value functions for the criteria, and then taking a weighted sum of these values, where the weights used were the consensus average weights as described in Section 7-2.6. The resulting scores have a potential range from 0 to 1, where 1 would indicate scoring the highest possible on all criteria, and 0 would result from the lowest score on all criteria. As can be seen in Figure 7-4 the scores ranged from 0.567 to 0.737. These overall values do not consider cost. They are a weighted sum of all criteria with the exception of cost. Cost-benefit tradeoffs will be considered below. These values also do not consider risks to cost or schedule. These risks will also be analyzed below.

7.4.2 Overall Performance from Different Value Perspectives

The overall values shown in Figure 7-4 depend in part on the weights used to trade off the values. Three sets of weights were developed as described in Section 7.2.6. A comparison of the results using these three different value perspectives is shown in Figure 7-5. As can be seen in the figure all three value perspectives result in Existing Modular having the highest score and Programs Baseline having the lowest score. Thus, for each of the value perspectives there is agreement on which of the technical options

performs worst and which performs best. There seems to be little consensus on the ranking of the remaining three alternatives from the different value perspectives. The one conclusion that might be drawn concerning these three alternatives (New Common, New Modular, and Existing Singular) is that they seem to be ranked relatively closely as compared with the Existing Modular and the Program Baseline Alternatives.

7.4.3 Cost-Benefit Analysis

The costs of the solid waste technical options are shown in Table 7-6. Costs were estimated for short-term capital (next 5 years), long-term capital (remaining capital after 5 years), maintenance and operating cost, and D&D cost. Total cost is the summation of these four costs. This information is presented graphically in Figure 7-6. As seen in the figure, New Modular is the most costly overall and Existing Singular is the least costly. Maintenance and operating costs were estimated to be least for Existing Singular; however, it has the second highest short-term capital cost. Existing Modular, which had the highest overall performance, is the second least costly overall. It also ties for first in short-term capital costs.

To show more clearly the relationship between costs and benefits, the options are plotted in a two-dimensional cost x benefit space shown in Figure 7-7. The horizonal axis in Figure 7-7 is the total cost, and the vertical axis is the overall public value. The information shown in Figure 7-7 is extremely interesting. It shows that Existing Modular dominates New Common, New Modular, and Programs Baseline; that is, Existing Modular provides more overall value at less cost than these other three options. Existing Singular is not dominated by Existing Modular. Existing Singular provides less value, but it also costs less. Thus, when considering overall cost and overall public value, a decision must be made as to whether the additional benefits of Existing Modular are worth the additional cost. More detailed comparisons and analyses of the basis for the overall public value scores are presented in following subsections.

Figures 7-8 through 7-10 show similar plots for short-term capital costs, long-term capital costs, and maintenance and operating costs. Figure 7-9 for long-term capital costs shows the same pattern as for total costs; that is, Existing Modular dominates all options except Existing Singular. Figure 7-8 for short-term capital costs shows a similar pattern except that Existing Modular dominates all the options. Figure 7-10 for maintenance and operating costs tells a different story. Existing Modular is still the best performer, but New Common and existing Singular are also dominating options. So if maintenance and operating cost is a large consideration, then some thought should be given to whether Existing Modular is worth the additional expense as compared with New Common, and whether New Common is worth the additional cost over Existing Singular. The next section provides a more detailed analysis of what is driving the performance on overall public value for each of the technical options.

7.4.4 Detailed Analysis of Performance on Public Values

The overall values for the technical options depend on how they scored on the major public value categories and the weights given to those categories. This is depicted graphically in Figure 7-11. Figure 7-11 shows the performance profile for each of the five technical options. For each technical option, bars are shown for each of the major public value categories. (The ordering is such that socioeconomic impact is the third bar.) The weight given to a public value (which is the same for all the options) is represented by the bar's width. The option's performance or score for the public value is represented by the bar's height. Thus, the total area of all bars is the option's overall value.

Performance profiles show the relative strengths and weaknesses of each technical option. Recall that Existing Modular and Existing Singular were the two non-dominated options with respect to total cost (Figure 7-7). A comparison of these two technical options shows that Existing Modular scores better on Public Health and Safety, and worse on Worker Health and Safety. The scores are similar for Socioeconomic Impact and Schedule. Existing Modular does better on Environmental Impact and worse on System Manageability. Their scores were similar for Demonstrate Integration of Programs.

It is also interesting to study the Program Baseline's performance profile. Program Baseline is dominated by both Existing Modular and Existing Singular; however, it scores better than both of these on Public Health and Safety. Thus, even for dominated options there are tradeoffs.

A comparison of New Modular and New Common is also interesting. These options scored very closely overall (0.721 versus 0.719), but there are trade offs when comparing them. They score close to each other on Health and Safety (actually New Modular scores slightly worse on Worker Health and Safety), and score the same on Socioeconomic Impact. New Modular does better on Schedule, Environmental Impact, and System Manageability; however, it does much worse on Demonstrate Integration of Programs (which is given little weight in the analysis).

The performance profiles shown in Figure 7-11 are in terms of the seven major categories of public values that were identified for the analysis. The discussion above is an analysis at the major-category level. Comparisons are also possible at the level of specific criteria. Figure 7-12 presents all ten possible paired comparisons analyzed at the level of specific criteria. For each of these ten comparisons, shown are the overall scores for the two technical options being compared, and the difference in their scores. It is this difference that each comparison accounts for. For example, when comparing Existing Modular with New Modular, this difference is 0.015 on a 0-to-1 scale. This difference is accounted for graphically by the bars for this comparison. The first bar represents this total difference, and it is in the Existing Modular column, showing that the overall difference favors Existing Modular. The other bars are ordered according to the magnitude of the differences, and their lengths are relative to the total difference in the first bar. The bars under Existing Modular are for those criteria that favor

that option, and the bars under New Modular are for those criteria that favor that option. If all the bars favoring Existing Modular were joined end-for-end and compared to all the bars on the left similarly joined, the total length for Existing Modular would be longer by the amount of the total difference bar at the top. This analysis shows how the technical option's scores on specific criteria account for the overall differences, and shows the tradeoffs that are involved at the level of specific criteria.

Consider, for example, Existing Modular as compared with Existing Singular. These were the two non-dominated options identified in the cost-benefit analysis. Figure 7-12 shows that the overall difference is 0.067 in the favor of Existing Modular. Figure 7-12 also shows that the criteria favoring Existing Modular include Public Transportation Safety, Short-Term Environmental Impact, Making Available Areas of High Use Value, Public Radiation Exposure--Chronic, Long Term Environmental Impact, Public Chemical Exposure--Chronic, and Minimize D&D Costs to Programs. Criteria that favor Existing Singular are Commuter Transportation Safety, Capture Economic Opportunities Locally, Integrated Use of Facilities, and miscellaneous other criteria.

7.4.5 Sensitivity Analysis

A sensitivity analysis was also carried out to explore the robustness of technical option rankings to changes in the weights assigned to major public value categories. This is separate from the sensitivity analysis to different value perspectives shown in Figure 7-5. The sensitivity analysis to weights placed on the major categories of public values is shown in Figure 7-13. Each panel in this figure shows the effect of varying the weight placed on one public value from 0% to 100% while keeping the weights on the other public values at their relative proportions.

Consider the panel for Worker Health and Safety shown in the upper right corner of the first page of Figure 7-13. The horizontal axis is the percent weight placed on this panel. The vertical axis is Overall Public Value on a 0-to-1 scale. The plotted lines show how the Overall Public Value for each of the technical options changes as a function of the weight placed on Worker Health and Safety. (Note that the order in which the lines appear in the legend is the same order in which they fall at 100% weight on the right, and that, because some of the coded lines were slightly corrupted in the reduction, this should be the basis for judging which lines correspond to which options.) The other vertical line, at 19%, marks the weight used in the analysis. One can move this line mentally from side to side to see the impact of changing the weight on Worker Health and Safety. One can see from this panel that placing less weight on Worker Health and Safety would not change the order in which the technical options were ranked. If additional weight is placed on Worker Health and Safety, then at about 30% weight New Common becomes the highest ranked option, and at about 40% weight Existing Singular becomes the highest ranked option and remains so regardless of how much additional weight is placed upon Worker Health and Safety. Thus, the ranking for Existing Modular is seen to be fairly robust within a wide range of weights for this particular objective.

Consider the final panel on the second page of Figure 7-11. Here it can be seen that Existing Modular is ranked first regardless of the weight placed on Socioeconomic Impact. If no weight were placed on Socioeconomic Impact, it would still score well enough on the other objectives to be ranked first, and if all the weight were placed on Socioeconomic Impact, it would still rank first because it scored highest on this objective.

The rank for Existing Modular is fairly robust within the range of weights that were elicited. For each of the categories of public value, if one considers the range of weights placed on them by the four respondents as shown in Table 7-5, then Existing Modular remains the highest ranked technical option over the range of weights obtained for all but two of the categories. The two categories for which this does not hold are Environmental Impact and Demonstrate Integration of Programs. If the weight on Environmental Impact is decreased from 13% to 8%, then Existing Modular becomes a very close third behind New Common and New Modular. If the weight on Demonstrate Integration of Programs is decreased from 6% to 3%, then Existing Modular ranks second to New Modular. However, for either of these objectives, increasing rather than decreasing the weight does not change the order of the ranking within the range of all the weights that were elicited. This analysis, combined with the analysis from different value perspectives in which Existing Modular was always ranked first, seems to indicate that the ranking of first for Existing Modular is robust over a wide range of relative values.

7.4.6 Risk Analysis

The risk analysis is based upon the uncertainties described in Section 7.2.5. This analysis considers the risk to cost and schedule from three sources: (1) regulatory uncertainty, (2) uncertainty concerning the resolution of waste-processing issues, and (3) funding uncertainties. The results of this analysis are illustrated in Figures 7-14 and 7-15. Figure 7-14 shows the risk profile for cost in the form of a cumulative distribution function (CDF) on total cost, and Figure 7-15 shows the risk profile for schedule risk as a CDF on number of years until start up. The figures show CDFs for each of the technical options except for the Program Baseline. Risk data for the Program Baseline were not collected.

In order to understand the risk information contained in the CDF, consider Figure 7-14. Each point on a CDF represents the probability, on the Y-axis, that the cost will be less than or equal to the amount on the X-axis. Thus, for example, there is a 25% chance that the cost for New Common will be less than or equal to $2.9 billion. The CDFs are based upon the possible scenarios illustrated by the decision tree shown in Figure 7-3, the data in Tables 7-2 through 7-4, and the estimated costs in Table 7-6. The CDFs were constructed by calculating, for each of the 96 possible paths through the decision tree, the probability of that combination of events occurring and the resulting net impact to cost and schedule if that combination of events did occur.

The CDFs in Figure 7-14 show at a glance the cost risk for each of the technical options. One can see, for example, that the risk associated with New Common is the greatest of all the options. The cost for this option could potentially be as little as $2.7 billion to as much as $3.4 billion-- a range of $700 million. The cost risk for New Modular is considerably less--a range of approximately $300 million. Also shown in Figure 7-14 are the expected

(most likely or average) costs when risk are considered. Shown for comparison (in parentheses) are the estimated costs without consideration of risk, which were available from Table 7-6 as well as from Figure 7-6. Thus, as can be seen from Figure 7-14, the expected cost of Existing Modular is $2.144 billion as compared with $2.1 billion when risk is not considered.

The large cost-risk for New Common is the cumulative risk from the perspective of all the sources considered. It involves a large single-item capital cost that would require a different approval process. Because all the processes would be in a single building, the resolution of specific processing uncertainties has the potential to impact all the processing. Similarly, with regulatory uncertainties, the failure to resolve specific issues has the potential to affect a wider scope of operations. Any of these potential delays can be costly, which is reflected in the greater range of potential costs as seen in Figure 7-14.

New Common is also the most risky from a schedule perspective. There is 5% chance that the start-up of a New Common facility could be delayed for more than 20 years. Figure 7-15 shows that the remaining three options have nearly identical risk profiles for Schedule. It is interesting to note that the risk analysis shows an expected start-up date of 16 years for New Common, and 12 years for the other three options. This compares to 8 and 6 years, respectively, for the estimates that did not consider risks. Thus, considering risk doubles the time required until start-up in every case.

