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FAST FLUX TEST FACILITY

CONCEPTUAL SYSTEM DESIGN DESCRIPTION
FOR THE
RADIOACTIVE WASTE SYSTEM
No. 24

December 5, 1968

PACIFIC NORTHWEST LABORATORY
Richland, Washington 99352
Operated by
Battelle Memorial Institute
for the
U.S. Atomic Energy Commission under Contract No. AT(45-1)-1830
Configuration Control Board Directive No. A-0021A

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AT(45-1)-1830 Configuration Control Board Directive No. A-0170
November 19, 1969

6. TEXT CHANGE

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Change in Radiation Shielding Design Safety Criteria
### Conceptual System Design Description For The Radioactive Waste System

**December 5, 1969**

Configuration Control Board Directive No. A-0124A

Sept. 17, 1969

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**Re-direction of conceptual design.**

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Incorporates Design Safety Criteria and editorial comments.
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RADIOACTIVE WASTE SYSTEM

INTRODUCTION

The FFTF Radioactive Waste System provides the equipment and facilities required for the routine collection, transfer, storage, and disposal of radioactive liquid and solid wastes. Radioactive solid wastes and radioactive liquid wastes not normally piped to the Radioactive Waste System Receiving tanks, are packaged in appropriate containers by the systems generating the waste for collection and disposal by the Radioactive Waste System.

Section 1.0, Functions and Design Requirements, of this CSDD, is baseline data; the remainder is reference design.

The contents of this document support and expand the requirements established in the Overall Conceptual Systems Design Description.1

---
1. Refer to References, Appendix A, Item 1.
SECTION 1.0 FUNCTIONS AND DESIGN REQUIREMENTS

1.1 FUNCTIONS

The following functions are provided by the Radioactive Waste System:

- Collect radioactive liquid (aqueous and immiscible organic solvent) wastes.
- Prepare radioactive liquid wastes for disposal.
- Provide for transfer of low level radioactive aqueous wastes to disposal facilities at the FFTF site.
- Provide waste containers (tank cars, shielded casks) for transfer of intermediate and high level radioactive aqueous wastes and radioactive immiscible organic solvent wastes1 to the 200 Area for disposal.
- Arrange for transfer and disposal of intermediate and high level radioactive aqueous wastes and radioactive organic wastes.
- Collect packaged radioactive solid wastes and transfer to the 200 Area for disposal, or to interim storage at FFTF and then to the 200 Area for disposal.

1.2 DESIGN REQUIREMENTS

The design requirements for performing the functions outlined in Section 1.1 are listed below:

1.2.1 Basic Design Requirements

A. The design of the Radioactive Waste System shall conform to applicable Hanford Standards, Guides, Specifications, and Standard Design Criteria. FFTF standards and specifications shall be issued when required for conditions not

1. Radioactive liquid wastes containing organic solvents not miscible in water are disposed of separately from aqueous wastes. Throughout this document, those liquid wastes containing organic solvents not miscible in water will be classified as "organic" wastes.
within the scope of the referenced Hanford documents. A representative, but not necessarily all inclusive, listing of applicable Standards, Guides, Specifications, and Design Criteria is found in Appendix A, Items 2, 3, 4, 5.

DDCN-2 B. This system shall satisfy the criteria establishing quality which shall be defined and documented during design. These criteria shall cover:

- Design
- Fabrication and construction
- Operation
- Maintainability

C. The Radioactive Waste System shall be designed such that the interfacing systems will not be affected adversely as a result of the design.¹

D. The following are design requirements for handling of radioactive liquid wastes.

1. Provide cleaning vessel drain lines and valves,² cell drains and/or sumps,³ valves, piping, and receiving tanks within the containment vessel and within the fuel handling and storage areas and the radioactive maintenance area of the structure contiguous to the containment vessel. Aqueous and organic wastes from fuel and equipment cleaning vessels² shall be routed to separate organic, high level aqueous, intermediate level aqueous, and low level aqueous receiving tanks.

---

2. Refer to Interfaces, Appendix C, Items 12 and 17.
3. Refer to Interfaces, Appendix C, Items 4, 7, 9, 11, 12, 13 and 17.
Categories of radioactive aqueous waste are as follows:

- Low level (disposal and controls in accordance with AECM-0524). ¹
- Intermediate level (<100μ Ci/ml). ²
- High level (>100μ Ci/ml). ²

Number and capacity of receiving tanks shall be in accordance with waste flow rates and pump capabilities based upon design studies. ³

2. Provide a Radioactive Liquid Waste Loadout Station for loading radioactive liquid wastes into railroad tank cars and shielded casks for transfer to disposal facilities at the 200 Area. ⁴

3. (Paragraph Deleted)

4. (Paragraph Deleted)

5. Provide pumps, valves, and associated equipment for transferring radioactive liquid wastes from receiving tanks within the Reactor Service Building and Containment Vessel to shipping container loadout stations. A minimum of one spare drain line shall be provided. Piping penetrations through containment shall meet the requirements of the Reactor Containment System. ⁵

6. Provide automatic valves, activated by radiation monitors, to stop flow of above limits waste to the loadout station. ⁶ Manual override capability shall be provided.

1. Refer to References, Appendix A, Item 8.
2. Refer to References, Appendix A, Item 6.
3. Refer to Support Information Requirements, Appendix B, Items 1 and 2.
4. Refer to Interfaces, Appendix C, Item 5.
5. Refer to Interfaces, Appendix C, Item 9.
6. Refer to Interfaces, Appendix C, Item 22. ¹-³
7. Receiving tank design shall include the following:
   - Tank bottom sloping to the pump (or jet) sump.
   - Sparging nozzles for tank cleanup.
   - Tank cooling and/or heating if found warranted.¹
   - Sample nozzle.
   - Nozzles for equipment and pipe connections.
   - Spare nozzle.

8. Provide agitators or circulating educators for mixing contents of receiving tanks.

9. Provide pumps (or jets) for discharging contents of the receiving tanks to transfer equipment.

10. Provide off-gas vent condensers or moisture separators for the receiving tanks.

11. Radioactive liquid receiving tank inlet piping shall be designed to prevent a negative line pressure due to the receiving tank off-gas lines being vented to the Ventilation Exhaust System.²

12. System layout shall be designed so that there is no backup of radioactive liquid wastes in the waste source drain lines.

13. (Paragraph Deleted)

¹ Refer to Support Information Requirements, Appendix B, Item 2.
² Refer to Interfaces, Appendix C, Item 7.
14. Tanks, pumps, and associated equipment shall be provided for neutralizing receiving tank liquid wastes.

DDCN-2 15. Shielded receiving tank cells shall be provided with drain sumps and sump pumps. Tank cells shall be provided with concrete surface protection (sealing) to facilitate decontamination and prevent leakage of radioactive fluid to the ground in the event of major tank leakage.

DDCN-2 16. Personnel access ports shall be provided to receiving tank cells for routine maintenance, inspection, and equipment calibration.

DDCN-2 17. Spare sleeves shall be provided through shielding walls for future piping. Number and location of sleeves shall be determined during preliminary design.

DDCN-2 18. Pipe valves, equipment and tank materials shall be compatible with the radioactive liquid waste handled.

DDCN-3 19. Piping runs and headers shall be of the minimum length practical to minimize flushing wastes.

DDCN-3 20. Radiological Design Criteria, BNWL-MA-3 and Radiation Protection Procedures, BNWL-MA-6 shall be used as a guide in the design of the shielding and access barriers in order that shielding and/or access barriers will limit radiation exposures to within the requirements of AECM-0524.

DDCN-2 21. High activity components shall be shielded. Valving for high activity components shall be installed in low dose rate locations as practicability permits.

DDCN-2 1. Refer to References, Appendix A, Item 7.
2. Refer to Support Information Requirements, Appendix B, Item 2.
22. A graphic control panel shall be provided in the Radioactive Liquid Waste Loadout Station from which transfer of wastes from receiving tanks to the loadout station may be controlled.

23. Local control panels shall be provided in the containment vessel and process area receiving tank sampling and monitoring rooms. All equipment shall be controlled from the respective panel with the exception of transfer of wastes from the receiving tanks to the loadout station.

24. Provide a panel in the reactor control room having the following instrumentation and controls:
   - Radioactive liquid waste system annunciator alarms.
   - Emergency controls and operating status indicating lights for receiving tank agitators and discharge pumps.

25. Safety showers shall be installed in the Radioactive Liquid Waste Loadout Station. Design shall be in accordance with Hanford Standards. ¹

26. Process water and steam drops shall be provided in the Radioactive Liquid Waste Loadout Station adjacent to railroad tank cars and shielded cask loadout stations for equipment decontamination. ¹

27. Floor drains in the railroad tank car loadout area shall discharge to the intermediate level aqueous waste receiving tank during transfer of aqueous waste, and to the organic waste receiving tank during transfer of organic waste. Floor drains in the

¹ Refer to References, Appendix A, Item 2.
DDCN-2

shielded cask loadout area shall discharge to the high level aqueous receiving tank from the aqueous cask loadout station, and to the organic waste receiving tank from the organic waste loadout station.

28. A railroad tank car and shielded liquid casks shall be provided for transporting intermediate level aqueous wastes and high level aqueous wastes, respectively, to the 200 Area disposal site. Organic wastes will be transferred to the 200 Area disposal site in either a separate tank car or shielded cask depending upon activity level and personnel dose limits. Equipment shall be similar to that in use by Battelle-Northwest\(^1\) as shown in Drawings SK-3-14117 and SK-3-14118 in Appendix G and be compatible with existing and planned ARHCO, ITT/FSS and BNW handling facilities.

Need, number and acquisition or borrowing of railroad tank cars is the subject of studies.\(^2\) Need and number of shielded casks will be determined by studies.\(^2\)

DDCN-1

29. (Paragraph Deleted)

30. A drinking fountain, and change room with shower, sink, water heater, and toilet, shall be provided in the Radioactive Liquid Waste Loadout Station.

---

1. Refer to References, Appendix A, Item 9.
2. Refer to Support Information Requirements, Appendix B, Item 2.
31. Underground radioactive liquid waste lines shall be encased for purposes of detecting and collecting waste leakage.

32. Interface requirements for Liquid Waste Handling Services or equipment are to be provided by other systems as follows:

- Remotely operated valve controls; receiving tank level recorders and alarms, (redundant alarms shall be provided which shut off the inlet line valves); receiving tank temperature recorders and alarms; receiving tank specific gravity indicators; receiving tank pH indicators; and receiving tank cell sump liquid level alarms are provided by the Plant Instrumentation System. Alarms shall sound in the Radioactive Liquid Waste Loadout Station and the FTR control rooms.

- Electric motor controls are provided by the Building Electrical Power System.

- Liquid waste radioactivity monitors, liquid samplers, ventilation exhaust monitors, and criticality alarms are provided by the Radiation Monitoring System. Radioactivity monitors shall be installed in all waste effluent streams. Radioactivity monitors and liquid samplers shall be installed in receiving tank recirculation and discharge lines. Above normal activity alarms shall sound in the Liquid Waste Loadout Station and FTR control rooms.

---

1. Refer to Interfaces, Appendix C, Item 21.
2. Refer to Interfaces, Appendix C, Item 1.
3. Refer to Interfaces, Appendix C, Item 22.
Continuous readout air monitors shall be provided by the Radiation Monitoring System. Above-normal activity alarms shall sound in the Liquid Waste Loadout Station and FTR control rooms, and in the receiving tank sampling and monitoring rooms.

Beta-gamma sensitive radiation monitors shall be located in all areas occupied by personnel. Above-normal alarms shall sound in the Liquid Waste Loadout Station and FTR control rooms, and in the receiving tank sampling and monitoring rooms. Monitors and alarms are provided by the Radiation Monitoring System.

Paragraph Deleted

A public address system within the Radioactive Liquid Waste Loadout Station and telephone communications between the Radioactive Liquid Waste Loadout Station and the FTR control rooms and receiving tank control stations shall be provided by the Communications System.

Sanitary water, process water, sanitary sewer, process sewer, steam, instrument air, breathing air, and utility air shall be provided to the Radioactive Liquid Waste Loadout Station by the Site Facilities System and the Service Piping System.

1. Refer to Interfaces, Appendix C, Item 22.
2. Refer to Interfaces, Appendix C, Item 2.
3. Refer to Interfaces, Appendix C, Item 5.
4. Refer to Interfaces, Appendix C, Item 6.
- Underground radioactive liquid waste lines and process sewer connections shall be provided by the Site Facilities System.\(^1\)

- A traveling bridge crane, of about 35-ton capacity, shall be provided in the Radioactive Liquid Waste Loadout Station by the Site Facilities System\(^1\) for loading shielded liquid casks onto trucks or railroad cars.