7.5 DISCUSSION/SUMMARY

Figure 7-16 summarizes much of the analysis that has been described in the preceding sections. For each technical option this figure shows the overall public value and risk-based estimates of the option's costs. The horizontal lines show 90% confidence intervals for cost. These represent the range in costs such that there is only one chance in twenty that they would fall above the range and one chance in twenty that they would fall below the range. (Estimates for the Programs Baseline are not risk-based and no range is given.) The vertical lines show the ranges in overall public value based upon the three value perspectives as depicted in Figure 7-5 and described in Section 7-4.2.

Thus, Figure 7-16 shows for each option the best estimates of its costs and overall value, as well as how far it may reasonably be thought to deviate from these estimates, given uncertainties in cost and value tradeoffs. As can be seen in the figure, there is no overlap of the options, even when considering their regions of uncertainties. This allows one to conclude that the analysis shown on Figure 7-7, which was based on best estimates, still applies given uncertainties in cost and value tradeoffs. Consequently, we can be confident in the assertion that Existing Modular dominates all the technical options except for Existing Singular, and the fundamental decision is whether the additional value offered by Existing Modular is worth the additional costs.

The additional value offered by Existing Modular over Existing Singular is due to Public Health and Safety, Environmental Impact, and D&D costs savings. The increase in value for Public Health and Safety is due to less potential for chronic exposure to either chemical or radiological contaminants, and increased Public Transportation Safety. The additional

value for Environmental Impact is both short-term, as a result of being further from the Columbia River, and long-term, as a result of fewer acres and sites requiring D&D; thus, there would be less potential for residual contamination.

It should also be pointed out that while Existing Modular costs more overall than Existing Singular, the short-term capital costs and the D&D costs are lower. The greater costs are long-term capital and maintenance and operating which are spread out over the project's life, and therefore may be easier to bear.

It should also be pointed out that the estimated schedule and the risk profile for the schedule are the same for both Existing Modular and Existing Singular. However, the expected start date for all options doubles when risk is considered. This would seem to indicate a benefit from working closely with regulators in the near-term to resolve regulatory issues and processing uncertainties.

The cost risk does not appear to be as great for existing options as for new construction options -- especially New Common. It should, however, be pointed out that the cost uncertainties are most likely underestimated. The estimates are from potential impacts of external events, that is, events to some extent outside the control of the Solid Waste Program. The impacts from these events are important to consider; however, they are not the only source of uncertainty in the cost estimates. Cost estimates come from the aggregation of many individual estimated cost parameters, each of which has associated uncertainties. An analysis including these parametric uncertainties would show greater overall uncertainties for costs. Thus, the 90% confidence intervals for cost depicted in Figure 7-14 are most likely too narrow.

7.6 REFERENCES

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Von Neumann, J. and O. Morgenstern (1947), *Theory of Games and Economic Behavior*, Princeton University Press, Princeton, New Jersey.

Figure 7-1 Public Values Used in the Analysis of Solid Waste Technical Options

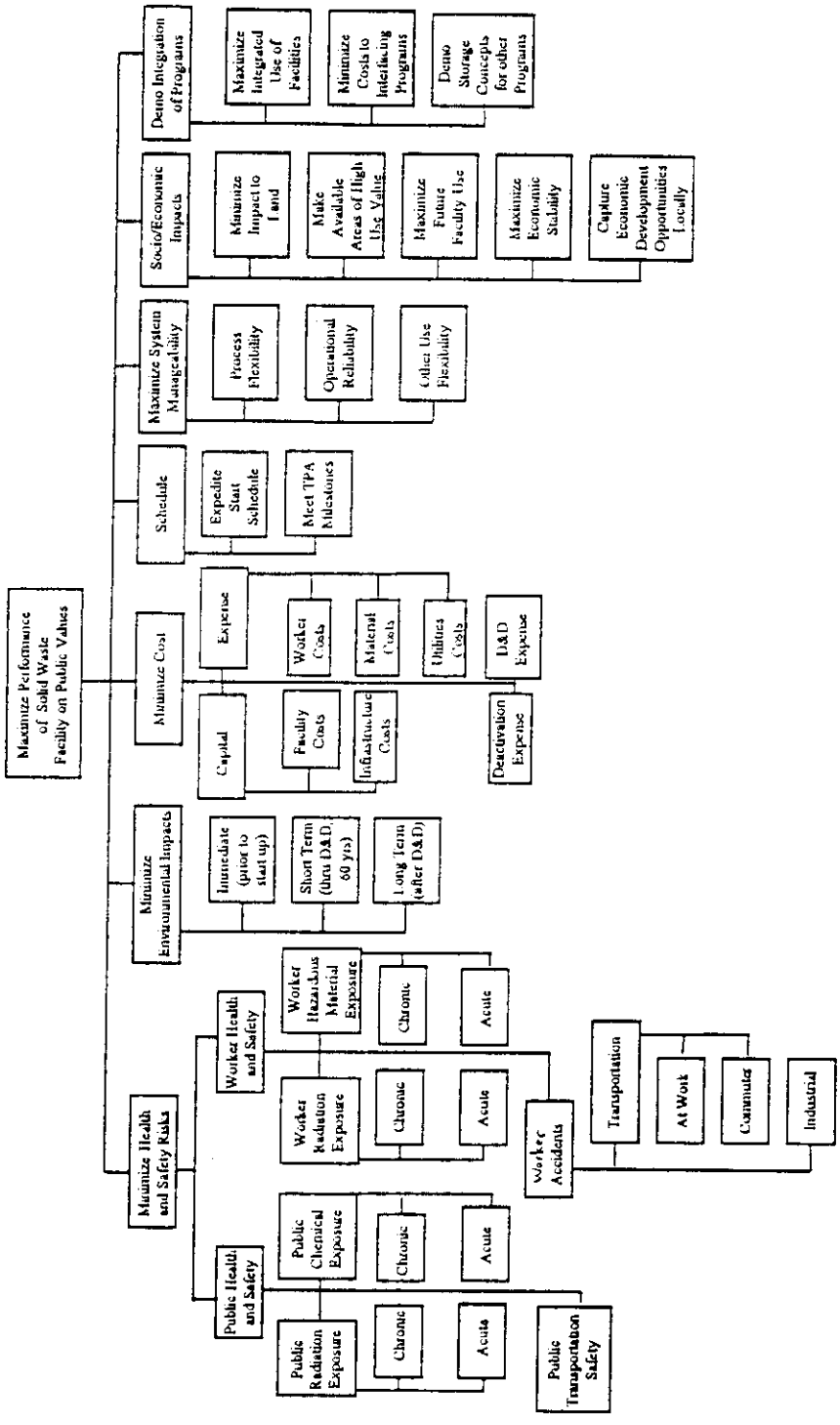


Figure 7-2 Example Value Functions Used in Solid Waste Technical Options

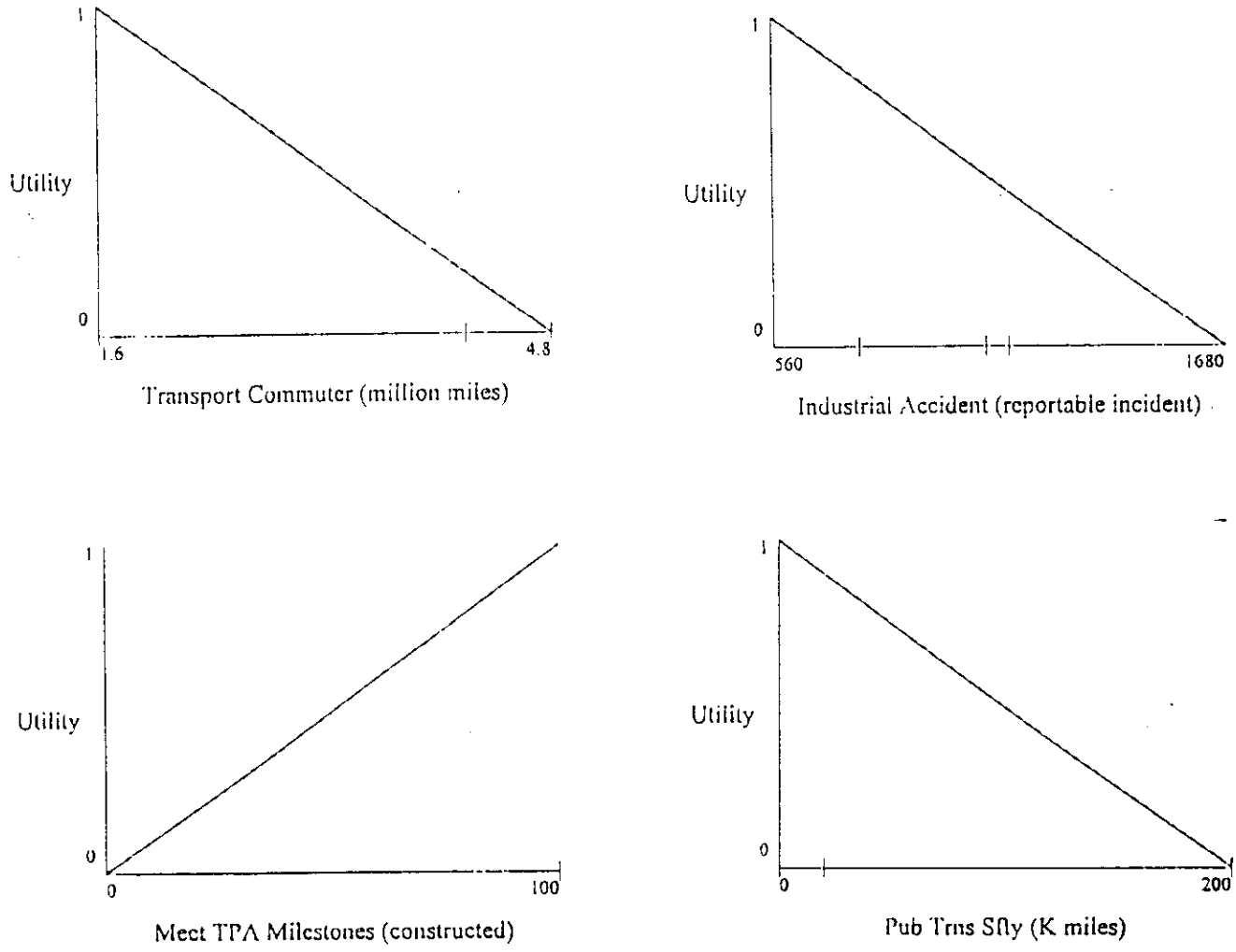


Figure 7-3 Decision Tree Showing Possible Scenarios Resulting in Impacts to Cost and Schedule.

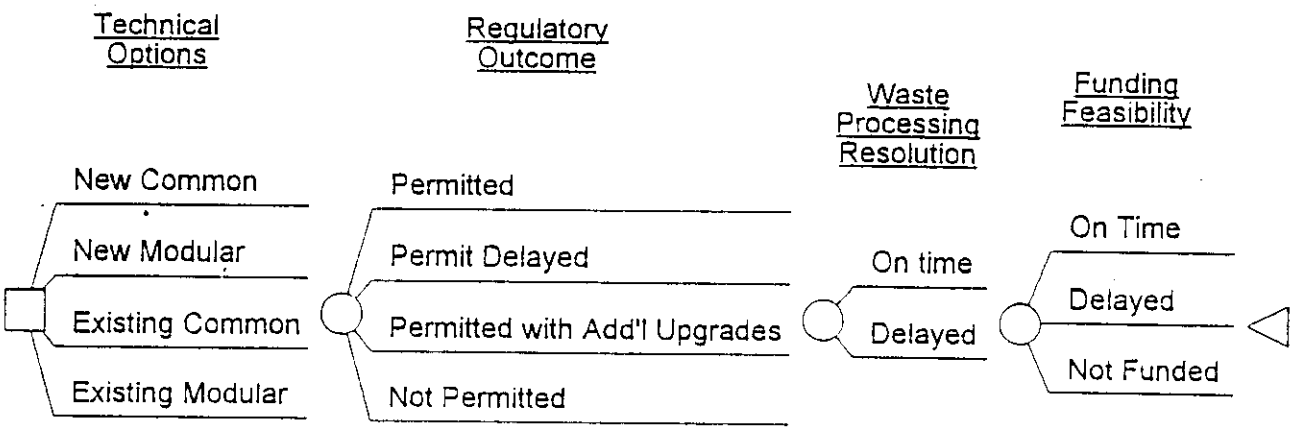
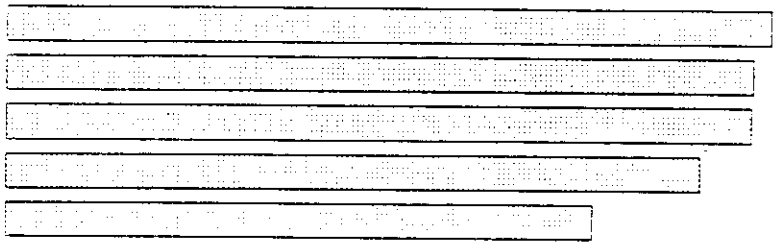


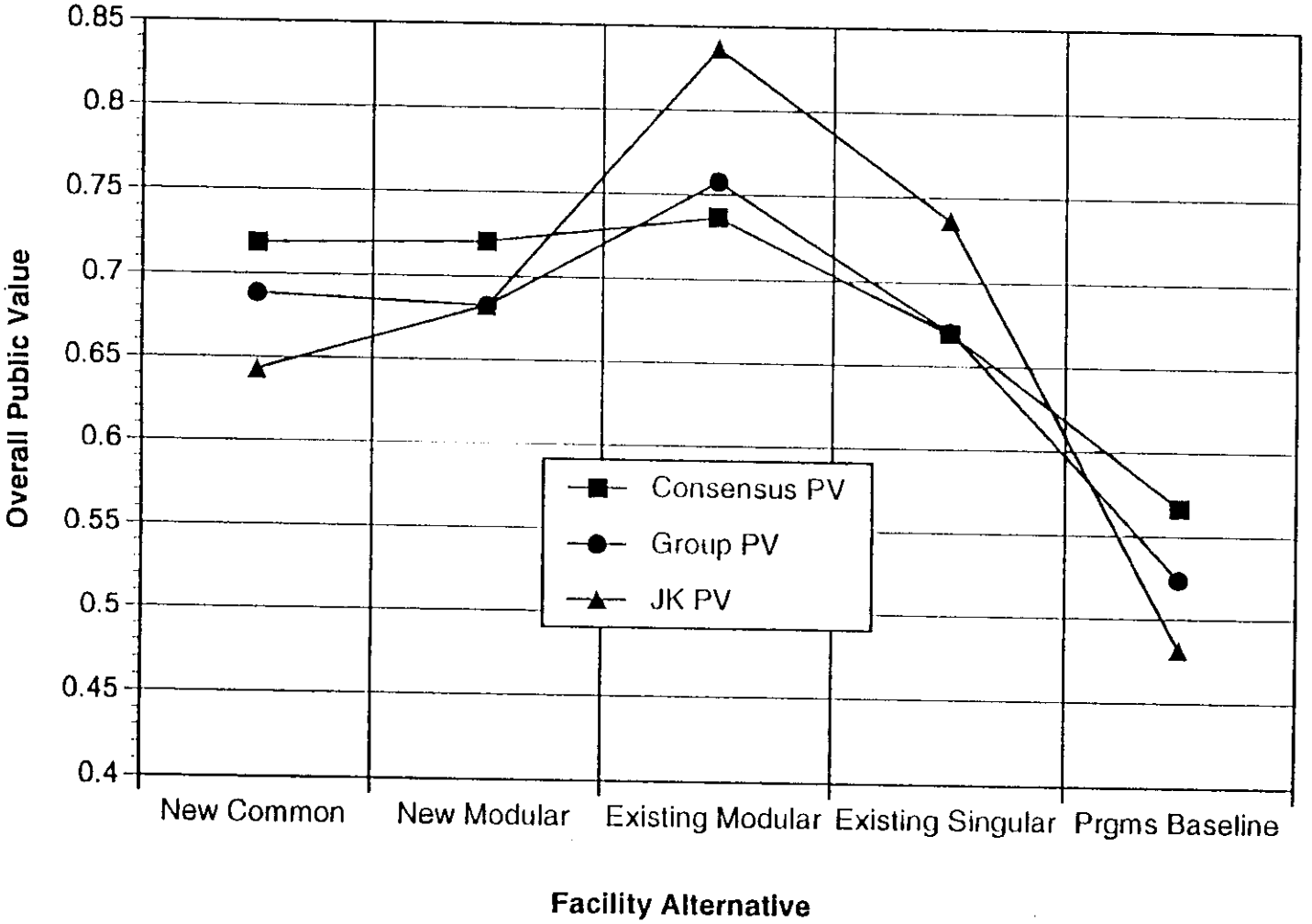
Figure 7-4 Overall Performance on Public Values

Alternative	Value
Existing Modular	0.737
New Modular	0.721
New Common	0.719
Existing Singular	0.670
Program Baseline	0.567