- Off-gas venting of receiving tanks, ventilation of the Radioactive Liquid Waste Loadout Station, the receiving tank cells and sampling rooms, and the solid waste interim storage vaults shall be provided by the Heating and Ventilation System.\(^2\)

- Fire protection is provided by the Plant Fire Protection System.\(^3\)

E. The following are design requirements for handling of radioactive solid wastes.

1. Interim shielded storage vaults shall be provided within the FTR Building for high level radioactive solid wastes\(^4\) in a location served by the high bay area crane. The capacity, location, and shielding are to be determined by a design study.\(^5\)

2. Interim storage facilities shall be provided within or contiguous to the FTR Building for low level radioactive solid wastes.\(^4\) The capacity and location are to be determined by a design study.\(^5\)

---

1. Refer to Interfaces, Appendix C, Item 5.
2. Refer to Interfaces, Appendix C, Item 7.
3. Refer to Interfaces, Appendix C, Item 8.
4. Refer to Interfaces, Appendix C, Item 4.
3. Provide a shielded transfer cask and containers for routine high level radioactive solid wastes. The number, capacity, shielding, and transporting methods are to be determined by a design study.  

4. Systems generating radioactive solid wastes which will be buried, shall limit the quantities of sodium present in accordance with the recipient's requirements (Atlantic Richfield Hanford Co.) which will be established. A study will be performed to determine the amounts of sodium that may be present on or within items to be buried and how those items unacceptable for burial may be stored.  

5. Interface Requirements for Solid Waste Handling Services or equipment are to be provided by other systems as follows:

---

Interim storage cells and areas are provided by the Structures Facility.

Cranes for handling and transporting radioactive solid waste containers and shielded casks are provided by the Structures Facility.

Any special connections required for transferring radioactive solid waste containers from the generating source locations to a shielded cask shall be provided by the waste generating systems. The methods of transferring waste containers into a shielded cask and the special connection design are subjects of a design study.

Inert gas service shall be provided to inert gas cell transfer port locations used for transferring radioactive solid waste to a shielded cask.

Ventilation of shielded interim storage cells and low level waste storage areas are provided by the Heating and Ventilation System.

Fire Protection is provided by the Plant Fire Protection System.

1. Refer to Interfaces, Appendix C, Item 4.
3. Refer to Interfaces, Appendix C, Item 19.
4. Refer to Interfaces, Appendix C, Item 7.
5. Refer to Interfaces, Appendix C, Item 8.
1.3 DESIGN SAFETY CRITERIA

The following are the Design Safety Criteria for the Radioactive Waste System:

**DDCN-3**

A. Personnel radiation protection shall be provided such that personnel radiation exposures are within the limits of AECM-0524. (DSC 1.1)

B. The design of the Radioactive Liquid Waste System will prevent the release to the environment of radioactive waste exceeding the limitations of AECM-0524. (DSC 1.2)

C. The design of the Radioactive Waste System must permit representative sampling of the contents of all waste receiving tanks in the system. (DSC 1.3)

D. The design will provide for the transfer of the contents of any radioactive aqueous liquid waste tank to any alternate storage location in the system. (DSC 1.4)

E. The design will provide for leak detection of lines, valves, tanks and other components of the system. (DSC 1.5)

F. The design will provide for venting gas from the radioactive liquid waste tanks to radioactive gas handling portion of the Heating and Ventilation System. (DSC 1.6)

G. The design will provide means to safely store and transport solid radioactive waste to a disposal area. (DSC 1.7)

H. The design will provide for segregation of aqueous and immiscible organic liquid waste solutions. (DSC 1.8)

I. Appropriate holdup capacity must be provided for the radioactive liquid waste. (DSC 1.9)

J. The design will provide for neutralization of the liquid waste to the extent required by materials of construction and ultimate disposal processes. (DSC 1.10)

K. The design of the Radioactive Liquid Waste System will provide for level measurement and an appropriate alarm system. (DSC 1.11)

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1. Refer to References, Appendix A, Item 16, Section 8.
L. The Radioactive Liquid Waste System will be designed to facilitate those operating procedures required to prevent criticality. (DSC 1.12)

M. Criticality detectors and alarms will be provided for the radioactive liquid waste system. (DSC 1.13)

N. Radioactivity monitoring and control will be provided on all effluent streams. (DSC 1.14)

O. Provisions will be included in the design to clean and/or flush all radioactive liquid waste lines and tanks. (DSC 1.15)

P. The design will include remote control facilities to provide the capability of minimizing and/or controlling the release of radioactive liquid waste to the environment resulting from an accident involving the waste system. (DSC 1.16)

1. Refer to References, Appendix A, Item 16, Section 8.
SECTION 2.0 PHYSICAL DESCRIPTION OF THE SYSTEM

The Radioactive Waste System Conceptual Design is based on the Functions and Design Requirements delineated in Sections 1.1 and 1.2, respectively. The FFTF Radioactive Waste System provides the equipment and facilities for the routine collection, transfer, segregation, temporary storage, and disposal containers for radioactive liquid (aqueous and organic) and solid wastes\(^1\) (except alkali metal which is disposed of by the Sodium Receiving and Processing System). The conceptual design is dependent upon the volumes and types of wastes generated by other systems; therefore, this concept is subject to review and revision as the overall FFTF concept is finalized.

The conceptual design of handling of radioactive liquid wastes is based on a batch operation having the following sequence:

1. Drain radioactive liquid wastes to appropriate receiving tanks located in the reactor service building and reactor containment building.
2. Sample receiving tank contents prior to discharging.
3. Pump receiving tank contents to appropriate storage tank (low, intermediate, or high activity level of aqueous waste or organic waste) located in the Radioactive Liquid Waste Facility.
4. Sample storage tank contents prior to discharging (add neutralizing agents to intermediate level waste, as required, to achieve pH of 8 or greater).
5. Discharge low level radioactive aqueous waste to the process sewer crib for disposal at the reactor site.

\(^1\) Refer to FFTF Radioactive Waste Management Policy, Appendix E.
Discharge intermediate level aqueous waste to a tank car.
Discharge high level aqueous waste to shielded casks.
Discharge radioactive organic waste to either tank car or shielded casks per personnel exposure limits.
Arrange for disposal of radioactive wastes by Atlantic Richfield Hanford Co. (ARHCO).
Arrange for transportation of waste to the 200 Area disposal site by ITT-Federal Support Services.

Routine radioactive solid wastes are packaged by the system generating the waste, collected by the Radioactive Waste System, and transported to the 200 Area burial ground by ITT-Federal Support Services for burial by ARHCO. Transportation and burial arrangements are made by the Radioactive Waste System. The waste recipient, Atlantic Richfield Hanford Co. (ARHCO), has established segregating and packaging requirements\(^1\) for critical mass and chemical hazards control necessary for safe and proper burial ground and disposal facility management. Conformance with these requirements is the responsibility of the system generating the waste in addition to data for shipment records. The reference concept is based upon the use of standard store stock cardboard containers for packaging low level wastes, shielded casks for disposal of high level solid wastes, interim storage for low activity level wastes, and interim storage cells for high activity wastes. High level wastes too large for shielded cask disposal are packaged in special burial containers provided by Operations.

\(^1\) Refer to References, Appendix A, Item 13.
2.1 SUMMARY DESCRIPTION

2.1.1 Radioactive Liquid Waste

Radioactive liquid wastes are disposed of by the Radioactive Waste System via the Radioactive Liquid Waste Facility. Radioactive liquid wastes handled by this system are classified as follows:

- Low level aqueous [Disposal and controls in accordance with AECM-0524]¹
- Intermediate level aqueous (<100 μCi/ml)²
- High level aqueous (>100 μCi/ml)²
- Organic

Radioactive liquid wastes are received from systems within the FTR Building, the filter vault, and the sodium disposal building. These waste lines are shown on the plot plan Drawing SK-3-14113 in Appendix G. Studies will be made to optimize the design, based upon the system functions and design requirements considering cost, reliability, and conceptual design features.³

The reference concept includes radioactive liquid waste drainage piping, receiving tanks, and associated equipment for collection of radioactive liquid wastes within the containment vessel and the contiguous structure process area; discharge pumps and piping for transferring the wastes to interim storage tanks; and a facility⁴ which houses interim storage tanks and associated equipment for storing, neutralizing, discharging low level radioactive aqueous wastes to the process sewer crib, and for loading out intermediate and high level aqueous wastes and organic wastes for disposal in the 200 Area.

¹ Refer to References, Appendix A, Item 8.
² Refer to References, Appendix A, Item 6.
³ Refer to Support Information Requirements, Appendix B, Items 1 and 2.
⁴ Refer to Interfaces, Appendix C, Item 5.
The collection, storage, and loadout of radioactive liquid wastes are shown on schematic flow diagrams SK-3-14121 and SK-3-14116 in Appendix G. Radioactive Liquid Waste System estimated volumes and equipment characteristics are shown in Tables I and II, respectively.

2.1.1.1 Receiving Tanks and Equipment

As shown on Drawing SK-3-14121 and in Table II, single receiving tanks are provided for containment vessel drainage and for general drainage in the process area (the area adjacent to the containment vessel). Drainage at these locations is infrequent with the major contribution to the process area receiving tank being from the cask decontamination activity. By planning the cleaning and drainage operations, and through the use of administrative controls, adequate time may be allowed for decay of short-lived radionuclides before sampling and discharge of tank contents to the appropriate storage tank (low, intermediate, or high activity level aqueous). The tanks are sized for the maximum batch quantities thereby permitting decay of short-lived radionuclides. This permits discharging the aqueous waste to either a low, intermediate, or high activity level aqueous waste storage tank in accordance with sampling data. All radioactive organic wastes are discharged to the organic waste storage tank. The estimated maximum aqueous waste batch quantity is about 2300 gallons which is from the Radioactive Maintenance System. This requires a tank capacity of about 2500 gallons to provide adequate freeboard. All receiving tanks are identical in size (about 2500 gallons) and design so as to simplify fabrication and installation. The receiving tanks are equipped with an agitator, discharge pump with strainer, sparging nozzles, temperature sensors, tank level sensors, and specific gravity sensors.
### TABLE 1. Radioactive Liquid Waste Estimated Volumes

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<td>Cleaning vessel</td>
<td>5,000 gal/yr (organic)</td>
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<tr>
<td>Decontamination equipment</td>
<td>500 gal/yr (aqueous)</td>
</tr>
<tr>
<td>Hoods</td>
<td>100 gal/yr (organic)</td>
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<td><strong>IRRADIATED FUEL HANDLING SYSTEM</strong></td>
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<tr>
<td>Cleaning vessel</td>
<td>10,000 gal/yr (aqueous)</td>
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<tr>
<td>Cask decontamination</td>
<td>8,000 gal/yr (aqueous)</td>
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<tr>
<td>Fuel storage basin overflow</td>
<td>Infrequent³</td>
</tr>
<tr>
<td>Fuel storage and loadout basins</td>
<td>Infrequent³</td>
</tr>
<tr>
<td><strong>RADIOACTIVE MAINTENANCE SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>Cleaning vessels²</td>
<td>1,500 gal/batch (aqueous)</td>
</tr>
<tr>
<td></td>
<td>1,000 gal/batch (organic)</td>
</tr>
<tr>
<td></td>
<td>750 gal/batch (acid: to aqueous tank)</td>
</tr>
<tr>
<td>Cell drainage</td>
<td>Infrequent³</td>
</tr>
<tr>
<td><strong>NONIRRADIATED FUEL HANDLING SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>Vault, cell, fuel cell drainage</td>
<td>Infrequent³</td>
</tr>
<tr>
<td><strong>STRUCTURES</strong></td>
<td></td>
</tr>
<tr>
<td>Sodium laboratory, personnel decontamination</td>
<td>Infrequent³</td>
</tr>
<tr>
<td><strong>HEATING AND VENTILATION SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>Cooling coil condensate, filter building</td>
<td>Infrequent³</td>
</tr>
<tr>
<td><strong>RADIOACTIVE WASTE SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>Radioactive solid waste interim storage vaults</td>
<td>Infrequent³</td>
</tr>
<tr>
<td><strong>SODIUM RECEIVING AND PROCESSING SYSTEM</strong></td>
<td></td>
</tr>
<tr>
<td>Sodium hydroxide</td>
<td>Infrequent⁴ (Pump directly to tank car)</td>
</tr>
</tbody>
</table>