Preference Set = Consensus Average

Figure 7-5 Analysis Comparison for Different Value Perspectives



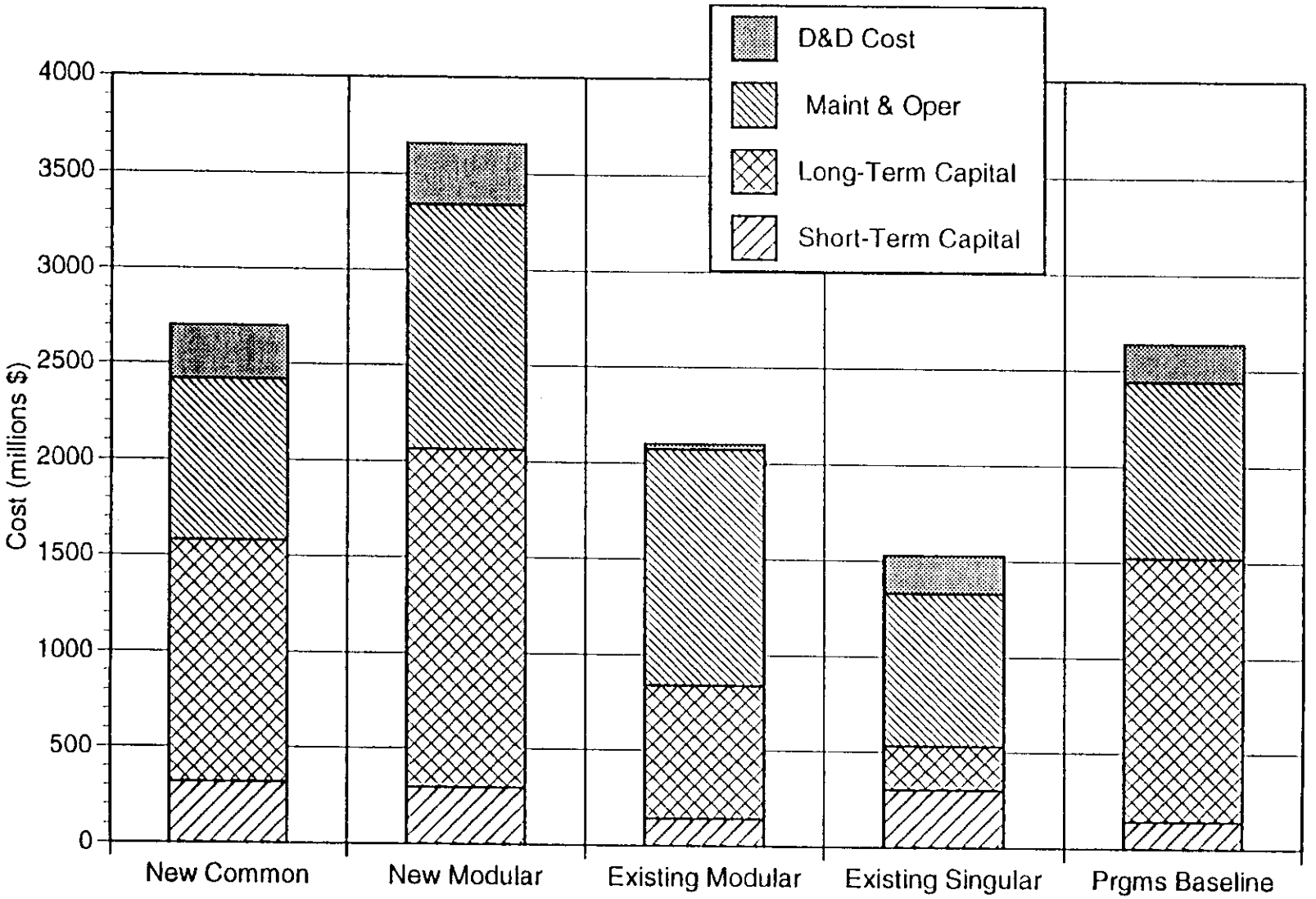


Figure 7-6 Solid Waste Technical Options Cost Comparison

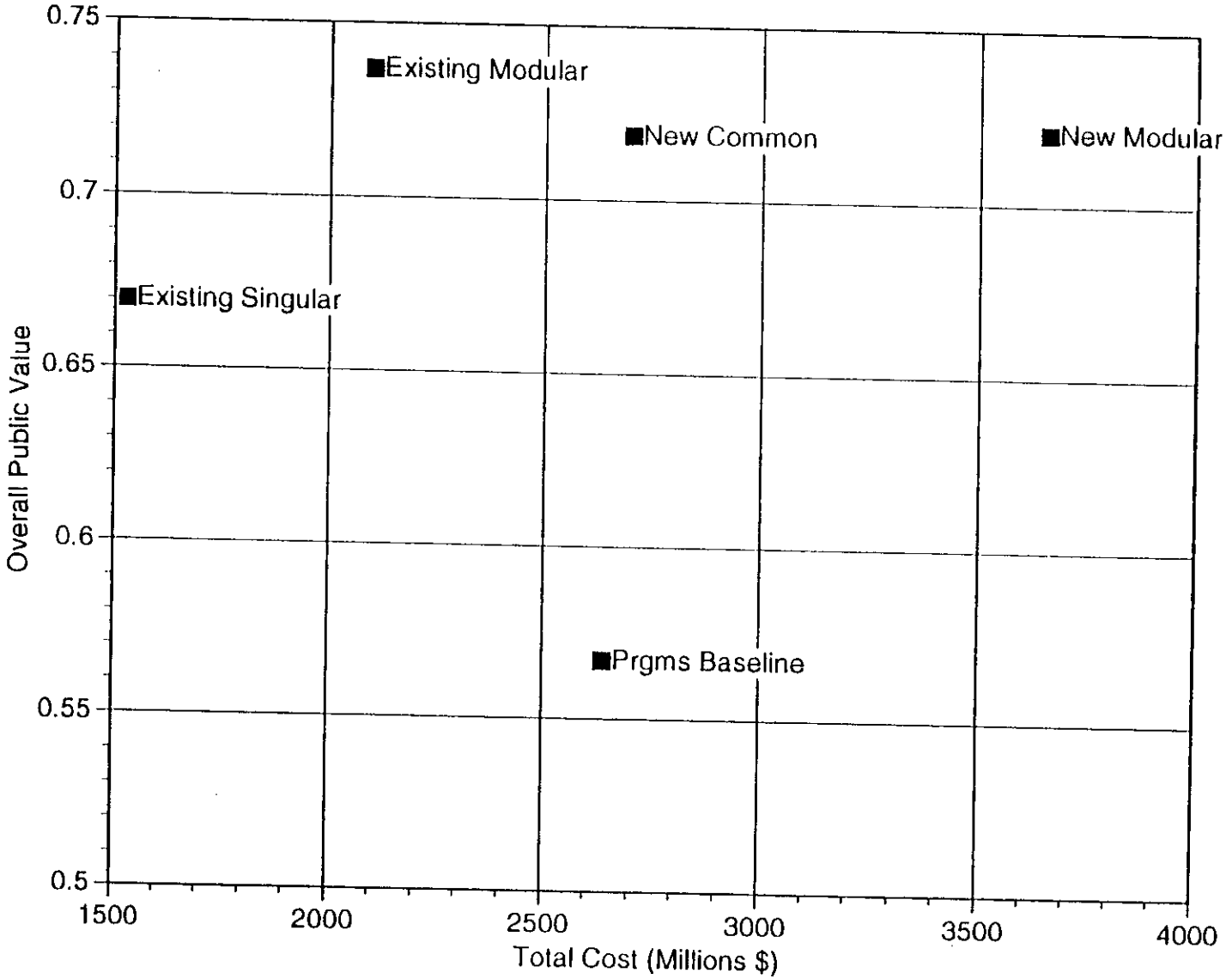
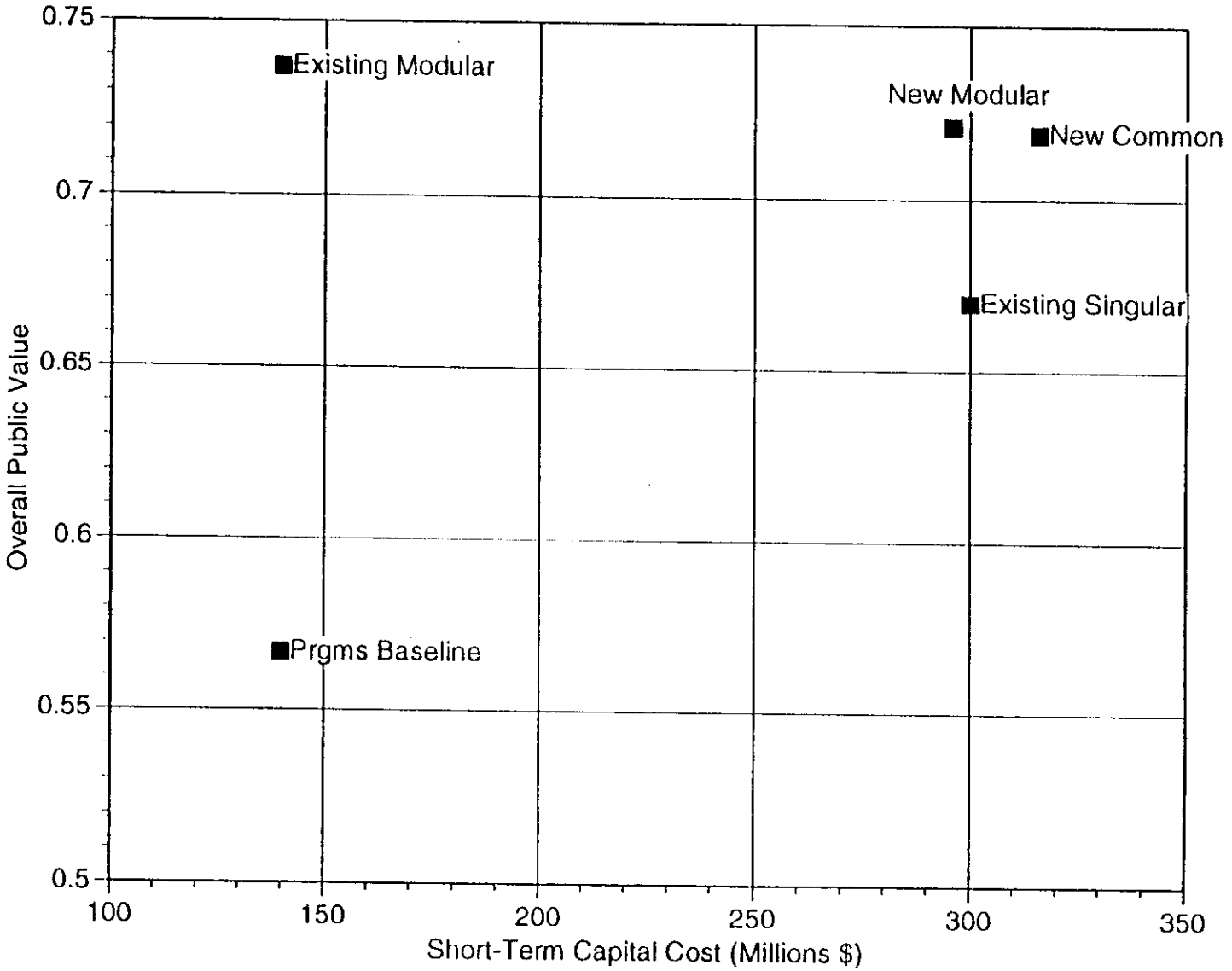