---

1. The listed data are based upon preliminary estimates of contributing systems and are subject to review and revision during preliminary design.
2. Total quantity of waste cannot be estimated at this time due to lack of maintenance frequency data.
3. Infrequent use - quantity unknown. System capacity is based upon those sources for which quantitative flows are known.
4. After establishing that waste activity level and solution concentration meet the recipients (ARHCO) requirements through sampling and analysis, the sodium hydroxide is pumped directly from the Sodium Receiving and Processing System to a railroad tank car in the Radioactive Liquid Waste Facility.
TABLE II. Radioactive Liquid Waste Equipment Characteristics

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTAINMENT VESSEL RECEIVING TANK (NO. 6) (General Drainage)</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>1</td>
</tr>
<tr>
<td>Capacity</td>
<td>2,500 gallons</td>
</tr>
<tr>
<td>Pump</td>
<td>50 gal/min</td>
</tr>
<tr>
<td>Agitator</td>
<td>3 hp</td>
</tr>
<tr>
<td>RECEIVING TANK NO. 1 (Cleaning Vessel Organic)</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>1</td>
</tr>
<tr>
<td>Capacity</td>
<td>2,500 gallons each</td>
</tr>
<tr>
<td>Pump</td>
<td>50 gal/min</td>
</tr>
<tr>
<td>Agitator</td>
<td>3 hp</td>
</tr>
<tr>
<td>RECEIVING TANKS NO. 2, 3 AND 4 (Cleaning Vessel Aqueous)</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>3</td>
</tr>
<tr>
<td>Capacity</td>
<td>2,500 gallons each</td>
</tr>
<tr>
<td>Pump</td>
<td>50 gal/min</td>
</tr>
<tr>
<td>Agitator</td>
<td>3 hp</td>
</tr>
<tr>
<td>RECEIVING TANK NO. 5 (General Drainage)</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>1</td>
</tr>
<tr>
<td>Capacity</td>
<td>2,500 gallons</td>
</tr>
<tr>
<td>Pump</td>
<td>50 gal/min</td>
</tr>
<tr>
<td>Agitator</td>
<td>3 hp</td>
</tr>
<tr>
<td>WASTE STORAGE TANKS</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>4</td>
</tr>
<tr>
<td>Capacity</td>
<td>5,000 gallons each</td>
</tr>
<tr>
<td>Pump (or jet)</td>
<td>100 gal/min</td>
</tr>
<tr>
<td>Agitator</td>
<td>7 hp</td>
</tr>
<tr>
<td>SUMP PUMPS</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>6</td>
</tr>
<tr>
<td>Capacity</td>
<td>25 gal/min</td>
</tr>
<tr>
<td>SHIELDED LIQUID WASTE TRANSFER CASKS</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>2</td>
</tr>
<tr>
<td>Capacity</td>
<td>500 gallons each</td>
</tr>
<tr>
<td>TANK CAR</td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>1 Borrowed</td>
</tr>
<tr>
<td>Capacity</td>
<td>from 300 Area</td>
</tr>
<tr>
<td></td>
<td>20,000 gallons</td>
</tr>
</tbody>
</table>

1. The listed data are based upon preliminary estimates of contributing systems and are subject to review and revision during preliminary design.
2. Circulating tank educators may be selected in place of agitators during preliminary design.
Equipment such as pumps and agitators are similar for all receiving tanks to permit interchange if a unit should fail, and also to minimize spare parts inventory. The receiving tank in the containment vessel is installed in a shielded\(^1\) room to minimize exposure to personnel. A separate sampling and monitoring equipment room is located above the tank room.\(^2\) All instrumentation readout and alarms, and equipment controls are mounted on a local panel board installed in the sampling and monitor room. All equipment activities may be controlled from the local panel board with the exception of the discharge line valves. These can be operated only from the Radioactive Liquid Waste Facility in order to minimize inadvertent or inappropriate waste discharge. Duplicate instrumentation readout and equipment controls (except sampling) are mounted on the Radioactive Liquid Waste Facility control panel. This permits monitoring tank conditions and discharging of tank contents from a central location. Radioactive Liquid Waste System annunciator alarms, and emergency controls and operating status indicating lights for receiving tank agitators and discharge pumps are installed on a panel in the reactor control room.

The process area receiving tanks are located below grade to permit gravity flow of drainage from equipment and some cells.\(^3\) To minimize the possibility of sodium metal falling into the drainage system, plugged drains or cell sumps and drains for future sump pump installations are provided as shown on Drawing SK-3-14121 in Appendix G. Provisions are made to permit tank or equipment replacement. The receiving tanks are installed in a shielded room to minimize

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1. Refer to Drawings, Appendix G, SK-3-14216.
2. Refer to Drawings, Appendix G, SK-3-14215.
3. Refer to Drawings, Appendix G, SK-3-14217, SK-3-14121.
exposure to personnel. A separate sampling and monitoring equipment room is located adjacent to the tank room. A local panel board and controls are provided as described above for the containment vessel receiving tank. A cell liquid level alarm probe, sump pump and associated piping are provided in the containment vessel receiving tank room and in the process area tank room. The sump pumps are provided for discharging cell decontamination wastes or equipment leakage. The pumps may be discharged to any receiving tank or storage tank as shown on Drawing SK-3-14121 in Appendix G. Jumpers are provided for connecting a receiving tank discharge line with the appropriate interim storage tank inlet line. Jumpers and connectors are located in a diversion box.

2.1.1.2 Radioactive Liquid Waste Facility and Equipment

Low, intermediate, and high activity aqueous waste storage tanks, organic waste storage tank, railroad tank car loadout station, and shielded cask loadout station are located in a Radioactive Liquid Waste Facility building as shown on Drawing SK-3-14114 in Appendix G. A schematic diagram of the equipment is shown on Drawing SK-3-14116 in Appendix G. Equipment characteristics are shown in Table II. A separate Radioactive Liquid Waste Facility is provided to minimize the effects of contamination release on overall plant operation should a waste spill occur during loadout. To further minimize the problem, waste transport equipment loadout stations are also housed within the Radioactive Liquid Waste Facility. Building ventilation air is exhausted to the FFTF ventilation exhaust filtration facility.¹

¹ Refer to Interfaces, Appendix C, Item 7.
Reacted sodium (sodium hydroxide) is pumped from the Sodium Disposal Facility directly to the railroad tank car fill line in the Radioactive Liquid Waste Facility. A decontamination drain line from the Filter Vault discharges into the intermediate activity aqueous drain line. The above lines and the radioactive liquid drain lines leading to the Radioactive Liquid Waste Facility are encased to prevent waste being discharged directly to the ground should a leak occur. The encasements slope toward a sump near the Waste Facility. A minimum of one spare drain line is installed between the reactor building and the Radioactive Liquid Waste Facility.

Storage tank capacity is 5000 gallons per tank which is the capacity of two full receiving tanks of the same activity level. If it were assumed that the bulk of the radioactive aqueous wastes were intermediate level, that storage tank would be emptied about four to eight times annually depending upon the rate of fuel and equipment cleaning. All radioactive liquid waste storage tanks are identical in size and design to simplify fabrication and installation. Each storage tank is equipped with an agitator, discharge pump (or jets), sparging nozzles, temperature sensors, redundant tank level sensors, and specific gravity sensors. Equipment such as pumps and agitators are similar for all storage tanks to permit interchange if a unit should fail, and also to minimize spare parts inventory.

Provisions are made for transfer of wastes between aqueous waste storage tanks to permit greater storage flexibility. Wastes may also be transferred to the organic waste storage tank should organic waste be inadvertently discharged to an aqueous storage tank from a receiving tank. The storage tanks are installed in separate cells in an underground

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1. Refer to Drawings, Appendix G, SK-3-14114, SK-3-14116.
shielded vault. Inlet and outlet waste pipe headers, supporting service lines, and remotely operated valves, (as far as practicable) are installed in inlet and outlet shielded pipe chases to minimize personnel exposure during maintenance.\(^1\) Shielded cover block design\(^1\) permits block removal from individual cells and from sections of each pipe chase. Each cell is equipped with a sump pump for removal of cell washdown wastes during maintenance work or waste from a rupture tank. The sump waste may be routed through a header to any tank or loadout station.

In addition to the storage tank cells and loadout stations, the facility also houses a control room; sampling and monitoring room; change room with shower, sink, water heater and toilet; and a neutralizing agent equipment room. All phases of the Radioactive Liquid Waste Facility operation, including transfer of receiving tank contents to the facility, are carried out from the facility control room except for connecting and disconnecting fill and overflow lines at the tank cars and casks, and positioning manual valves at the tank car loadout station.

2.1.1.3 Radioactive Liquid Waste Facility Controls and Instrumentation

Controls and instrumentation on the Radioactive Liquid Waste Facility control panel include the following:

- Storage tank equipment and remote valve controls
- Receiving tank transfer equipment and remote valve controls
- Storage and receiving tank temperature recorders and alarms
- Storage and receiving tank specific gravity indicators
- Recorders and alarms for all radioactivity monitors on all storage tank inlet lines

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\(^1\) Refer to Support Information Requirements, Appendix B, Item 2.
Recorders and alarms for all radioactivity monitors on all storage tank discharge lines

Recorders and alarms for the radioactivity monitor on the low level waste discharge line leading to the process sewer

Criticality alarms

Area radiation alarms

Exhaust ventilation air monitor readout and alarms

Continuous readout air monitors and alarms

Storage tank pH meters readout

Recorders and alarms for tank cell liquid sensors

Graphic display of radioactive liquid waste system.

Radioactive liquid waste system annunciator alarms, and emergency controls and operating status indicating lights for receiving tank agitators and discharge pumps, storage tank agitators, discharge pumps and discharge jets, and storage tank inlet valves are installed on a panel in the reactor control room. Instrument air is supplied to the Radioactive Liquid Waste Facility from the FFTF instrument air system\(^1\) Low, intermediate, and high level aqueous waste streams, and organic waste streams are continuously monitored by radioactivity monitors\(^2\) during transfer of waste to the Radioactive Liquid Waste Facility. The monitors are instrumented to sound alarms in the Radioactive Liquid Waste Facility and the FTR control rooms when radioactivity limits are exceeded. The low level and intermediate level aqueous waste stream monitors are also instrumented to automatically close the storage tank inlet valves when the radioactivity limits are exceeded. Valves are provided for manually diverting the waste stream to the appropriate higher level aqueous waste storage tank. (Manual override of the automatic features is

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1. Refer to Interfaces, Appendix C, Items 5 and 6.
2. Refer to Interfaces, Appendix C, Item 22.
provided.) Monitors and liquid samplers\(^1\) are provided for determining the radioactivity level, composition, and pH of the contents of each storage tank before disposal. As shown on Drawings SK-3-14114 and SK-3-14116, the piping is designed to permit the recirculation of tank contents so that representative samples may be taken. The sampling procedure is more fully described in Section 4.0, Principles of Operation.

2.1.1.4 Waste Neutralization Equipment

The recipient of radioactive liquid wastes, Atlantic Richfield Hanford Co. (ARHCO), requires that the pH of intermediate level aqueous wastes be 8 or greater\(^2\) for disposal. A neutralizing makeup tank, metering pump, piping, and valving are provided for adding neutralizing agents to all storage tanks. Although neutralizing agents need to be added to only the intermediate level aqueous waste storage tank to meet existing disposal requirements,\(^2\) neutralizing agent lines are run to all storage tanks to provide operating flexibility if it should be desired to store intermediate level wastes in other tanks or if neutralizing of other wastes may be required at some future date. High level aqueous wastes are not neutralized prior to shipment to minimize waste volume. The storage tanks are equipped with water jackets for removal of neutralization reaction heat as necessary.

2.1.1.5 Supporting Services

The storage tanks are vented through a water-cooled condenser to the FFTF exhaust ventilation filtration facility.\(^3\) Condensate is routed to the high level storage tank. Condenser and storage tank jacket cooling water is discharged to the low level storage tank since this water is not normally radioactive.

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1. Refer to Interfaces, Appendix C, Item 22.
2. Refer to References, Appendix A, Item 7.
3. Refer to Interfaces, Appendix C, Item 7.
Sanitary water is provided for drinking water and change room requirements. Sanitary wastes are disposed of by the sanitary sewer system. Safety showers are provided at the loadout stations and are supplied from the sanitary water main in accordance with established Hanford Mechanical Standards. Process water is supplied to storage tank sparging nozzles and service drops for use in cleanup and decontamination. Process water is also routed to storage tank cooling jackets and storage tank off-gas condenser. Steam drops are provided at the loadout stations for use in equipment and space decontamination.

Instrument, breathing and utility air are provided at the receiving and the storage tank locations. Breathing air headers are provided in the receiving tank cells and at the Radioactive Liquid Waste Facility railroad tank car and cask loadout stations.

2.1.1.6 Radioactive Liquid Waste Loadout and Disposal

Space is provided for successively loading two railroad tank cars with intermediate level aqueous waste at the railroad tank car loadout station. Piping and valves are also provided for loading organic waste into railroad tank cars, if desired, provided it is within personnel dose limits. Pipe connections and valving are provided for loading three shielded casks with high level aqueous waste at the cask loadout station. Piping and valves are also provided for loading high activity level organic waste into shielded casks. A building crane is provided for loading the shielded casks onto specially built and equipped low-boy semitrailer trucks furnished by ITT Federal Support Services, or onto a railroad

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1. Refer to Interfaces, Appendix C, Items 5 and 6.
2. Refer to References, Appendix A, Item 2.
3. Refer to Interfaces, Appendix C, Item 5.
4. Refer to References, Appendix A, Item 11.
car if desired. Trailer capacity is one shielded cask. Shielding is provided between the loadout stations and the personnel area as shown on Drawing SK-3-14114 in Appendix G. Loadout station floor drains are run to the storage tanks.

Low level aqueous wastes are disposed of at the FFTF site via the process sewer crib while intermediate level aqueous wastes are shipped by railroad tank car to the 200 Area for disposal. High activity aqueous wastes are shipped in shielded casks via truck (or railroad car) to the 200 Area for disposal also. Organic wastes may be transported either by tank car or shielded cask in accordance with the activity level and personnel dose limits. It is planned to utilize one of four existing tank cars assigned to Battelle-Northwest. This may be on an interim basis whereby a partially full tanker received from the 300 Area is filled at FFTF and then transported to the 200 Area for waste disposal. An alternate approach would be to keep the borrowed tank car at the Radioactive Liquid Waste Facility and utilize it as additional storage until full. (Shielding is provided for personnel occupied areas within the Radioactive Liquid Waste Facility.) The tanker would be "on call" for use in transporting 300 Area wastes should an emergency arise. Note that the capacity of the intermediate level aqueous storage tank is about 5000 gallons requiring the tank be filled and emptied four times before the tank car would be filled to its capacity of 20,000 gallons. If it were assumed that the bulk of the radioactive aqueous wastes were intermediate activity level, one to two tank car loads of this category of waste would be disposed of annually. A study will be performed to determine the feasibility of an FFTF owned tank car.

1. Refer to Support Information Requirements, Appendix B, Item 2.
2.1.2 Radioactive Solid Waste

Radioactive solid wastes are disposed of by the Radioactive Waste System either directly to the 200 Area burial grounds, operated by Atlantic Richfield Hanford Co., or to interim storage and then to the burial grounds. The method of handling radioactive solid waste packages and containers is based on the allowable personnel dose rate\(^1\) which is a function of activity level, time, and distance. Since handling of radioactive waste packages is essentially on an individual basis, two categories are arbitrarily listed as follows:

- **Low level.** Waste packages or containers are routinely handled on a contact basis and do not require shielding to maintain acceptable personnel dose rate.\(^1\)

- **High level.** Waste packages or containers require shielding or special remote handling techniques to maintain acceptable personnel dose rates.\(^1\)

Studies will be made to optimize equipment design, based upon the system functions and design requirements considering cost, reliability, and conceptual design features.\(^2\) Packaging, handling, transfer, and burial of radioactive solid wastes shall minimize personnel exposure\(^1\) and prevent the spread of uncontained radioactivity to the environs.

2.1.2.1 Radioactive Solid Waste Packaging

Radioactive solid wastes are received from systems within the FFTF Building and from the filter vault. Routine radioactive solid wastes are packaged by the system generating the waste and are then collected and transported to the 200 Area burial grounds by the Radioactive Waste System. The waste recipient,\(^1\)

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1. Refer to References, Appendix A, Item 11.
2. Refer to Support Information Requirements, Appendix B, Items 3, 4, 5, 6, and 7.
Atlantic Richfield Hanford Co., (ARHCO), has established segregating and packaging requirements\(^1\) for critical mass and chemical hazards control necessary for safe and proper burial ground management. Conformance with these requirements is the responsibility of the system generating the waste in addition to data for shipment records. The following are to be complied with in packaging of radioactive solid wastes as required by the recipient.\(^1\)

1. Fissionable material waste for disposal shall be packaged in metal containers.
2. The quantity of fissionable material per container shall not exceed the following:

<table>
<thead>
<tr>
<th>Min. Can Volume</th>
<th>Depleted and Natural U</th>
<th>Maximum Quantity per Can</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Enriched U</td>
</tr>
<tr>
<td></td>
<td></td>
<td>up to 0.95 wt.% U-235,</td>
</tr>
<tr>
<td>Up to 300 ml</td>
<td>No limit</td>
<td>0.7</td>
</tr>
<tr>
<td>300 to 600 ml</td>
<td>No limit</td>
<td>1.3</td>
</tr>
<tr>
<td>600 ml to 1 qt</td>
<td>No limit</td>
<td>2.0</td>
</tr>
<tr>
<td>1 qt to 6 qt</td>
<td>No limit</td>
<td>8.0</td>
</tr>
<tr>
<td>6 qt to 15 gal</td>
<td>No limit</td>
<td>8.0</td>
</tr>
<tr>
<td>15 gal to 55 gal*</td>
<td>No limit</td>
<td>8.0</td>
</tr>
</tbody>
</table>

*Concentration in any portion of the container shall not exceed 1 g fissile material/liter.

1. Chemicals which are incompatible (e.g., those which could react vigorously, or possible explode on combinations) shall not be packaged in the same waste container.
2. Toxic materials (e.g., beryllium) shall be packaged with the same degree of containment provided for plutonium-bearing wastes.
3. Waste containers shall not contain fission products capable of generating container surface temperature >100 °C while standing in air at ambient temperature.

1. Refer to References, Appendix A, Item 13.
Oxidizing materials, such as HNO₃, KMnO₄, etc., should not be present in packaged combustible solid wastes, unless the oxidizing material has been diluted or neutralized so that the fire hazard is eliminated.

Solid wastes should be essentially dry. Damp wastes should be packaged in an inner plastic container such that the integrity of the outer container is not jeopardized prior to burial. Liquid wastes for disposal by burial should be packaged with sufficient absorbing media (e.g., vermiculite) so that no liquid will escape should the container be broken.

Exterior surfaces of the waste package shall be free of smearable (loose) contamination (<200 c/m beta-gamma, <1000 d/m alpha).

The following shall be legibly noted on the outside of the containers¹ or as directed by administrative procedures:

- Building number and room number
- Dose rate at the surface of container
- External contamination release authorization
- Principal activity present and estimated curie value
- If the principal activity present is plutonium or uranium, the gram quantity should be noted.

The reference concept is based upon the use of standard store stock cardboard containers² for packaging low level wastes, shielded casks for disposal of high level solid wastes,³⁴ and interim storage cells.⁴⁵ High level wastes too large for shielded cask disposal are packaged in special burial containers provided by Operations.

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¹. Refer to References, Appendix A, Item 14.
². Refer to References, Appendix A, Item 10.
³. Refer to Drawings, Appendix G, SK-3-14119.
⁵. Refer to Drawings, Appendix G, SK-3-14215, SK-3-14216.
2.1.2.2 Radioactive Solid Waste Interim Storage and Disposal

Low level solid wastes are stored at locations within the FTR Building until sufficient packages have accumulated to permit economical transportation to the 200 Area burial grounds. Routine high level waste containers are normally transported directly from the contributing system to the 200 Area burial grounds in a shielded cask. Interim shielded waste vaults are provided within the FTR Building where high activity solid wastes in shielded containers may be stored pending disposal. Handling of the waste vault cover blocks and stored radioactive solid waste containers is done via the building traveling bridge crane. The waste containers are loaded onto railroad cars or trucks by the crane also. The storage vaults are not intended to be used for routine storage of wastes, but are provided for use during periods when it may be expedient to replace a certain piece of high activity equipment before disposal arrangements have been made. Although it is not a specific function of the interim storage vaults, radioactive equipment may be stored pending final disposition. Ventilation of the vaults is provided by the Heating and Ventilation System.\(^\text{1}\) Floor drains are provided in case vault decontamination is required.

2.2 DETAILED DESCRIPTION

The arrangement of equipment for handling radioactive liquid wastes is based on a batch process in which the wastes are collected in the reactor building and transferred to a Radioactive Liquid Waste Facility for interim storage and disposal. Low level solid wastes are stored at various locations within the FTR Building until sufficient packages have accumulated to make transportation and disposal economical. High level

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1. Refer to Interfaces, Appendix C, Item 7.
solid wastes are normally transferred directly to the burial grounds. Interim storage vaults are available where packaged high level solid wastes may be stored pending disposition. The packaging, storage, and disposal of radioactive liquid and solid wastes are the subjects of design studies.¹

2.2.1 Containment Vessel Receiving Tank Cell and Sample Area

A containment vessel receiving tank cell and sample area are provided by the Reactor Containment System² as shown on Drawings SK-3-14215 and SK-3-14216 in Appendix G. The tank is installed in a shielded cell about 10 x 10 x 15 ft high. Provisions are made for equipment installation and removal. The tank liquid sampler and activity monitor, and the remote equipment control and instrument panel are installed in a room above the tank. All in-cell equipment is designed for remote operation. Shielding is designed to limit personnel dosage in accordance with AECM-0524 and BNWL-MA-6.³

2.2.2 Process Area Receiving Tank Cell and Sample Room

The process area receiving tank cell and sample room are provided by the Structures Facility⁴ as shown on Drawing SK-3-14217 in Appendix G. The tank cell is about 20 x 30 x 30 ft high. Provisions are made for equipment installation and removal from the high bay area at grade level. The sample room is about 12 x 28 x 14 ft high and contains the waste tank contents sampling and monitoring equipment, and the remote equipment control and instrument panel. All in-cell equipment is designed for remote operation. Shielding is designed to limit personnel dosage in accordance with AECM-0524, BNWL-MA-6, and BNWL-MA-3.³

1. Refer to Support Information Requirements, Appendix B, Items 1, 2, 3, and 4.
2. Refer to Interfaces, Appendix C, Item 9.
3. Refer to References, Appendix A, Items 8, 11, and 15.
4. Refer to Interfaces, Appendix C, Item 4.
2.2.3 Radioactive Liquid Waste Facility

The Radioactive Liquid Waste Facility is provided by the Site Facilities System as shown on Drawings SK-3-14113 and SK-3-14114 in Appendix G. The Radioactive Liquid Waste Facility structure consists of an insulated metal building, approximately 66 x 100 x 22 ft high, and a contiguous below-grade tank vault measuring approximately 30 x 66 x 18 ft deep. The above-grade structure houses the control room; sampling and monitoring room; change room with shower, sink, water heater, and toilet; neutralizing equipment room, railroad tank car loadout station, and shielded cask loadout station. The below-grade tank vault is a concrete structure having a separate shielded cell for each of the four storage tanks and separate inlet and outlet shielded pipe chases. Removable concrete cover blocks just above grade level permit access to a cell or pipe chase, and provide personnel shielding. Personnel access ports are provided for routine maintenance, inspection, and equipment calibration. Shielding is designed to limit personnel dosage in accordance with AECM-0524, BNWL-MA-6, and BNWL-MA-3.¹

2.2.4 Radioactive Solid Waste Interim Storage Vaults

The radioactive solid waste interim storage vaults are provided by the Structures System as shown on Drawing SK-3-14215 in Appendix G. Four shielded vaults are provided with each one being about 10 x 10 x 20 ft deep. Cover block removal and replacement and radioactive waste container transferring are performed with the high bay crane. Shielding is designed to limit personnel dosage in accordance with AECM-0524, BNWL-MA-6, and BNWL-MA-3.¹

¹ Refer to References, Appendix A, Items 8, 11, and 15.
2.2.5 Support Services

2.2.5.1 Electrical Power

Normal electrical power is provided by the Building Electrical Power System\(^1\) to equipment in the containment vessel, process area, and Radioactive Liquid Waste Facility.

2.2.5.2 Lighting

General illumination is provided by the Lighting System\(^2\) in receiving tank cells, sample rooms, and in the Radioactive Liquid Waste Facility.

2.2.5.3 Communications

Communications equipment such as telephones, intercoms, and public address shall be provided by the Communications Systems.\(^3\) Intercoms and public address equipment shall be installed in receiving tank cells, sampling and monitoring rooms, and in the Radioactive Liquid Waste Facility. Telephones shall be provided to permit communications among personnel in the FTR control room, receiving tank sample rooms, and the Radioactive Liquid Waste Facility.

2.2.5.4 Ventilation

Ventilation is provided by the Heating and Ventilation System\(^4\) which ensures air flow from nonradioactive zones to zones of higher activity. Receiving and storage tank off-gas is vented to the ventilation exhaust system.