Figure 7-7 Composite Public Value versus Total Cost

Figure 7-8 Composite Public Value vs. Short-Term Capital Cost



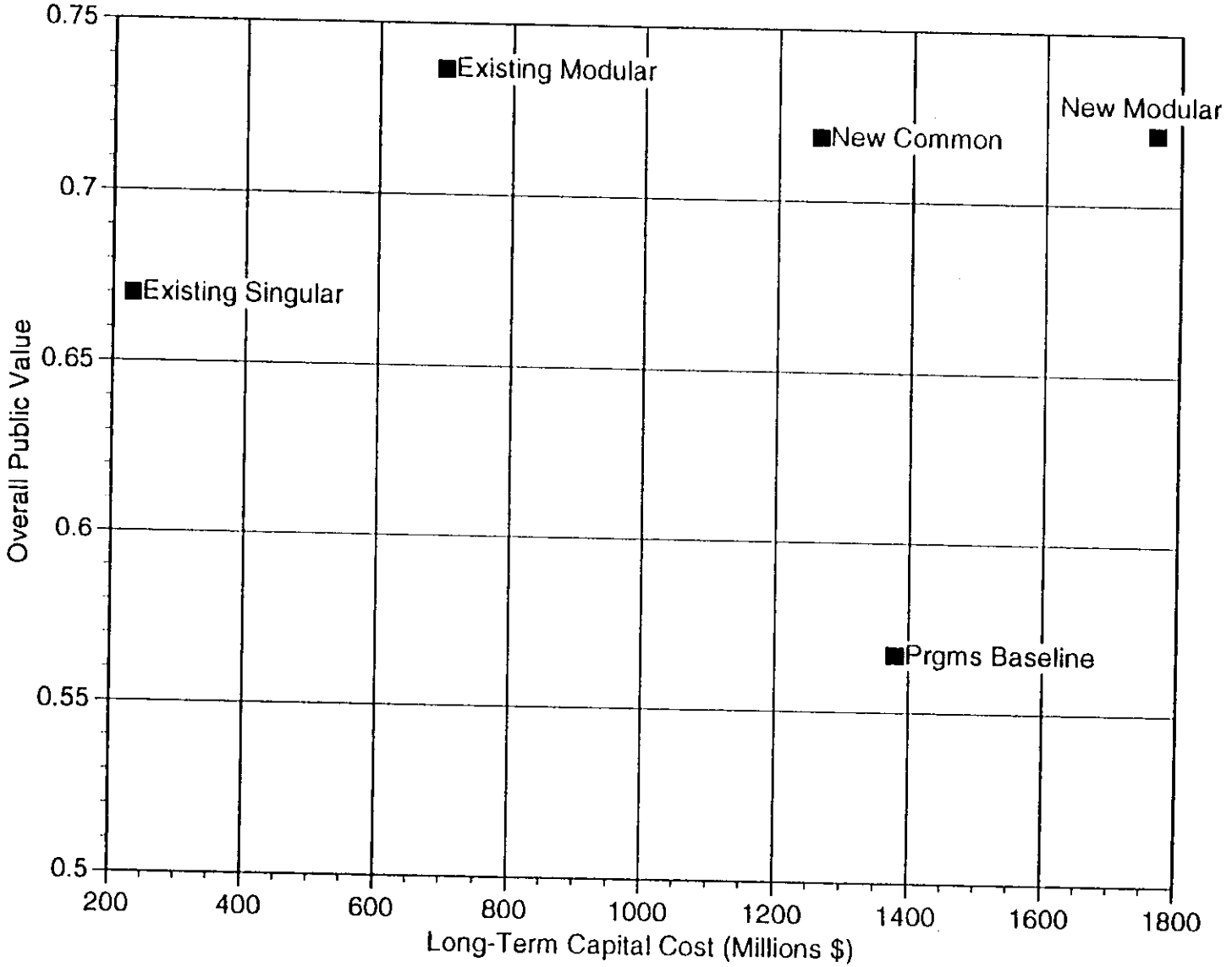


Figure 7-9. Composite Public Value vs. Long-Term Capital Cost

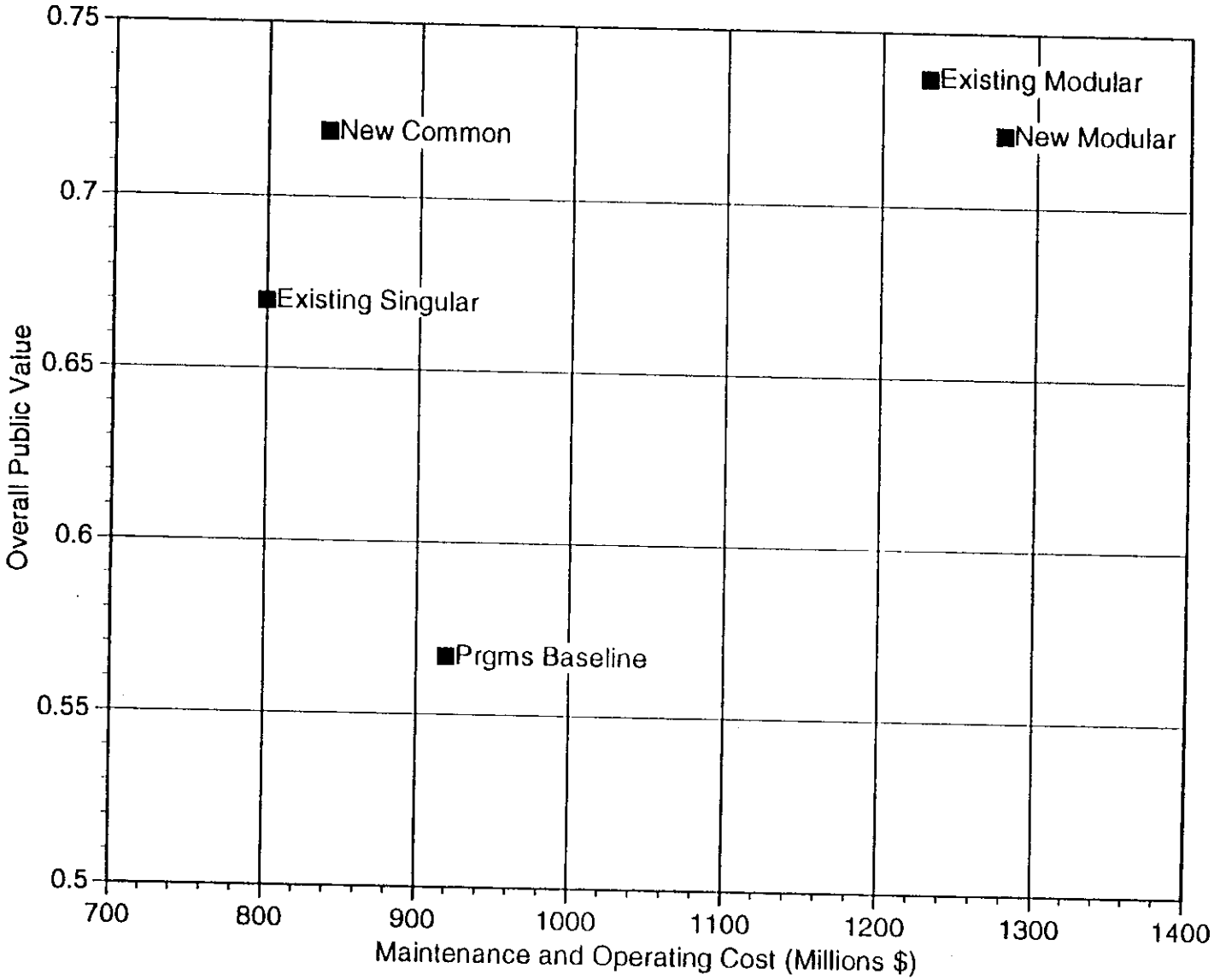


Figure 7-10 Composite Public Value vs. Maintenance and Operating Cost

Figure 7-11 Performance Profile for Solid Waste Technical Options

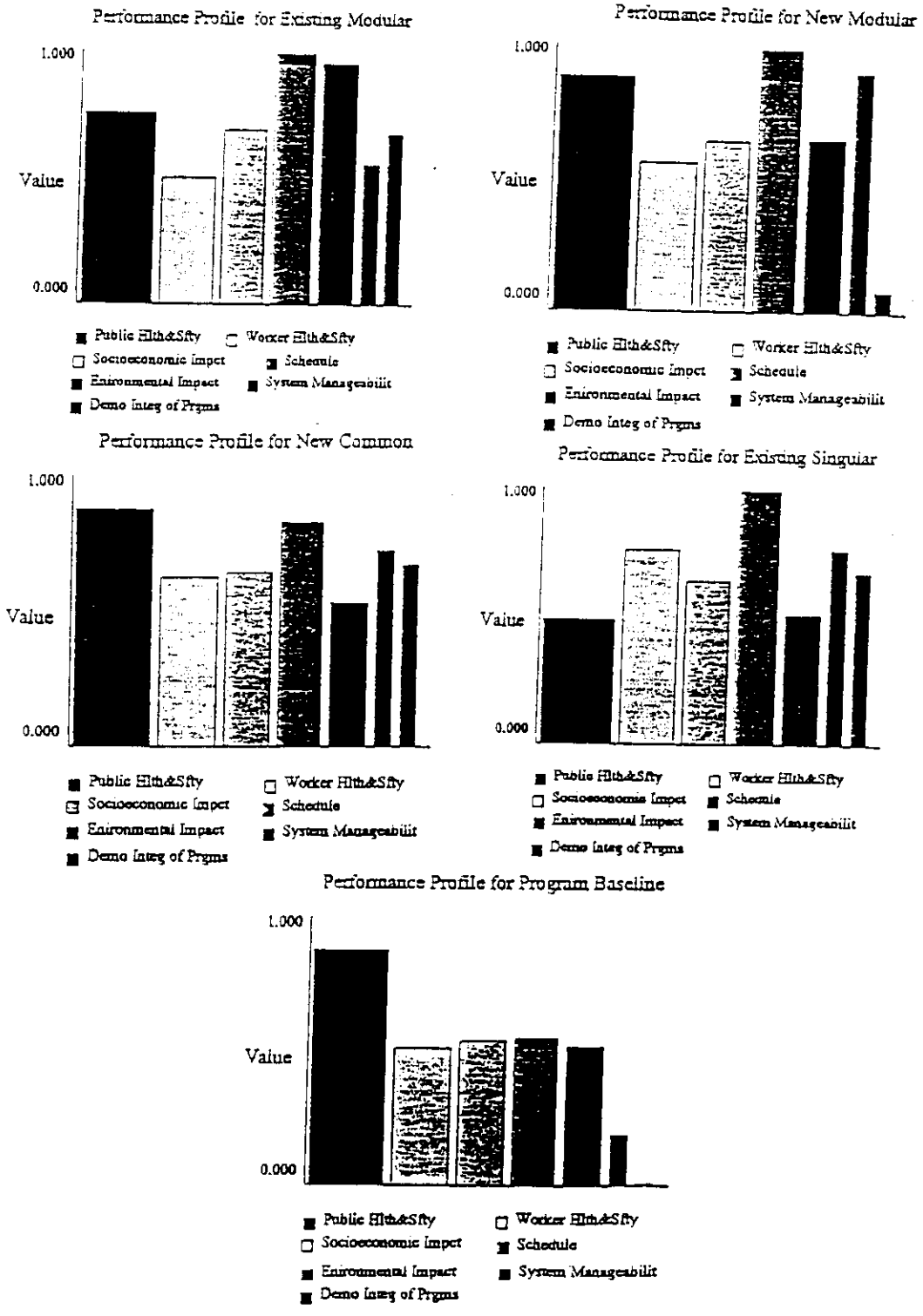
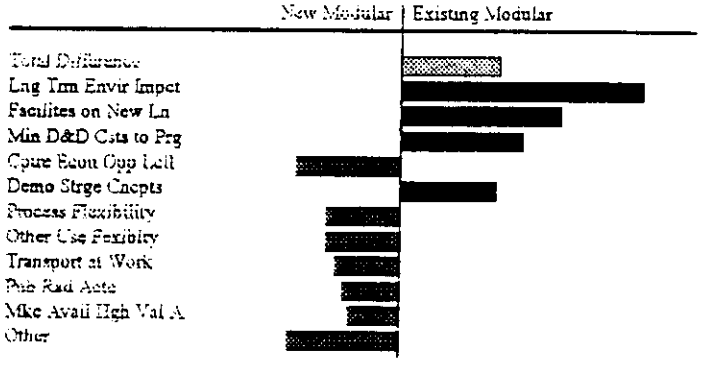
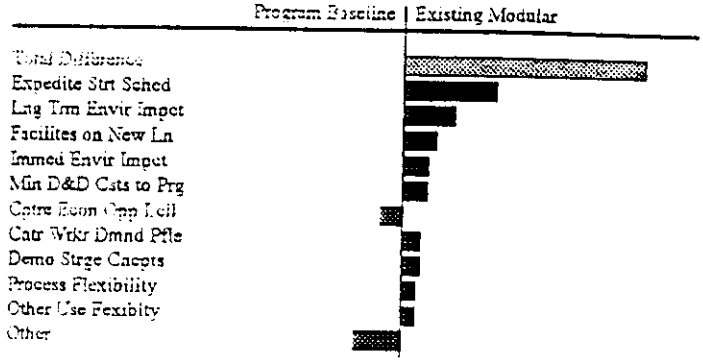


Figure 7-12 Paired Comparisons of Technical Options on Individual Criteria (Page 1 of 2)

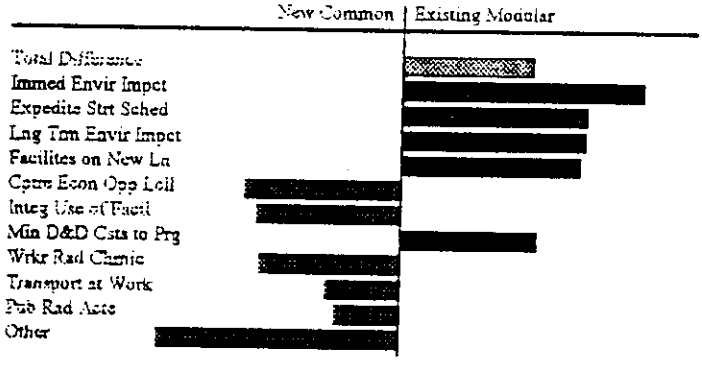
Overall Value for		
	Existing Modular (Alt1)	0.737
	New Modular (Alt2)	0.721
	Difference	0.015



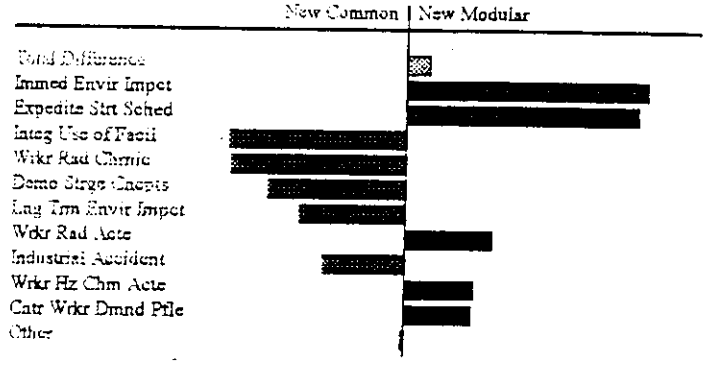
Overall Value for		
	Existing Modular (Alt1)	0.737
	Program Baseline (Alt2)	0.567
	Difference	0.170



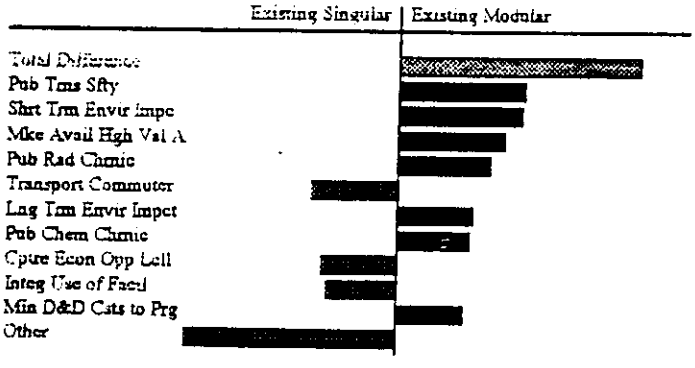
Overall Value for		
	Existing Modular (Alt1)	0.737
	New Common (Alt2)	0.719
	Difference	0.018



Overall Value for		
	New Modular (Alt1)	0.721
	New Common (Alt2)	0.719
	Difference	0.003



Overall Value for		
	Existing Modular (Alt1)	0.737
	Existing Singular (Alt2)	0.670
	Difference	0.067



Overall Value for		
	New Modular (Alt1)	0.721
	Existing Singular (Alt2)	0.670
	Difference	0.052

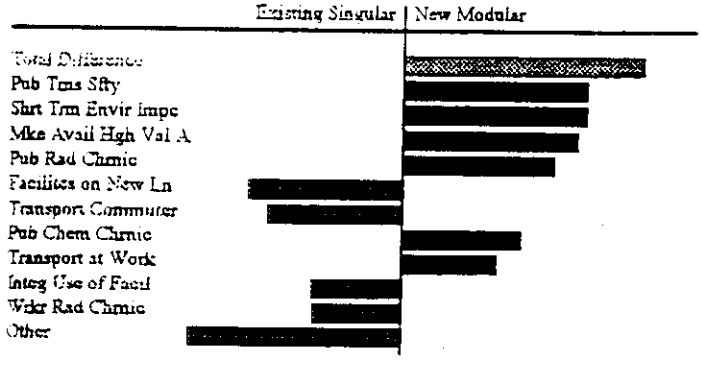
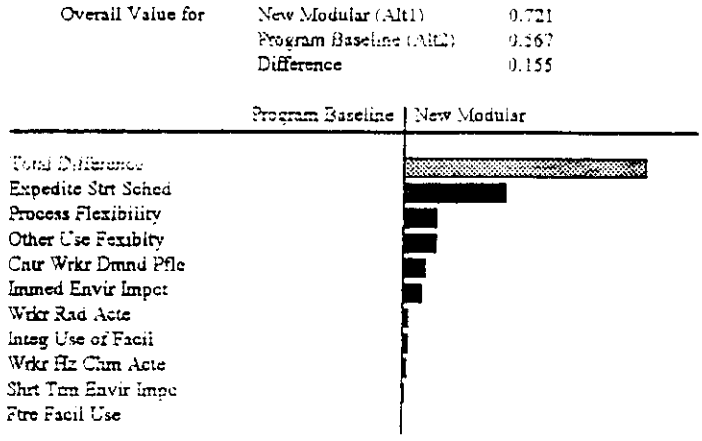
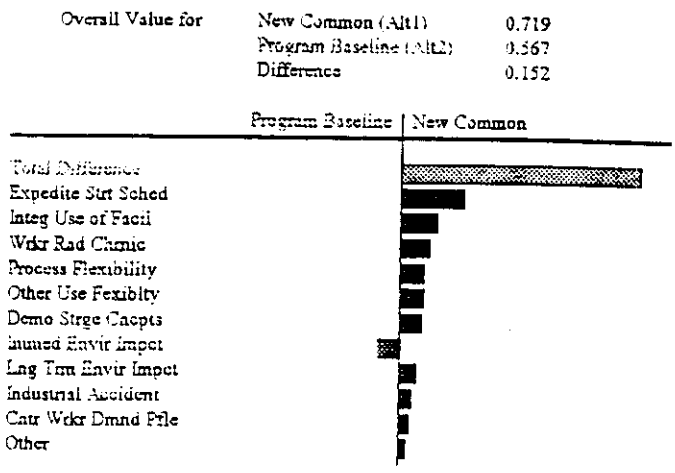
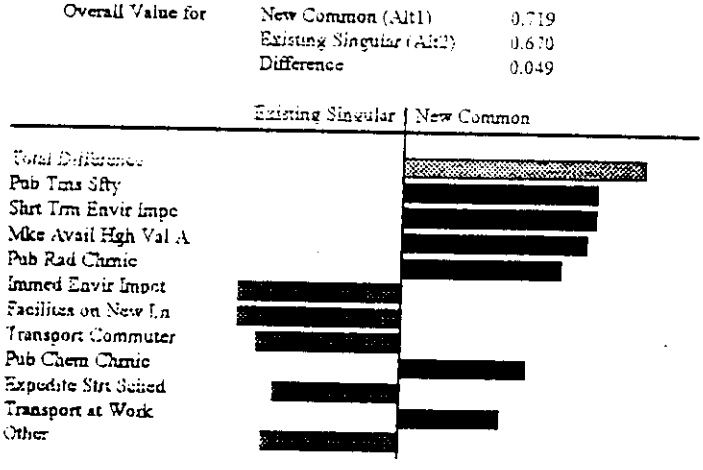