1. Refer to Interfaces, Appendix C, Item 1.
2. Refer to Interfaces, Appendix C, Item 3.
3. Refer to Interfaces, Appendix C, Item 2.
4. Refer to Interfaces, Appendix C, Item 7.
2.2.5.5 Service Piping

Process water, sanitary water, safety showers, drinking fountain, shower and toilet facilities, sanitary sewer, instrument air, and steam are provided by the Service Piping System as indicated on the drawings.\(^1\)

2.2.5.6 Underground Piping

Underground service piping and radioactive liquid waste piping are provided by the Site Facilities.\(^2\) Radioactive liquid waste piping is enclosed in an encasement which slopes to a sump at the Radioactive Liquid Waste Facility.

2.2.6 Components

The selection of materials, components, and equipment considers the fact that the type of radioactive liquid and solid wastes may range from basic to acidic in nature. In addition, decontamination agents and solutions are considered in the design.

2.2.6.1 Radioactive Liquid Waste Receiving Tanks

Receiving tanks are provided for accumulating drainage from equipment and spaces in the containment vessel and in the contiguous structure process area. One receiving tank is installed in the containment vessel for general drainage. In the process area, drainage from fuel and equipment cleaning vessels are routed to an organic waste tank and to high, intermediate, and low level aqueous waste tanks. A fifth receiving tank is provided for general drainage from other sources in the process area. Since the flows to the general

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1. Refer to Interfaces, Appendix C, Item 6.
2. Refer to Drawings, Appendix G, SK-3-14114, SK-3-14116 and SK-3-14121.
3. Refer to Interfaces, Appendix C, Item 5.
4. Refer to Drawings, Appendix G, SK-3-14113.
drainage tanks are infrequent there will be adequate short-lived radionuclide decay times prior to transferring tank contents to interim storage. Design is in accordance with applicable Hanford Standards. The tanks are fabricated of stainless steel. The bottom of each tank is sloped to a sump into which the discharge pump is installed. Capacity of each tank is about 2500 gallons which is based on the estimated largest single batch of waste. All receiving tanks are identical in size and design to simplify fabrication and installation. Sparging nozzles are installed inside each tank for cleanup purposes after the tank has been emptied. Each tank has the following nozzles or connections.

- Waste inlet
- Agitator
- Discharge pump
- Temperature sensor
- Liquid level sensor
- Specific gravity sensor
- Sparge line
- Off-gas vent
- Tank recirculation return
- Off-gas condenser condensate (process area general drainage tank only)
- Sample nozzle
- Spare nozzle

2.2.6.2 Radioactive Liquid Waste Interim Storage Tanks

Interim storage tanks are provided for accumulating and storing radioactive liquid wastes prior to disposal. One storage tank is provided for each of the following categories of radioactive liquid wastes: low, intermediate, and high level aqueous wastes and organic wastes. Organic wastes are disposed of separately from other wastes by the recipient,

1. Refer to References, Appendix A, Items 2, 3, 4 and 5.
Atlantic Richfield Hanford Co. (ARHCO), and are therefore segregated throughout the waste receiving, storing, and handling processes.

Design is in accordance with applicable Hanford Standards. The tanks are fabricated of stainless steel to accommodate all types of radioactive liquid wastes. The bottom of each tank is sloped to a sump into which the discharge pump (or jet) is installed. Capacity of each tank is about 5000 gallons. All storage tanks are identical in size and design to simplify fabrication and installation. However, a design study has been included to determine size of the intermediate level aqueous storage tank versus railroad tank car capacity. As sized above, four intermediate level aqueous storage tank fillings are required to fill an empty tank car. Sparging nozzles are installed inside each tank for cleanup purposes after the tank has been emptied. An external cooling water jacket is provided on each storage tank for temperature control of the contents, particularly during the neutralization process. Each tank has the following nozzles or connections.

- Waste inlet
- Agitator
- Discharge pump (or jet)
- Temperature sensor
- Liquid level sensor
- Specific gravity sensor
- Sparge line
- Off-gas vent
- Tank recirculation return

1. Refer to References, Appendix A, Items 2, 3, 4, and 5.
2. Refer to Support Information Requirements, Appendix B, Item 2.
3. Refer to Drawings, Appendix G, SK-3-14114.
. Off-gas condenser condensate (high level aqueous storage tank only)
. Neutralization
. Jacket cooling water inlet
. Jacket cooling water outlet
. Transport equipment vent and overflow
  . Intermediate level aqueous tank from tank car loadout station intermediate level aqueous lines
  . Organic tank from shielded cask and tank car loadout station organic lines
  . High level aqueous tank from shielded cask loadout station high level aqueous lines
. Floor drain (high level aqueous tank from aqueous cask loadout station and organic tank from organic cask loadout station)
. Sample nozzle
. Spare nozzle

2.2.6.3 Agitators

Agitators are provided for all receiving and storage tanks for mixing tank contents during sampling and discharge. The agitators are top-entering self-supported nozzle-mounted units each fitted with a turbine rotor. All surfaces exposed to the tank contents are stainless steel. A design study has been included to determine the feasibility of using circulating educators for agitating the contents of receiving and storage tanks instead of the above described agitator.\textsuperscript{1} The discharge pump of each tank would serve as the circulator for the mixing educators.

\textsuperscript{1} Refer to Support Information Requirements, Appendix B, Item 2.
2.2.6.4 Discharge Pumps

Pumps are provided for discharging contents of all receiving tanks, intermediate level aqueous storage tank, and low level aqueous storage tank. The discharge pumps are top-entering self-supported nozzle-mounted units, with the suction located in the tank sump below the low point of the bottom tank head. A low-level switch automatically shuts the pump off. The pump is equipped with a suction strainer. All surfaces exposed to the tank contents are stainless steel. A design study has been included to determine the feasibility of using steam jets for discharging the tanks instead of the above described pumps. The additional volume of waste created by the steam jets and increased disposal costs must be considered.

2.2.6.5 Discharge Jets

Steam jets are provided for discharging high-level aqueous waste and organic waste to shielded casks by the vacuum transfer technique. Additional jets are required to transfer these wastes to the railroad tank cars since vacuum fill may cause tank car rupture.

2.2.6.6 Receiving Tank Discharge Pump Strainers

Strainers are provided in the discharge line of each receiving tank discharge pump to prevent foreign objects from being discharged into the storage tanks.

2.2.6.7 Cell Sump Pumps

Sump pumps are provided for discharging equipment or tank leakage from the cells containing the receiving and storage tanks. The cell sump pumps are of the vertical type equipped

1. Refer to Support Information Requirements, Appendix B, Item 2.
with high- and low-level switches for automatic operation. All surfaces exposed to the sump contents are stainless steel.

2.2.6.8 Off-Gas Vent Condensers

Off-gas vent condensers are provided for removing moisture from the process area receiving tank and the storage tank vent lines before discharge into the ventilation exhaust system. Capacity and materials will be determined during preliminary design.

2.2.6.9 Off-Gas Vent Moisture Separator

An off-gas vent moisture separator is provided for removing moisture from the containment vessel receiving tank before discharge into the ventilation exhaust system. A water cooled condenser is not used because of restrictions against presence of aqueous solutions within the containment vessel. The moisture separator will utilize mesh for entraining the moisture. Size and materials will be determined during preliminary design.

2.2.6.10 Neutralizing Agent Makeup Tank and Agitator

A tank is provided for mixing storage tank neutralizing agents. The neutralizing agent tank and agitator are designed for corrosive use compatible with the agent or agents required for waste neutralization. Separate tanks and agitators are to be installed if widely diverse neutralizing agents are required.

2.2.6.11 Neutralizing Agent Pump

A pump is provided for adding neutralizing agents to the storage tanks. The neutralizing agent pump is of the adjustable metering type having materials of construction compatible

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1. Refer to Support Information Requirements, Appendix B, Item 2.
with the fluid handled. Separate pumps are to be installed for each neutralizing agent makeup tank if more than one tank is required.

2.2.6.12 Shielded Liquid Waste Transfer Cask

A shielded liquid waste transfer cask as shown on Drawing SK-3-14117 in Appendix G, is provided for transfer of high-level radioactive liquid wastes. All material, except shielding, is stainless steel for use in corrosive service. The number, capacity, and shielding required are to be determined through studies.

2.2.6.13 Cask Loading Crane

A crane is provided in the Radioactive Liquid Waste Facility by the Site Facility System. The crane is of the overhead traveling bridge type of about 35 tons capacity and having a single trolley. The crane shall extend over the railroad tracks as well as truck area to permit loading casks onto either trucks or railroad cars for shipment. The crane is manually operated from floor level through a control pendant. Brakes are provided on the bridge trucks, trolley trucks, and hook cable drum. Travel limit switches and stops are provided for limiting crane travel.

2.2.6.14 Railroad Tank Car

Under this concept it is planned to utilize one of four existing railroad tank cars assigned to Battelle-Northwest, although a study will be performed to determine the feasibility of an FFTF owned tank car. Should it be determined that an FFTF owned tank car is required, it shall be similar to the existing BNW tank cars.

1. Refer to Support Information Requirements, Appendix B, Item 2.
2. Refer to Interfaces, Appendix C, Item 5.
3. Refer to Drawings, Appendix G, SK-3-14118.
2.2.6.15 Low Level Solid Waste Containers

Small low-level solid wastes are packaged in store stock cardboard containers. Special containers are required for wastes larger than the above cartons and will be provided by Operations.

2.2.6.16 High Level Solid Waste Shielded Cask

Routine high-level solid wastes are packaged in metal containers which are sealed before disposal. A shielded cask is provided for transporting the containers to the 200 Area burial grounds. Special containers are required for disposal of nonroutine high level solid wastes too large for disposal by the shielded cask and will be provided by Operations.

Conceptual design of a waste container and shielded cask are shown on Drawing SK-3-14119 in Appendix G. The cask assembly consists of a lead-filled shielding shell, grapple hook, cable, winch, shield gate, gate valve, and transfer port mating flange. The lifting yoke is designed so that the cask may be transported by crane within the FFTF building in either a vertical or horizontal position.

The cask is designed for removal of waste containers from inert gas atmosphere spaces. This requires attachment to transfer ports from these spaces and provisions to purge and pressurize the cask interior with the appropriate inert gas. The winch assembly is located on top of the cask in a gastight housing equipped with a purge gas connection. In addition, pressurized gas seals are provided for any cask shell penetrations (other than the cable access port) and the gate valve stem. Inert gas, and gas piping to the transfer port

1. Refer to Interfaces, Appendix C, Items 12, 13, and 17.
locations are provided by the Inert Gas Receiving and Processing System. The grapple hook is designed to hold the waste container in position until the cask is in disposal position at the burial ground.

The waste container is equipped with a sealing cover and lifting bail designed for mating with the cask grapple hook.

The loaded cask will be hauled to the 200 Area burial ground on a truck specially designed to permit vertical disposal of the waste container into a sunken caisson. This is also the subject of a study.

2.2.7 Instruments and Controls


2.2.7.1 Master Control Panel

A master control panel is installed in the Radioactive Liquid Waste Facility. All pipe lines; valves; controls; tank and pipe line liquid activity monitors; tank level, temperature, specific gravity indicators; annunciator alarms; and equipment in the Radioactive Liquid Waste System are graphically displayed on the panel board. All motors and remotely operated equipment are controlled from the panel.

1. Refer to Interfaces, Appendix C, Item 19.
3. Refer to Drawings, Appendix G, SK-3-14116, SK-3-14121, and SK-3-14071, Sht. 1, 2, and 3.
4. Refer to Radioactive Liquid Waste System Transfer Controls, Appendix F.
2.2.7.2 Local Control Panels

Local control panels are installed in the containment and process area receiving tank sampling and monitoring equipment rooms. All pipe lines; valves; controls; liquid activity monitors; tank level, temperature, and specific gravity indicators; alarms; and equipment for each receiving tank cell are graphically displayed on the respective local panel board. All motors and remotely operated equipment are controlled from the panels except the discharge line valves.\(^1\),\(^2\) These valves can be operated only from the master control panel in order to minimize inadvertent or inappropriate waste discharge.

2.2.7.3 FTR Control Room Panel

A panel is installed in the reactor control room having the following instrumentation and controls:

- Radioactive Liquid Waste System annunciator alarms.
- Emergency controls and operating status indicating lights for receiving tank agitators and discharge pumps, storage tank agitators, discharge pumps and jets, and storage tank inlet valves.

2.2.7.4 Remote Valve Controls

All remotely operated valves are controlled from the master and local graphic control panels as described above. Switch (and valve) positions are shown by indicating lights. Valve controls are a design interface with the Plant Instrumentation System.\(^3\)

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1. Refer to Drawings, Appendix G, SK-3-14116, SK-3-14121, and SK-3-14071, Sht. 1, 2, and 3.
2. Refer to Radioactive Liquid Waste System Transfer Controls, Appendix F.
3. Refer to Interfaces, Appendix C, Item 21.
2.2.7.5 Electric Motor Controls

All system electric motors are controlled from the master and local graphic control panels. Operating status of each motor is shown by indicating lights. Motor controls are a design interface with the Building Electrical Power System.  

2.2.7.6 Receiving and Storage Tank Level Recorders

All receiving and storage tanks are equipped with level recorders suitable for corrosive service. Level recorders, high-level alarms, and high-high level (backup) alarms are installed on the local and master control panels and on the reactor control room display panel. The high-high level alarms close the inlet valve to the respective tank.

2.2.7.7 Receiving and Storage Tank Temperature Recorders

All receiving and storage tanks are equipped with tank temperature recorders suitable for corrosive service. Tank temperature recorders and high-temperature alarms are installed on the local and master control panels and on the reactor control room display panel.

2.2.7.8 Receiving and Storage Tank Specific Gravity Indicators

All receiving and storage tanks are equipped with specific gravity indicators suitable for corrosive service. Readout instrumentation is installed on the local and master control panels.

2.2.7.9 Liquid Waste Radioactivity Monitors and Samplers

Liquid waste radioactivity monitors and liquid samplers are provided by the Radiation Monitoring System.

1. Refer to Interfaces, Appendix C, Item 1.
2. Refer to Interfaces, Appendix C, Item 21.
3. Refer to Interfaces, Appendix C, Item 22.
piping is provided by the Radioactive Waste System. The monitoring and sampling equipment to be used is the subject of a design study by the Radiation Monitoring System.\textsuperscript{1} Radioactivity recorders and above-limits alarms are installed on the local and master control panels. Alarms are installed on the reactor display panel.

The following waste streams are monitored by radioactivity monitors:

1. Low level aqueous waste (upstream of the storage tank)\textsuperscript{2}
2. Intermediate level aqueous waste (upstream of the storage tank)\textsuperscript{2}
3. High level aqueous waste (upstream of the storage tank)\textsuperscript{2}
4. Organic waste (upstream of the storage tank)\textsuperscript{2}
5. Discharge line to process sewer crib.\textsuperscript{2}

Radioactivity monitors and liquid samplers are installed in the discharge lines of the storage tanks.\textsuperscript{3} This location permits radioactivity monitoring to be carried out during the recirculating cycle when samples are being taken for tank content analysis, and also when tank contents are being discharged. Radioactivity monitors and liquid samplers are installed in the discharge lines of the receiving tanks.\textsuperscript{4}

The low level aqueous waste line monitor is equipped with instrumentation to close the inlet valve when above-limit wastes are detected.\textsuperscript{2} Manually controlled valves are provided to divert above-limits waste to either intermediate or high-level aqueous waste pipe lines in accordance with the radioactivity level.\textsuperscript{2}

\textsuperscript{1} Refer to References, Appendix A, Item 12.
\textsuperscript{2} Refer to Drawings, Appendix G, SK-3-14114.
\textsuperscript{3} Refer to Drawings, Appendix G, SK-3-14116.
\textsuperscript{4} Refer to Drawings, Appendix G, SK-3-14121.
The intermediate level aqueous waste line monitor is similarly designed for stopping the flow of above-limit waste should the intermediate level aqueous waste limits be exceeded. Manually controlled valves are provided to divert above-limits waste to the high-level aqueous waste line. The monitor in the discharge line to the process sewer crib is equipped with instrumentation to shut the discharge valve if radioactivity limits are exceeded.

### 2.2.7.10 Criticality Monitors

Neutron sensitive criticality detectors are provided by the Radiation Monitoring System in the receiving and storage tank cells. Alarms are installed in the Radioactive Liquid Waste Facility, receiving tank sampling and monitoring rooms, and in the reactor control room.

### 2.2.7.11 Storage Tank pH Meters

Meters are provided for determining the pH of the contents of each storage tank. Readout instrumentation is provided on the Radioactive Liquid Waste Facility control panel. The meters and indication instrumentation are a design interface with the Plant Instrumentation System.

### 2.2.7.12 Beta-Gamma Radiation Monitors

Beta-gamma sensitive area radiation monitors are provided in the FTR Building receiving tank cells, sampling and monitoring rooms, and in the Radioactive Liquid Waste Facility cells and personnel areas. Alarms are installed in the receiving tank cells, sampling and monitoring rooms.

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1. Refer to Drawings, Appendix G, SK-3-14114.
2. Refer to Interfaces, Appendix C, Item 22.
3. Refer to Interfaces, Appendix C, Item 21.
Waste Facility Control Room, and the reactor control room. Monitors and alarms are provided by the Radiation Monitoring System.

2.2.7.13 Exhaust Ventilation Air Monitors

Exhaust ventilation air monitors and alarms are provided by the Radiation Monitoring System. Alarms are installed in the receiving tank sampling and monitoring rooms, Radioactive Liquid Waste Facility control room, and reactor control room.

2.2.7.14 Continuous Readout Air Monitors

Continuous readout air monitors are provided in the FTR Building receiving tank cells, sampling and monitoring rooms, and in the Radioactive Liquid Waste Facility cells and personnel areas. Alarms are installed in the receiving tank cells, sampling and monitoring rooms, Radioactive Liquid Waste Facility control room, and the reactor control room. Monitors and alarms are provided by the Radiation Monitoring System.¹

¹ Refer to Interfaces, Appendix C, Item 22.
SECTION 3.0 SAFETY CONSIDERATIONS

3.1 HAZARDS

3.1.1 Radioactive Liquid Wastes

A. Failure of equipment or personnel error could dump above-limits aqueous wastes into the low level or intermediate level aqueous services.

B. Operator error could result in high activity aqueous waste being routed to the process sewer crib from the Liquid Waste Facility.

C. Malfunction of receiving and neutralizing tank level recorders and/or alarms or operator inattention may permit tank overfill and subsequent overflow into the vent headers and the tank vent condensers.

D. Sludge could accumulate in the receiving and storage tanks. In time this might create a critical mass if fissile material were discharged to the radioactive waste system.

E. Improper sampling of liquid wastes could result in improper disposal of radioactive liquid wastes.

F. Operator error or equipment malfunction could cause spread of contamination to the environs during the tank car or shielded cask filling operations.

G. A highway accident could cause rupture of a high level liquid waste shielded cask, containing high level aqueous waste or similar activity organic waste, while it is being transported to the 200 Area disposal site.

H. A leak or rupture in a receiving or storage tank could result in tank contents draining to the cell enclosure.
I. An accumulation of fuel materials from cleaning of fuel elements or of equipment containing fuel material could cause a critical mass problem in receiving or storage tanks.

3.1.2 Radioactive Solid Wastes

A. Lack of segregation of radioactive solid wastes in packaging for disposal could cause excessive contamination spread, personnel exposure, or fire hazards.

B. Dropping a container of solid wastes could result in rupture of the container and subsequent contamination spread.

3.2 PRECAUTIONS

3.2.1 Radioactive Liquid Wastes (Match items in Section 3.1.1 above)

A. Radioactivity monitors, equipped with instrumentation for closing inlet valves, are installed in the low and intermediate level aqueous waste pipe lines. Before transfer can be accomplished, the appropriate jumper must be installed to connect the receiving tank discharge line and the storage tank inlet line. Jumpers and connector heads are located in a diversion box.

B. A radioactivity monitor, equipped with instrumentation for actuating a discharge line valve, is installed in the discharge line to the process sewer crib. Flow of above-limits aqueous waste to the process sewer would be automatically stopped by monitor equipment actuation of the line shutoff valve. Planned operation, based on the use of jumpers for routing waste from the aqueous tanks to the process sewer crib after sampling and analysis of tank contents, will minimize improper transfer.
C. The receiving and storage tanks are equipped with redundant tank level alarms which shut off the inlet line valves.

D. The receiving and storage tanks are equipped with internal water spray headers for cleaning the tanks after emptying. Tank bottoms slope to a pump sump so the sludge will run to the vicinity of the discharge pump suction. Periodic sampling and analysis of tank contents will minimize unknown accumulation of fissile materials. Critical mass detectors are installed near the tanks with alarms located respectively in the receiving tank sampling and monitoring rooms, Radioactive Liquid Waste Facility control room, and in the reactor control room.  

E. Representative samples of radioactive liquid waste from receiving and storage tanks are obtained by rapid turnover of tank contents through use of agitators, and recirculation piping from the discharge pumps. Liquid samples are bled from the tank discharge line and returned to the recirculation line.

F. Automatic sequencing of valves will assure proper valve operation for any given transfer operation. The tank car and shielded cask loadout stations are housed in a ventilated structure with the ventilation exhaust air being discharged to the Heating and Ventilation System exhaust facility. Steam and water are available for decontamination and cleaning of equipment. Equipment connections are capped before transporting to the 200 Area disposal site.

1. Refer to Interfaces, Appendix C, Item 22.
2. Refer to Interfaces, Appendix C, Item 7.
G. Liquid waste shielded casks are transported to the 200 Area disposal site under very restricted conditions. A caravan, including the caravan director, ITT Patrol, and radiation monitoring personnel are required to accompany the shipment.  

H. Liquid level instrumentation is installed in each receiving and storage tank cell sump with alarms located respectively in the receiving tank sampling and monitoring rooms, and Radioactive Liquid Waste Facility control room. Each cell sump is equipped with a pump discharging to a header which permits pumping cell contents to another tank.

I. It will be assumed, by procedure, that all fuel material lost from a fuel element during cleaning or that all fuel material in equipment being cleaned will be deposited in a waste receiving tank or tanks. Sampling and analysis of the tank contents will provide data on the concentration of fuel material. All receiving tanks are equipped with internal water spray nozzles thereby permitting dilution and cleanup. The degree of cleanup would be determined through sampling and analysis. The above analysis data will be utilized in discharging the receiving tank contents to a storage tank. The sampling and analysis of the storage tank contents will provide data on the concentration of fuel material in the tank which will be utilized for determining ultimate disposal. All storage tanks are also equipped with internal water spray headers.

3.2.2 Radioactive Solid Wastes (Match items in Section 3.1.2 above)

A. Personnel training and administrative controls\(^1\) minimize improper segregating of radioactive solid wastes during packaging. (See Section 2.1.2)

B. Personnel training and design features, taking into consideration the possible dropping of waste containers (such as mechanically sealed lids on metal containers), minimize the damage to waste containers during handling and resultant contamination spread.

\(^1\) Refer to References, Appendix A, Item 13.
SECTION 4.0 PRINCIPLES OF OPERATION

The Radioactive Waste System is essential for effective and safe removal of radioactive liquid (aqueous and organic) and solid wastes from the FFTF. It is mandatory that all applicable procedures and regulations be closely followed to minimize spread of contamination and undue exposure to personnel.

4.1 STARTUP

4.1.1 Radioactive Liquid Wastes

Valving must be checked to assure that all are in the prescribed positions. Extra precautions must be taken to assure that wastes will not be inadvertently discharged to a location designated for lower activity wastes. Transporting vehicles and shielded casks must be readily available by reactor startup.

4.1.2 Radioactive Solid Wastes

Shielded containers, casks, and specialized transporting and handling equipment must be readily available before reactor startup.

4.2 NORMAL OPERATION

4.2.1 Radioactive Liquid Wastes

4.2.1.1 Containment Vessel Wastes

Containment vessel radioactive liquid wastes are routed to a receiving tank located in the reactor containment vessel (Tank No. 6). Since drainage is infrequent, adequate time may be allowed for decay of short-lived radionuclides before sampling and discharge of the tank contents through approved operating procedures.