Figure 7-12 Paired Comparisons of Technical Options on Individual Criteria (Cont. Page 2 of 2)







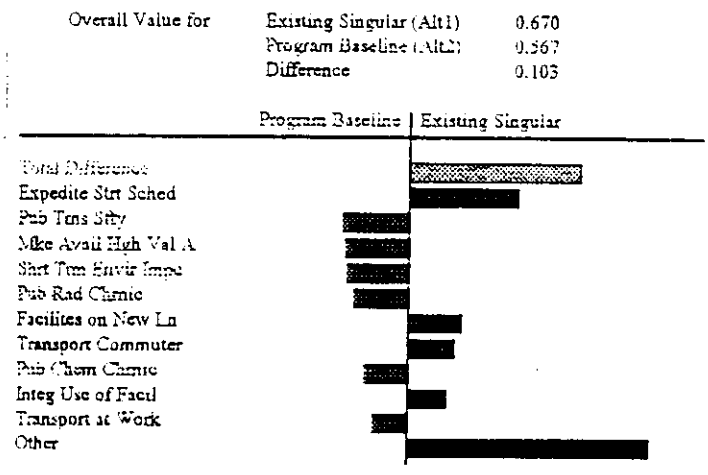
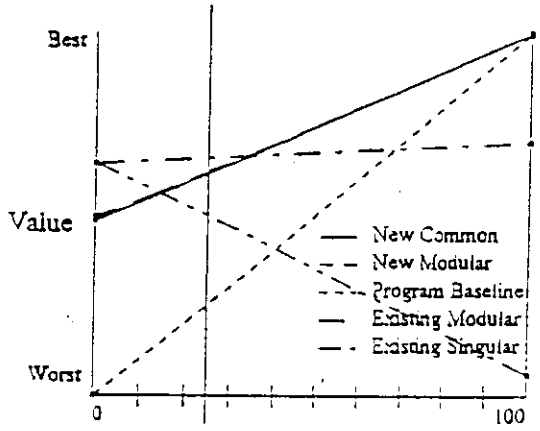
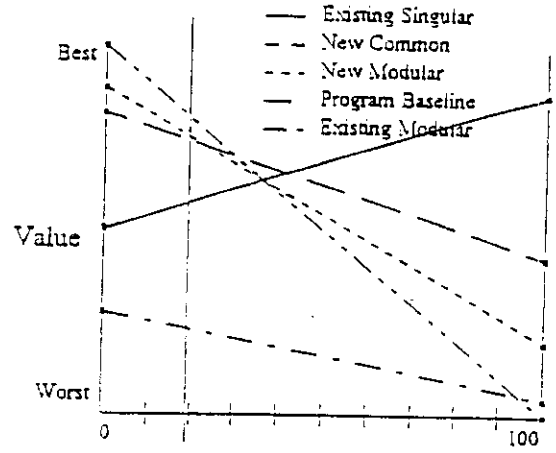


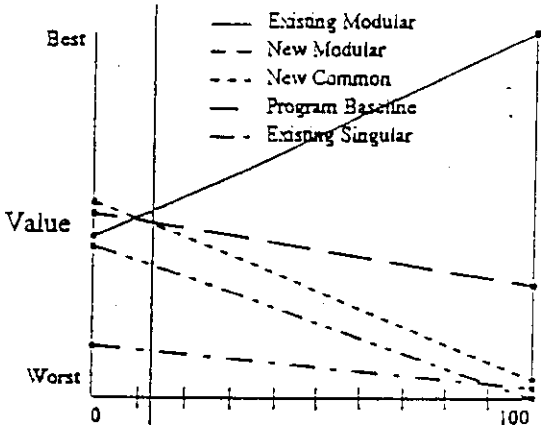
Figure 7-13 Sensitivity of Overall Public Value to Weights Placed on Specific Public Values (Page 1 of 2)



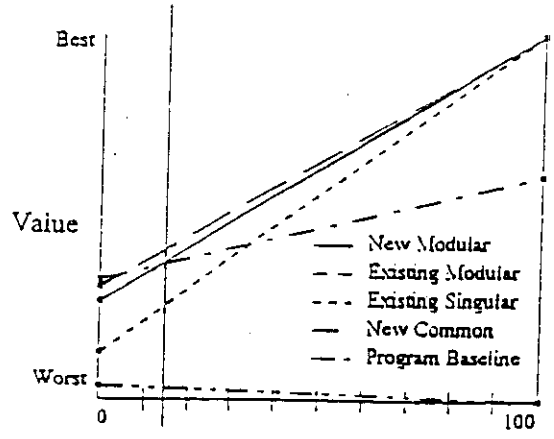
Percent of Weight on Public Hlth&Sfty Objective



Percent of Weight on Worker Hlth&Sfty Objective

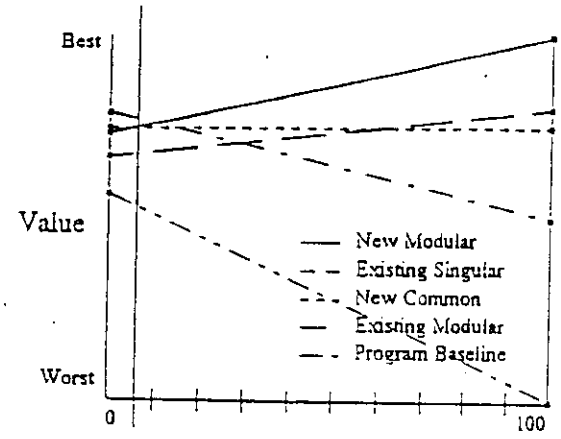


Percent of Weight on Enironmental Impact Objective

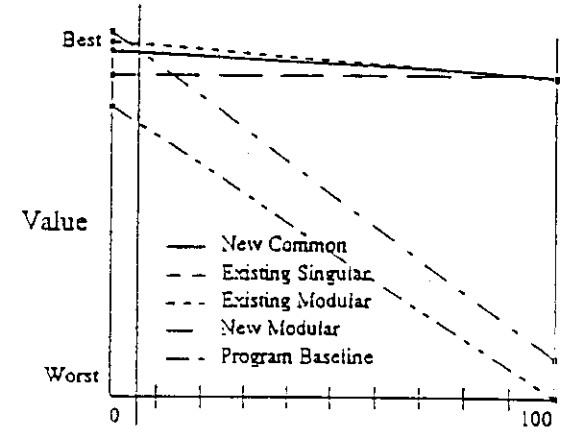


Percent of Weight on Schedule Objective

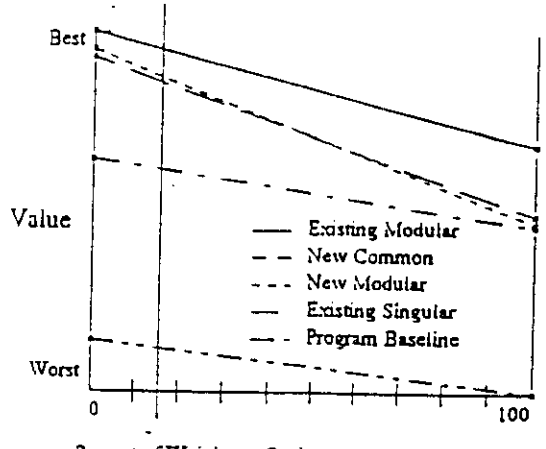
Figure 7-13 Sensitivity of Overall Public Value to Weights Placed on Specific Public Values (Cont. Page 2 of 2)



Percent of Weight on System Manageabilit Objective



Percent of Weight on Demo Integ of Prgms Objective



Percent of Weight on Socioeconomic Impct Objective

Figure 7-14 Risk Profile for Cost of Technical Options

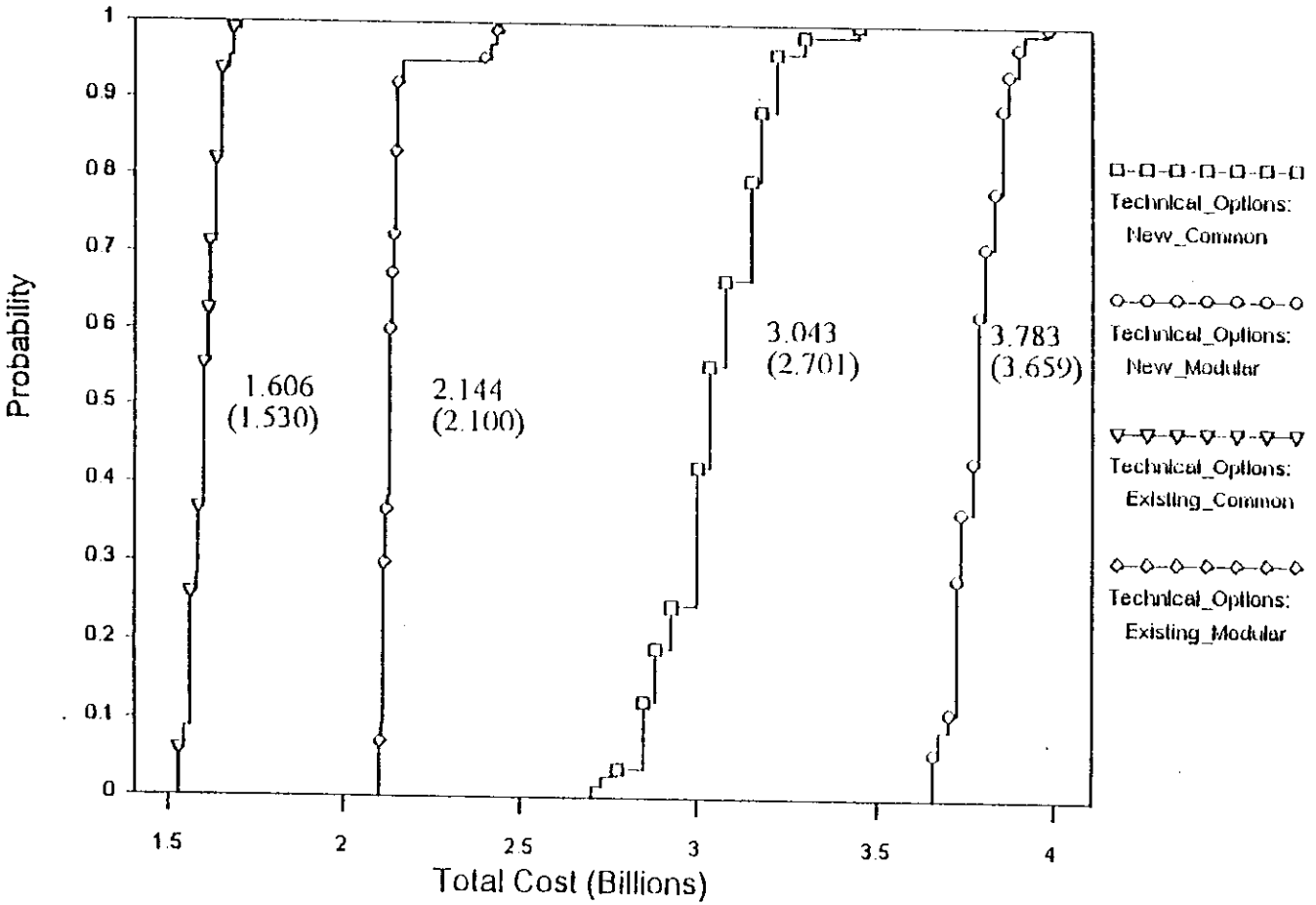
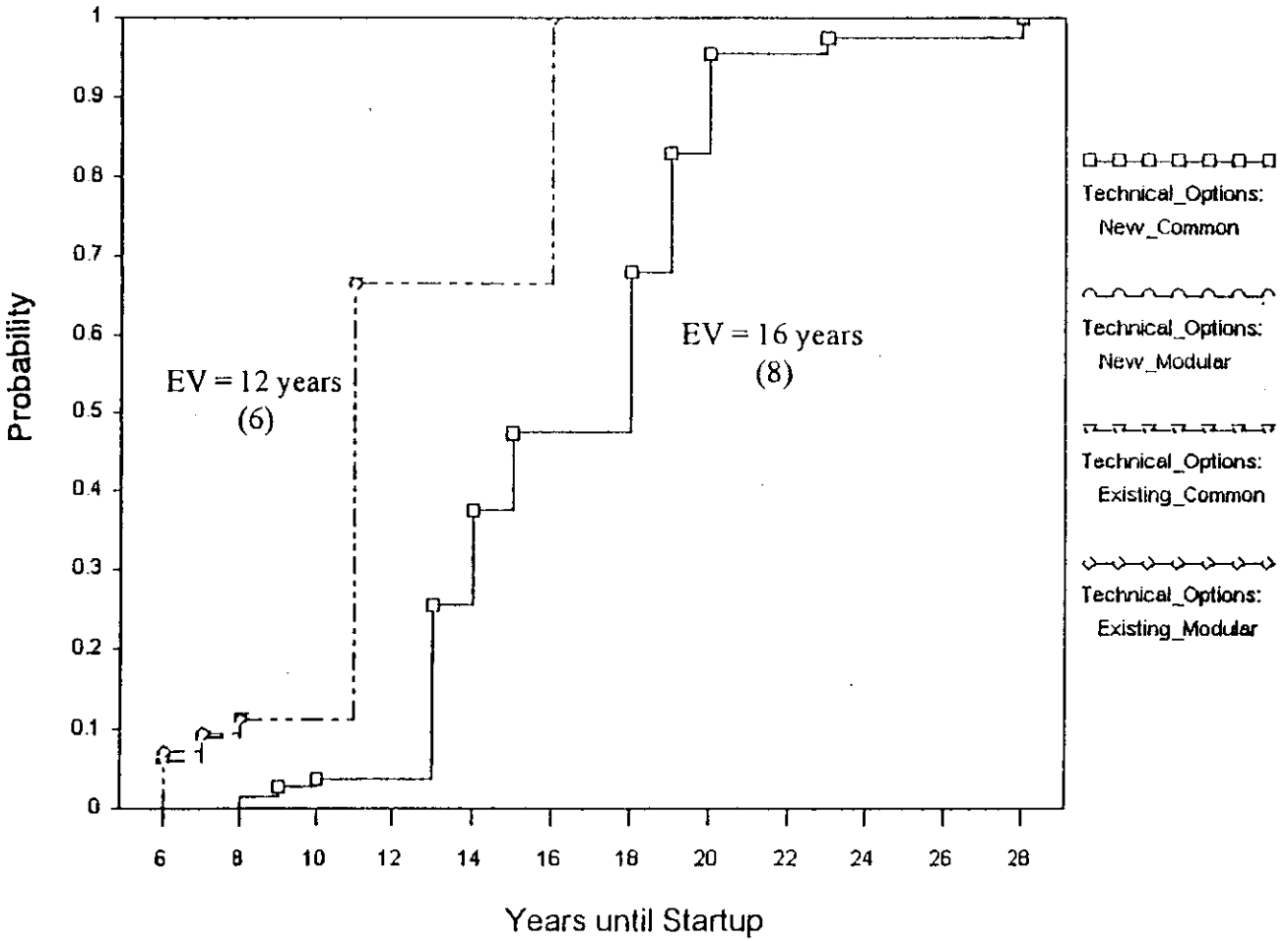


Figure 7-15 Risk Profiles for Schedule for Technical Options



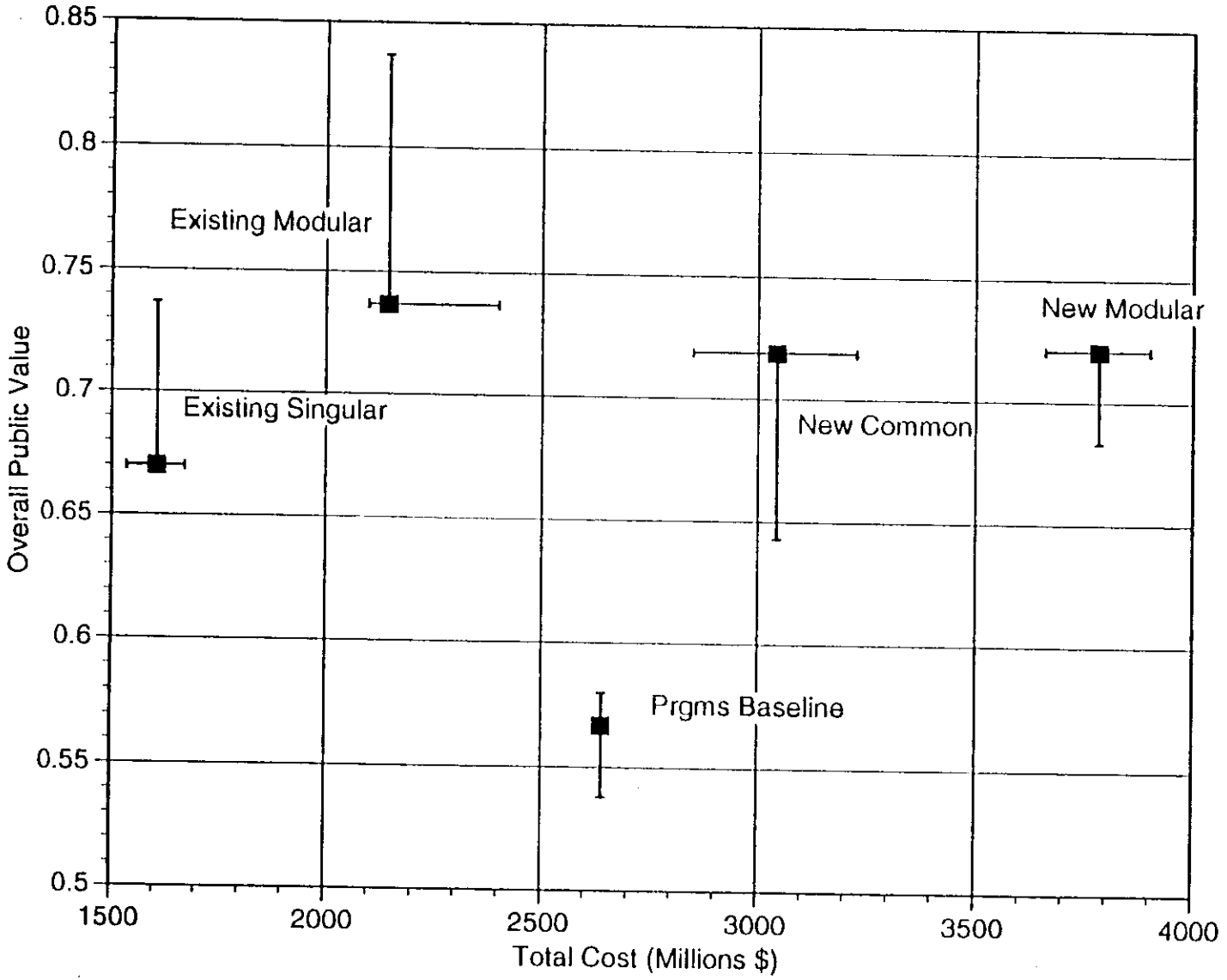


Figure 7-16 Composite Public Value versus Total Cost Using Risk Analysis Data and Value Perspective Ranges

Table 7-1 Scales Used in the Analysis of Solid Waste Technical Options (Page 1 of 4)

PUBLIC VALUES/CRITERIA		SCALE
Health and Safety		
Public Radiation Exposure		
	Chronic	Distance in miles from major populaton center (10 to 25)
	Acute	Distance in miles from major populaton center (10 to 25)/Safety Class (>3 to 1)
		100. 25 miles and safety class 1.
		90. 25 miles and safety class2.
		80. 25 miles and safety class 3 or 10 miles and safety class 1.
		70. 10 miles and safety class 2.
		60. 10 miles and safety class3.
		30. 25 miles and safety class >3.
		0. 10 miles and safety class >3.
Public Chemical Exposure		
	Chronic	Distance in miles from major populaton center (10 to 25)
	Acute	Distance in miles from major populaton center (10 to 25)/Safety Class (>3 to 1)
		100. 25 miles and safety class 1
		90. 25 miles and safety class2.
		80. 25 miles and safety class 3 or 10 miles and safety class 1.
		70. 10 miles and safety class 2.
		60. 10 miles and safety class3.
		30. 25 miles and safety class >3.
		0. 10 miles and safety class >3
Public Transportation Safety		Number of miles transporting solid waste on public roads (200K [Expected .048 accidents] to 0)
Worker Health and Safety		
Worker Radiation Exposure		
	Chronic	Number of Radiation Workers
	Acute	Maximum number of individuals that could be exposed in single incident (245 to 40)/ Safety Class (>3 to1)
		100. 40 Workers and safety class 1.
		90. 40 workers and safety class2.
		80. 40 workers and safety class 3 or 245 workers and safety class 1.
		70. 245 workers and safety class 2.
		60. 245 workers and safety class3.
		30. 40 workers and safety class >3.
		0. 245 workers and safety class >3.

Table 7-1 Scales Used in the Analysis of Solid Waste Technical Options (Cont. Page 2 of 4)

PUBLIC VALUES/CRITERIA	SCALE
Worker Hazardous Chemical Exposure	
Chronic	Estimated number of workers for life of project (400 to 150)
Acute	Max no. of individuals that could be exposed in single incident (245 to 40)/Safety Class (>3 to 1)
	100. 40 Workers and safety class 1.
	90. 40 workers and safety class2.
	80. 40 workers and safety class 3 or 245 workers and safety class 1.
	70. 245 workers and safety class 2.
	60. 245 workers and safety class3.
	30. 40 workers and safety class >3.
	0. 245 workers and safety class >3.
Worker Accidents	
Transportation	
At Work	Number miles solid waste materials are transported (600K to 200K) (.145 to .048 Accidents)
Commuter	Worker commuter miles per year from site boundary 4.8M to 1.6M) (4.6 to 1.5 disabling injuries)
Industrial	Number of reportable incidents for life of project (1680 to 560) (15K to 5K person yrs for prj life)
Environmental Impact	
Immediate (prior to start up)	Risk to environment prior to start up (Add'l accum that must be managed if start in 11 yrs instd of 6)
Short term (thru D&D 60 yrs)	Proximity to Columbia River:
	100. All Facilities at least 6 miles from Columbia River in 200 Area
	60. One or more facilities within 4.5 mi of Columbia River; no facilities within 2.5 mi of River
	30. One or more facilities within 2.5 miles of Columbia River
	0. One or more facilities within 1.0 mile of Columbia River
Long term (after D&D)	Number of additional acres and/or sites reqiring D&D.
	100. No additional acreage and/or sites requiring D&D
	65. One additional site and 10 additional acres requiring D&D
	0. Four additional sites and 20 additional acres requiring D&D
Cost	
Short-Term Capital (5 years)	Dollars (Millions)
Long-Term Capital	Dollars (Millions)
Maintenance and Operating Costs	Dollars (Millions)
D&D Costs	Dollars (Millions)
Total Costs	Dollars (Millions)

Table 7-1 Scales Used in the Analysis of Solid Waste Technical Options (Cont. Page 3 of 4)

PUBLIC VALUES/CRITERIA	SCALE
Schedule	
Expedite Start Schedule	Amount and when processing capacities come on line:
	100. 30% on line in 6 years, and the remaining 70% on line in 11 years
	75. 30% on line in 8 yrs, and the remaining 70% on line in 14 yrs, or 100% on line in11 yrs
	25. 30% on line in 15 years, and the ramaining 70% on line in 20years
	0. 100% on line in 20 years
Meet TPA Milestones	Whether a significant delay in major and/or minor TPA milestones:
	100. Meets all TPA milestones
	50. Significant delays in one or more minor milestones but meets all major milestones
	0. Significant delay in a major TPA milestone
System Manageability	
Process Flexibility	Variety of material types and sizes and throughput combinations that can be processed
	100. Facility is easily modified to change relative throughput of waste stream types and can process a variety of waste and material sizes
	0. Physical restrictions of building provide for little or no ability to change relative throughput of waste stream types and is limited in the variety of sizes that can be processed
Operational Reliability	Operating efficiency (60 to 75%)
Other Use Flexibility	Facility potential for processing and storage besides intended campaign (yes or no)
	100. Facility has potential for processing and storage besides intended campaign
	0. No potential for processing and storage besides intended campaign
Socio/Economic Impacts	
Minimize Impact to Land	
Facilities on New Land	Acres required for buildings of undistrbed and/or previous sites:
	100. Buildings on 50 acres of previous site
	30. Buildings on 50 acres of undisturbed land
	20. Buildings on 50 acres of undisturbed land and 20 acres of previous sites
	0. Buildings on 70 acres of undisturbed land
Roads Needed	Miles of road constructed (3 to 0)
Make available areas of high use value	Extent of facilities located outside 200 Area:
	100. All facilities located in 200 Area
	20. Some facilities outside 200 Area
	0. All facilities outside 200 Area
	0. Four additional sites and 20 additional acres requiring D&D