1. Refer to Drawings, Appendix G, SK-3-14121, SK-3-14216.
When the tank is about full, the contents are sampled for activity level and radionuclide composition. In order to get a representative sample it is imperative that the tank contents be thoroughly mixed. This is achieved through use of an agitator and recirculating the tank contents by means of the discharge pump and recirculation piping as shown on Drawing SK-3-14121 in Appendix G. Prior to sampling, the appropriate valving is positioned for tank content recirculation and the tank agitator and discharge pump are started. After about 30 minutes of this operation, an eight-ounce sample is drawn over a 30-minute period and the pump and agitator shut off. The sample is delivered to an Analytical Laboratory for analysis. When the analysis results are returned, the receiving tank contents are then pumped to the appropriate storage tank located in the Radioactive Liquid Waste Facility.\(^1\) By means of a jumper and valving arrangement, in a diversion box, the waste may be routed to low, intermediate, or high activity level aqueous waste storage tanks or to an organic waste storage tank in accordance with the analysis results.\(^2\) All of the tank discharge operations are carried out from the master control panel in the Radioactive Liquid Waste Facility control room.\(^3\) Design of the piping\(^2\) permits monitoring the tank discharge line for activity level to assure proper waste routing. After the tank has been emptied, the tank is rinsed internally by process water via the sparging nozzles. The nozzles are turned off after the discharge pump automatically shuts off when the tank is empty. Upon completion of emptying and spray rinsing of the tank,

1. Refer to Drawings, Appendix G, SK-3-14113, SK-3-14114, SK-3-14116 and SK-3-14121.
2. Refer to Drawings, Appendix G, SK-3-14121.
3. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1, 2, and 3.
the agitator is shut off, tank valving is positioned for receiving waste, the discharge valving is closed, the diversion box jumpers are removed, and blank connector heads are installed on the nozzles.

4.2.1.2 Process Area Organic Cleaning Wastes

Organic cleaning wastes from fuel cleaning vessels and equipment cleaning vessels are piped to the organic waste receiving tank (No. 1). The sampling procedure is similar to that described above in Section A. The organic waste is pumped directly to the organic waste storage tank in the Radioactive Liquid Waste Facility after the diversion box jumper has been installed.

4.2.1.3 Process Area Aqueous Cleaning Wastes

High, intermediate, and low level aqueous wastes from fuel cleaning vessels and from equipment cleaning vessels are drained to Receiving Tanks No. 2, 3, and 4. For purposes of disposal, aqueous wastes from the cleaning equipment are segregated from the organic wastes. These aqueous wastes are not mixed with aqueous wastes from other process area sources so as to minimize the amount of intermixed wastes should organic solvents, used in the cleaning process, be inadvertently routed to the aqueous receiving tank. The sampling and discharge procedures are similar to those described in Section A.

4.2.1.4 Process Area General Drainage Wastes

General radioactive liquid waste drainage from the process area is routed to Receiving Tank No. 5 as shown on Drawing SK-3-14121 in Appendix G.

1. Refer to Drawings, Appendix G, SK-3-14121.
The sampling and discharge procedures for the general drainage waste receiving tank are similar to those described in Section A.

4.2.1.5 Immiscible Organic Waste in Aqueous Waste Receiving Tanks

Should organic wastes be discharged inadvertently to an aqueous receiving tank, this condition will appear during sampling of the tank contents before discharge to a storage tank. Then, by leaving the tank in a state of quiesence for a period of time to permit separation of the organic waste from the aqueous waste, the aqueous solution may be pumped to an aqueous waste storage tank. When samples of the waste discharge stream indicate the presence of organic waste, the stream is then diverted to the organic storage tank. The same procedure would apply if a similar condition existed in an aqueous waste storage tank.

4.2.1.6 Low Level Aqueous Wastes

Low level aqueous wastes are piped to a low level aqueous waste interim storage tank located in the Radioactive Liquid Waste Facility. The waste stream is continuously monitored upstream by a radioactivity monitor with activity indication and above normal alarms located in the FTR and the Radioactive Liquid Waste Facility control rooms. Should the radioactivity limits be exceeded, the storage tank inlet line valve is automatically closed. Manually controlled valves are provided for diverting the flow to the intermediate level aqueous waste interim storage tank located in the Radioactive Liquid Waste Facility. If the activity is in excess of the intermediate level limits, the waste is diverted to a high level aqueous waste interim storage tank.
Liquid samples are taken in a manner similar to that discussed in Section 4.2.1.1. Upon verification that the tank contents meet the release limit requirements, it is discharged to the process sewer crib for disposal. Installation of a jumper between the tank discharge and the process sewer is required before transfer. The jumper is removed and blank connector heads are installed on the line nozzles upon completion of the transfer operation.

4.2.1.7 Intermediate Level Aqueous Wastes

Intermediate level aqueous wastes (\(\leq 100 \mu\text{Ci/ml}\)) are piped to an intermediate level aqueous waste interim storage tank located in the Radioactive Liquid Waste Facility. The waste stream is continuously monitored by a radioactivity monitor located upstream of the tank. Activity indication and above-normal alarms are located in the FTR and the Radioactive Liquid Waste Facility control rooms. Should the intermediate level aqueous waste radioactivity limits be exceeded, the storage tank inlet line valve is automatically closed. Manually controlled valves are provided for diverting the flow to the high level aqueous waste interim storage tank. The intermediate level aqueous waste above-normal activity alarms are sounded in the two control rooms.

When the intermediate level aqueous waste interim storage tank becomes about three-fourths full, the contents are sampled for radionuclide content and pH. The appropriate tank valving is positioned for tank content recirculation and the tank agitator and discharge pump are started. After about 30 minutes of this operation, an eight-ounce sample is drawn

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1. Refer to References, Appendix A, Item 8.
2. Refer to Interfaces, Appendix C, Item 5.
over a 30-minute period and then delivered to an Analytical Laboratory for analysis. Upon completion of the sample analysis for radionuclide content and pH, the appropriate neutralizing agent is added if the pH is not 8 or greater.\(^1\) During the addition of the neutralizer, the agitator is continuously operated. Tank temperature is monitored, and jacket cooling water is turned on if the temperature reaches about 150 °F. A liquid sample is again taken, as described above, to verify that the pH is 8 or greater.

The full waste storage tank is emptied into a railroad tank car as soon as possible after the liquid sample data is satisfactory in order to have the tank available for waste storage. Pipe connections are made to a railroad tank car,\(^2,3\) valving is positioned at the Loadout Station, and the appropriate tank valving is remotely positioned from the Radioactive Liquid Waste Facility control room panel. The tank agitator and discharge pump are then started and the tank emptied. The waste stream is monitored by a radioactivity monitor with activity indication and above-normal alarms located in the Radioactive Liquid Waste Facility control room. Above-normal alarms are also located on a panel in the FTR control room. The sparging spray nozzles are turned on for a period of time until the activity level of the pump discharge has decreased to a constant level. The discharge pump automatically shuts off when the tank is empty. Upon completion of emptying and spray rinsing of the tank, the agitator is shut off, tank valving is positioned for receiving waste, loadout station valving is closed, tank car connections are broken, and the tank car connections are capped. During and

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1. Refer to References, Appendix A, Item 7.
2. Refer to Drawings, Appendix G, SK-3-14114, SK-3-14116, and SK-3-14118.
after the tank car filling operation, the fill lines, connections, and tank car are surveyed by radiation monitoring personnel for the protection of operating personnel. Any spills of radioactive waste are cleaned up, and the equipment is decontaminated by operating personnel. After the railroad tank car is full (approximately 20,000 gallons) and compliance with the shipment procedures and records\(^1\) has been verified, the car is shipped to the Atlantic Richfield Hanford Co. (ARHCO) at the 200 Area for waste disposal. The tank car is decontaminated both internally and externally at the 200 Area before being returned to the Radioactive Liquid Waste Facility.

4.2.1.8 High Level Aqueous Wastes

High level aqueous wastes (>100 \(\mu\)Ci/ml) are piped to a high level aqueous waste interim storage tank located in the Radioactive Liquid Waste Facility. The waste stream is continuously monitored by a radioactivity monitor located upstream of the tank. Activity recording instrumentation is located in both the FTR and the Radioactive Liquid Waste Facility control rooms.

When the storage tank becomes full, the contents are discharged into shielded casks by the vacuum fill technique. A steam jet creates a vacuum in the cask being filled which causes the waste from the storage tank to flow into the cask. This manner of fill minimizes contamination spread should there be a faulty cask-to-pipe connection. Sampling equipment is provided for determining composition and pH before transporting to the 200 Area for disposal. A full cask is

\(^1\) Refer to Radioactive Waste Shipment Agreements and Records, Appendix D, Items 1, 3, 5 (or 6).
loaded by the building crane onto a specially designed "Low Boy" truck trailer supplied by ITT Federal Support Services. The shielded cask is transported to the 200 Area for waste disposal and returned, by convoy, in accordance with established procedures. The building crane extends over the tank car loadout station thereby permitting loading a shielded cask (or casks) onto a railroad car for shipment to the disposal site if desired.

4.2.1.9 Organic Wastes

Organic wastes are piped to an organic storage tank located in the Radioactive Liquid Waste Facility. The waste stream is continuously monitored by a radioactivity monitor located upstream of the tank. Activity recording instrumentation is located in both the FTR and the Radioactive Liquid Waste Facility control rooms.

When the storage tank is full, the contents are sampled as discussed in 4.2.1.7. If the activity level is such that shielded transfer is not required, the waste is discharged to a railroad tank car, as discussed in 4.2.1.7, except that the operation is by steam jet. Should shielded casks be required for transfer of the waste to the disposal site, the cask filling and transporting procedures are the same as those discussed in 4.2.1.8.

4.2.2 Radioactive Solid Wastes

4.2.2.1 Low Level Solid Wastes

Small low level solid wastes are packaged in cardboard cartons by the system generating the wastes in accordance with

1. Refer to Radioactive Waste Shipment Agreements and Records, Appendix D, Items 1, 5 (or 6).
Section 2.1.2. The containers are transferred to designated locations at the FFTF by the Radioactive Waste System.\(^1\) (Items larger than the standard cardboard containers are packaged in special containers provided by Operations.) After a truckload of wastes have accumulated, they are hauled out to the 200 Area for trench burial.\(^2,3\)

4.2.2.2 High Level Solid Wastes

Cask Disposal. Small high level solid wastes are packaged in metal containers equipped with sealing lids in accordance with Section 2.1.1 by the system generating the waste. The container,\(^4\) except for the lifting bail, is encased in a plastic wrap to minimize contamination of the cask\(^4\) interior; and is then moved into the cask receiving position by the waste generating system. (For discussion purposes this is assumed to be directly beneath a valved ceiling transfer port.)\(^4,5\)

The transfer of the loaded waste container into the cask would be as follows:

1. Cask positioned on the transfer port by a building crane.\(^6\)
2. Transfer port and cask flanges are joined and sealed.
3. Inert purge gas connections are made.
4. Cask purged by same type of gas as that in cell housing the waste container.\(^7\)

---

2. Refer to Radioactive Waste Shipment Agreements and Records, Appendix D, Items 2, 4, 5 (or 6).
3. Refer to References, Appendix A, Items 11, 14.
4. Refer to Drawings, Appendix G, SK-3-14119.
5. Refer to Interfaces, Appendix C, Items 12, 13, and 17.
6. Refer to Interfaces, Appendix C, Item 4.
7. Refer to Interfaces, Appendix C, Item 19.
Transfer port valve opened.
Cask gate valve opened.
Cask shielding gate opened.
Cask grapple lowered into mating connection of waste container.
Waste container raised into cask.
Above-noted valves returned to closed positions.
Purge gas connections broken.
Flange connections broken.
The loaded cask is surveyed by radiation monitoring personnel and released after shipping requirements have been met. The cask is then shipped by truck to the 200 Area for waste container disposal in accordance with established procedures.

4.2.2.3 High Level Solid Wastes

Non-Cask Disposal. High level solid wastes too large for shielded cask disposal will be prepared and packaged in a special burial container provided by Operations. The container is surveyed by radiation monitoring personnel and released for burial or interim storage depending upon waste activity level, availability of transportation, and interruption of other work activities. The waste may be shipped either by truck or railroad car to the 200 Area for trench burial, depending upon activity level, in accordance with established procedures.

4.3 SHUTDOWN

Shutdown of the Radioactive Liquid Waste Facility equipment will be in accordance with the FFTF Operating Manual (to be published). Interfacing systems supplying services, and

---

1. Refer to References, Appendix A, Item 13.
2. Refer to Radioactive Waste Shipment Agreements and Records, Appendix D, Items 2, 4, 5 (or 6).
those systems generating wastes handled by the Radioactive Waste System will be notified to make adjustments prior to system shutdown as deemed necessary by operating personnel.

4.4 SPECIAL OR INFREQUENT OPERATION

Plant and personnel safety will be considered during special or infrequent operation of the Radioactive Liquid Waste Facility. Special plant and personnel procedures will be prepared, approved, and enforced for all such required operations.

Decontamination efforts will occur only rarely and pre-planning will permit adequate programming of the waste operation in relation to emptying storage tanks and stockpiling tank cars and/or casks before the decontamination effort is started.

Small quantities of contaminated liquid may drip onto the tank cars or shielded casks or onto the floor when connecting or disconnecting the fill lines. Water and steam are available for decontaminating and cleaning up the spill. Some air contamination may occur, however, this is filtered through the Heating and Ventilation System\textsuperscript{1} exhaust air filtration system.