Table 7-1 Scales Used in the Analysis of Solid Waste Technical Options (Cont. Page 4 of 4)

PUBLIC VALUES/CRITERIA	SCALE
Economic Stability	
Construction Worker Demand Profile	Whether demand is even or consists of ups and downs:
	100. Construction demand is at nearly the same level over a period of 10 years
	50. All construction takes place over 2-3 years
	0. Construction demand peaks 2 or 3 times over 10 years, and little or no demand between cycles
Operator Work Demand Profile	Whether demand is even or consists of ups and downs:
	100. Operational worker demand is at nearly the same level for the life of the project
	0. Operational wrkr demand requires periods of multiple shifts and periods below capacity
Capture Economic Oportunities Locally	Amount of economic opportunity for local business:
	100. Solid waste cleanup plan will most likely result in at least one large scale opportunity for a new or existing local business or several moderately sized opportunities
	80. Solid waste cleanup plan will most likely result in at least one moderate scale opportunity for a new or existing local business or several small sized opportunities
	20. Solid waste cleanup will most likely result in one small scale opportunity for a new or existing local business
	0. Solid waste cleanup will most likely result in no new opportunities for a new or existing business
Demo Integration of Programs	
Integrated use of facilities	Extent same facilities are shared by multiple programs:
	100. Multiple programs using the same facilities
	0. All programs using independent facilities
Minimum costs to interfacing programs	Dollars saved by other programs in D&D expenses (0 to TBD)
Demo storage concepts to other programs	Whether demonstrate can store and process other waste types
	100. Can store and process other waste types
	0. Can not store and process other waste types

Table 7-2 Estimated Likelihood and Impacts of Regulatory Outcome

Technical Option	Regulatory Outcome	Prob	Delta Cost (millions)	Years Delayed
New Common	Permitted	0.4	0	0
	Permits Delayed	0.3	30	1
	Upgrades Required	0.25	75	2
	Not Permitted	0.05	300	10
New Modular	Permitted	0.5	0	0
	Permit Delayed	0.25	15	1
	Upgrades Required	0.2	45	2
	Not Permitted	0.05	130	10
Existing Common	Permitted	0.5	0	0
	Permit Delayed	0.25	18	1
	Upgrades Required	0.2	51	2
	Not Permitted	0.05	72	10
Existing Modular	Permitted	0.6	0	0
	Permit Delayed	0.2	5	1
	Upgrades Required	0.15	25	2
	Not Permitted	0.05	30	10

Table 7-3 Estimated Likelihoods and Impact of Unresolved Waste Processing Issues

Technical Option	Waste Processing Resolution	Prob	Delta Cost (millions)	Years Delayed
New Common	Resolved	0.4	0	0
	Not Resolved	0.6	150	5
New Modular	Resolved	0.4	0	0
	Not Resolved	0.6	65	5
Exiting Common	Resolved	0.4	0	0
	Not Resolved	0.6	36	5
Existing Modular	Resolved	0.4	0	0
	Not Resolved	0.6	15	5

Table 7-4 Estimated Likelihoods and Impacts of Funding Uncertainty

Technical Option	Funding Uncertainty	Prob	Delta Cost (millions)	Years Delayed
New Common	On Time	0.1	0	0
	Delayed	0.4	150	5
	Not Funded	0.5	300	10
New Modular	On Time	0.3	0	0
	Delayed	0.4	65	5
	Not Funded	0.3	130	10
Exiting Common	On Time	0.3	0	0
	Delayed	0.4	36	5
	Not Funded	0.3	72	10
Existing Modular	On Time	0.3	0	0
	Delayed	0.4	15	5
	Not Funded	0.3	30	10

Table 7-5 Weights Used in the Analysis of Solid Waste Technical Options (Page 1 of 2)

Public Value/Criteria	SS	AC	JK	LD	Consensus Average	Average	Grp/Avg
Public Health and Safety	**0.25**	**0.28**	**0.12**	**0.23**	**0.25**	**0.22**	**0.15**
Public Radiation Exposure							
Chronic	0.040	0.017	0.027	0.042	0.033	0.031	0.020
Acute	0.081	0.111	0.045	0.065	0.085	0.075	0.051
Public Chemical Exposure							
Chronic	0.040	0.006	0.009	0.032	0.026	0.022	0.016
Acute	0.081	0.078	0.013	0.048	0.069	0.055	0.041
Public Transportation Safety	0.008	0.067	0.022	0.045	0.040	0.036	0.024
Worker Health and Safety	**0.18**	**0.21**	**0.12**	**0.19**	**0.19**	**0.17**	**0.15**
Worker Radiation Exposure							
Chronic	0.006	0.010	0.015	0.040	0.019	0.018	0.010
Acute	0.044	0.069	0.030	0.032	0.049	0.044	0.038
Worker Hazardous Chemical Exposure							
Chronic	0.002	0.003	0.012	0.024	0.010	0.010	0.008
Acute	0.044	0.049	0.024	0.024	0.039	0.035	0.030
Worker Accidents							
Transportation							
At Work	0.011	0.042	0.018	0.017	0.023	0.022	0.018
Commuter	0.033	0.021	0.003	0.034	0.029	0.023	0.022
Industrial	0.035	0.014	0.018	0.032	0.027	0.025	0.021
Environmental Impact	**0.08**	**0.14**	**0.23**	**0.17**	**0.13**	**0.16**	**0.18**
Immediate (prior to start up)	0.016	0.033	0.070	0.051	0.033	0.042	0.047
Short term (thru D&D,60 yrs)	0.033	0.066	0.046	0.073	0.057	0.054	0.080
Long term (after D&D)	0.026	0.040	0.116	0.051	0.039	0.058	0.055

Table 7-5 Weights Used in the Analysis of Solid Waste Technical Options (Cont. Page 2 of 2)

Public Value/Criteria	SS	AC	JK	LD	Consensus Average	Average	Grp/Avg
Schedule	**0.20**	**0.13**	**0.29**	**0.12**	**0.15**	**0.18**	**0.15**
Expedite Start Schedule	0.111	0.104	0.193	0.089	0.102	0.124	0.104
Meet TPA Milestones	0.089	0.021	0.097	0.027	0.046	0.058	0.047
System Manageability	**0.08**	**0.04**	**0.03**	**0.07**	**0.06**	**0.05**	**0.05**
Process Flexibility	0.016	0.020	0.018	0.028	0.022	0.021	0.016
Operational Reliability	0.033	0.008	0.004	0.014	0.018	0.015	0.013
Other Use Flexibility	0.026	0.014	0.007	0.027	0.022	0.019	0.016
Socio/Economic Impacts	**0.13**	**0.18**	**0.17**	**0.17**	**0.16**	**0.16**	**0.23**
Minimize Impact to Land							
Facilities on New Land	0.025	0.040	0.064	0.034	0.033	0.041	0.047
Roads Needed	0.012	0.006	0.019	0.008	0.009	0.011	0.013
Available areas of high use value	0.025	0.057	0.013	0.032	0.038	0.032	0.054
	0.020	0.003	0.000	0.012	0.011	0.009	0.016
Economic Stability							
Construction Worker Demand Profile	0.020	0.011	0.013	0.014	0.015	0.014	0.021
Operator Worker Demand Profile	0.010	0.034	0.039	0.040	0.028	0.031	0.040
Capture Economic Oportunity Locally	0.015	0.029	0.026	0.036	0.026	0.026	0.037
Demo Integration of Programs	**0.10**	**0.03**	**0.04**	**0.05**	**0.06**	**0.05**	**0.09**
Integrated use of facilities	0.043	0.014	0.012	0.014	0.024	0.021	0.038
Minimum costs to interfacing progrms	0.035	0.003	0.024	0.019	0.019	0.020	0.030
Demo storage concepts to other programs	0.022	0.011	0.007	0.014	0.015	0.013	0.024

Table 7-6 Scores for Technical Options on Public Values Criteria (Page 1 of 2)

PUBLIC VALUES/CRITERIA	UNITS	New Single	New Modular	Existing Modular	Existing Single (WNP-1)	Programs Baseline
Public Health and Safety						
Public Radiation Exposure						
Chronic	Miles (10-25)	25	25	22	10	25
Acute	Miles (10-25)/Safety Class (>3 to 1)	80 (25/3)	80 (25/3)	70 (22/3)	80 (10/1)	80 (25/3)
Public Chemical Exposure						
Chronic	Miles (10-25)	25	25	22	10	25
Acute	Miles (10-25)/Safety Class (>3 to 1)	80 (25/3)	80 (25/3)	70 (22/3)	80 (10/1)	80 (25/3)
Public Transportation Safety	Miles (0-200K)	0	0	20	200	0
Worker Health and Safety						
Worker Radiation Exposure						
Chronic	Rad Wrkrs	249	327	326	249	327
Acute	Wrkrs (245-40)/Safety Class (>3 to 1)	60 (245/3)	80 (116/3)	70 (154/3)	80 (245/1)	70 (154/3)
Worker Hazardous Chemical Exposure						
Chronic	Wrkrs (400 to 150)	249	327	326	249	327
Acute	Wrkrs (245-40)/Safety Class (>3 to 1)	60 (245/3)	80 (116/3)	70 (154/3)	80 (245/1)	70 (154/3)
Worker Accidents						
Transportation						
At Work	Miles (600K to 200K)	200	200	370	560	200
Commuter	Miles/yr 4.8M to 1.6M)	4.8	4.8	4.2	1.6	4.8
Industrial	Reportable incidents	776	1152	1094	776	1152
Environmental Impact						
Immediate (prior to start up)	Constructed (0-100)	0	80	100	100	40
Short term (thru D&D,60 yrs)	Constructed (0-100)	100	100	92	30	95
Long term (after D&D)	Constructed (0-100)	30	0	95	40	0

Table 7-6 Scores for Technical Options on Public Values Criteria (Cont. Page 2 of 2)

PUBLIC VALUES/CRITERIA	UNITS	New Single	New Modular	Existing Modular	Existing Single (WNP-1)	Programs Baseline
Cost						
Short-Term Capital (5 years)	Dollars (Millions)	316	296	140	300	140
Long-Term Capital	Dollars (Millions)	1262	1765	700	230	1380
Maintenance and Operating Costs	Dollars (Millions)	840	1279	1230	800	920
D&D Costs	Dollars (Millions)	283	319	<30	200	200
Total Cost	Dollars (Millions)	**2701**	**3659**	**2100**	**1530**	**2640**
Schedule						
Expedite Start Schedule	Constructed (0-100)	75	100	100	100	35
Meet TPA Milestones	Constructed (0-100)	100	100	100	100	100
System Manageability						
Process Flexibility	Constructed (0-100)	75	100	50	90	0
Operational Reliability	Operating efficiency (60 to 75%)	70	70	70	70	70
Other Use Flexibility	Constructed (0-100)	75	100	50	70	0
Socio/Economic Impacts						
Minimize Impact to Land						
Facilities on New Land	Constructed (0-100)	0	0	75	100	0
Roads Needed	Miles (3 to 0)	2	3	1	2	3
Make available areas of high use value	Constructed (0-100)	100	100	80	0	100
Future Facility Use	Percentage (0 % 100)	5	5	0	0	0
Economic Stability						
Construction Worker Demand Profile	Constructed (0-100)	50	100	100	80	0
Operator Worker Demand Profile	Constructed (0-100)	100	100	100	100	100
Capture Economic Oportunities Locally	Constructed (0-100)	100	80	20	100	80
Demo Integr of Programs						
Integrated use of facilities	Constructed (0-100)	100	20	20	100	0
Minimum costs to interfacing programs	Dollars saved (0 to 600M)	0	0	600	0	0
Demo storage concepts to other programs	Constructed (0-100)	100	0	100	100	0

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