Maintenance of pumps, valves, and other equipment in the Radioactive Liquid Waste Facility may require curtailment or cessation of operations connected with that portion of the system. The majority of the valves are placed in pipe chases separate from the tank vaults to reduce radiation exposure to maintenance personnel. Each storage tank is

\textsuperscript{1} Refer to Interfaces, Appendix C, Item 7.
also placed in a separate cell to reduce personnel exposure during maintenance. Contamination spread is minimized by exercising caution during the maintenance operation.

4.5 EMERGENCY OPERATION

A criticality or high radiation condition in either a receiving or storage tank could cause an evacuation alarm to be sounded. Emergency remote controls for the tank pumps and agitators, and/or critical valving, are located in the FTR control room on the Radioactive Liquid Waste System display panel. These controls are provided in the event operations personnel are unable to place the equipment in a safe status before evacuating due to a criticality or high radiation condition at the radioactive liquid waste handling areas.

4.6 OPERABILITY

On a periodic basis, an interruption of the instrument air supply to the Radioactive Liquid Waste Facility shall be simulated to verify that the backup air supply functions properly.
SECTION 5.0 MAINTENANCE PRINCIPLES

5.1 PREVENTIVE MAINTENANCE

A. Liquid level indicating instruments, high liquid level alarm, high-high level liquid alarms, and liquid radioactivity monitors, are calibrated in accordance with plant maintenance standards.

B. Liquid radioactivity monitors in the low level and intermediate level radioactive aqueous waste streams are periodically tested to verify automatic closure of the respective storage tank inlet valves.

C. Periodic routine inspections are made through personnel access ports to verify proper operation of equipment and controls. Major maintenance is performed as necessary to assure continued reliable operation. Cover blocks are removed for major access.

D. Special lubricants are provided for equipment operating in high radiation zones.

5.2 UNSCHEDULED MAINTENANCE

Studies are to be made to determine the effects of unscheduled maintenance on operation of the Radioactive Liquid Waste System as follows: ¹

1. Need for emergency capacity spare storage tanks.
2. Need for spare equipment such as valves, pumps, and tank agitators.

¹ Refer to Support Information Requirements, Appendix B, Item 2.
APPENDIX A

REFERENCES
APPENDIX A

REFERENCES


2. HWS-10001, *Hanford Mechanical Standards*
   - Section M-1, Plumbing
   - Section M-2, Process and Service Piping

3. HWS-10003-1, *Hanford Guides*, Volume 1
   - DG-100-M, Guide for Process and Service Piping
   - DG-102-M, Guide for Packing and Gasket Materials


5. HWS-10006, *Hanford Standard Design Criteria*
   - SDC-1.1, Standard Design Criteria, General
   - SDC-1.2, Standard Design Criteria for Codes, Standards and Specifications


APPENDIX B

SUPPORT INFORMATION REQUIREMENTS
## APPENDIX B

### SUPPORT INFORMATION REQUIREMENTS

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
<th>Type of Effort</th>
<th>Source</th>
<th>When Required</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Radioactive Liquid Waste Quantities &amp; Composition Analysis Study</td>
<td>Engr. Study</td>
<td>A-E</td>
<td>Preliminary Design</td>
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<tr>
<td>2</td>
<td>Radioactive Liquid Waste Transfer, Storage &amp; Disposal Requirements Study</td>
<td>Engr. Study</td>
<td>A-E</td>
<td>Preliminary Design</td>
</tr>
<tr>
<td>3</td>
<td>Radioactive Solid Waste Quantities &amp; Composition Analysis Study</td>
<td>Engr. Study</td>
<td>A-E</td>
<td>Preliminary Design</td>
</tr>
<tr>
<td>4</td>
<td>Radioactive Solid Waste Packaging Storage &amp; Disposal Requirements Study</td>
<td>Engr. Study</td>
<td>A-E</td>
<td>Preliminary Design</td>
</tr>
<tr>
<td>5</td>
<td>Buried Radioactive Solid Waste Sodium Limits</td>
<td>Study</td>
<td>PNL-189 Task SU-2</td>
<td>Preliminary Design</td>
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<tr>
<td>6</td>
<td>Disposal Procedures Study &amp; Requirements for DDCN-1 Nonburable Sodium-Bearing Radioactive Solid Wastes</td>
<td>Study</td>
<td>PNL-189 Task SU-2</td>
<td>Early in Preliminary Design</td>
</tr>
<tr>
<td>7</td>
<td>System Effectiveness Goals</td>
<td>Reliability Analysis</td>
<td>PNL- DSA-1</td>
<td>Early in Preliminary Design</td>
</tr>
</tbody>
</table>
1. RADIOACTIVE LIQUID WASTE QUANTITIES AND COMPOSITION ANALYSIS STUDY

Objective

It is the objective of this study to determine the quantities and composition analysis of radioactive liquid waste.

Description of Work

Review the various systems to determine the following characteristics of radioactive liquid wastes:

a. Quantities
b. Rates (continuous, batch)
c. Composition (radionuclide, curies, specific gravity, solids content)
d. Radioactivity level of aqueous waste
   1. Low (disposal and controls in accordance with AECM-0524)
   2. Intermediate (≤100 μCi/mL)
   3. High (>100 Ci/mL)
e. Radioactivity level of organic waste
   1. Non-shielded container (≤100 μCi/mL)
   2. Shielded cask (>100 μCi/mL)

2. RADIOACTIVE LIQUID WASTE TRANSFER, STORAGE AND DISPOSAL REQUIREMENTS STUDY

Objective

It is the objective of this study to determine the transfer, storage, and disposal requirements for radioactive liquid waste.

Description of Work

a. Determine the size and number of receiving tanks.
b. Determine the size, number, and emergency spare capacity of the interim storage tanks.
c. Determine the feasibility of using tank circulating eductors instead of agitators for mixing the contents of receiving tanks and of interim storage tanks.

d. Determine the feasibility of using steam jets instead of pumps for discharging wastes from receiving tanks and from interim storage tanks. Estimate added waste disposal expense from steam condensate at the rates of $5.00 per gallon for cask disposal and $0.10 per gallon for tank car disposal.

e. Determine the agents, flow rates, and equipment required for neutralizing radioactive liquid waste prior to disposal.

f. Determine the need for and the flow rate of cooling and/or heating water for receiving and storage tank jackets.

g. Determine the type, number, and capacity of receiving and interim storage tank off-gas vent condenser or moisture separators.

h. Determine the need for use of remote hardware features in equipment installation such as remote nuts, flanges, gaskets, and pipe connectors.

i. Determine cell and equipment shielding requirements.

j. Determine the number of railroad tank cars (20,000-gallon capacity) required for transporting intermediate level liquid wastes to the disposal site. Consideration shall be given to storage tank capacity and shielding required around a partially loaded tank car in the Radioactive Liquid Waste Facility if the car is used for storage until full. Borrowing of existing BNW tank cars instead of buying tank cars shall be considered also.
k. Determine number, capacity and shielding requirements of high level radioactive liquid waste shielded casks.

l. Determine the Radioactive Liquid Waste Facility crane capacity requirements.

m. Determine construction materials for pipe, valves, tanks, casks, condensers, pumps, jets, agitators, instruments, and other components compatible with estimated most active or corrosive materials handled.

n. Determine the compatibility of liquid wastes routed through common pipe lines and/or collected in common tanks.

3. RADIOACTIVE SOLID WASTE QUANTITIES AND COMPOSITION ANALYSIS STUDY

Objective

It is the objective of this study to determine the quantities and composition analysis of radioactive solid waste.

Description of Work

Review the various systems to determine the following characteristics of radioactive solid wastes.

a. Quantities

b. Rates

c. Composition (basic material, radionuclides, curies)

d. Radioactivity level

1. Low (waste packages or containers are routinely handled on a contact basis and do not require shielding to maintain acceptable personnel dose rates).

2. High (waste packages or containers require shielding or special remote handling techniques to maintain acceptable personnel dose rate).
4. RADIOACTIVE SOLID WASTE PACKAGING, STORAGE, AND DISPOSAL REQUIREMENTS STUDY

Objective

It is the objective of this study to determine the packaging, storage, and disposal requirements for radioactive solid waste.

Description of Work

a. Determine the capacity, location, shielding, and configuration of interim storage cells and spaces.

b. Determine the number, capacity, shielding, and transporting methods for solid waste shielded transport cask and waste containers.

c. Determine methods of transferring waste containers from inert gas spaces into shielded transport cask and cask-to-cell connection design.

5. BURIED RADIOACTIVE SOLID WASTE SODIUM LIMITS

Objective

It is the objective of this study to determine the maximum amount of sodium that may be present on radioactive solid waste buried in the 200 Area burial ground and establish the limits of sodium presence on buried radioactive solid wastes that are mutually acceptable by BNW and Atlantic Richfield Hanford Company (ARHCO is the responsible contractor in charge of the 200 Area burial grounds).

Description of Work

Initiate discussions with ARHCO to mutually establish and document limiting amounts of sodium that may be present (externally and/or internally) with radioactive solid wastes to be buried in the 200 Area burial grounds.
6. **DISPOSAL PROCEDURES AND REQUIREMENTS FOR NON-BURIABLE SODIUM-BEARING RADIOACTIVE SOLID WASTES**

**Objective**

It is the objective of this study to determine the disposal procedures, requirements, and locations for sodium-bearing radioactive solid wastes unacceptable for burial in the 200 Area burial grounds.

**Description of Work**

The work required includes:

1. Survey unused Hanford facilities to locate those available which meet the following requirements:
   - Personnel radiation exposure levels shall be within the limits of AECM-0524 and BNWL-MA-6.
   - Adequate shielding shall be provided to accommodate radioactivity from accumulated wastes.
   - Cranes and other equipment deemed necessary for remote handling of waste containers shall be provided.
   - Storage volume shall not be less than 30,000 ft$^3$. The site shall accommodate the largest piece of equipment expected to be stored. Candidates are cold traps and U-tube heat exchangers.

2. Recommend a disposal site and an alternate:
   - Determine annual rental expense, if any.
   - Determine disposal procedures and requirements for sites selected.
   - Determine site modifications or additional equipment required and their costs.
7. **SYSTEM EFFECTIVENESS GOALS**

**Objective**

It is the objective of this study to define the parts of the system that could result in reactor unavailability.

**Description of Work**

Perform a system failure modes and effects analysis.
APPENDIX C

INTERFACES
## APPENDIX C
### INTERFACES*

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
<th>Interfacing Systems Title</th>
<th>Interface Description</th>
</tr>
</thead>
<tbody>
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<td>12</td>
<td>Building Electrical Power&lt;sup&gt;x&lt;/sup&gt;</td>
<td>Normal Electrical Supply</td>
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<tr>
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<td>15</td>
<td>Communications&lt;sup&gt;x&lt;/sup&gt;</td>
<td>Communications-Control Room to Radioactive Liquid Waste Facility &amp; Receiving Tank Areas</td>
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<td>3</td>
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<td>General illumination</td>
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<tr>
<td>4</td>
<td>21</td>
<td>Structures&lt;sup&gt;x&lt;/sup&gt;</td>
<td>Provide temporary storage vaults for solid wastes, cranes and hoists for handling and transfer of packaged wastes</td>
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<tr>
<td>5</td>
<td>22</td>
<td>Site Facilities&lt;sup&gt;x&lt;/sup&gt;</td>
<td>Process sewer, radioactive waste lines, Radioactive Liquid Waste Facility, steam, sanitary water, ventilation exhaust duct, instrument air, breathing air, utility air</td>
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<td>6</td>
<td>23</td>
<td>Service Piping System&lt;sup&gt;x&lt;/sup&gt;</td>
<td>Steam, process water, sanitary water, sanitary sewer, instrument air, breathing air, utility air</td>
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<tr>
<td>7</td>
<td>25</td>
<td>Service Piping System&lt;sup&gt;†&lt;/sup&gt; Heating and Ventilation&lt;sup&gt;‡&lt;/sup&gt; Heating and Ventilation&lt;sup&gt;x&lt;/sup&gt;</td>
<td>Disposal of Radioactive Wastes Disposal of Radioactive Filters Ventilation of Radioactive Liquid Waste Facility, Receiving Tank Cells and Sample Rooms, and Solid Waste Interim Storage Cells, Tank Off Gas</td>
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* Interface requirements will be updated as other FFTF concepts are developed.
† Service required by system.
‡ Service provided by system.
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<th>Item</th>
<th>System Number</th>
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<th>Interface Description</th>
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<td>26</td>
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<td>Fire alarms and protection</td>
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<td>Reactor Containment</td>
<td>Containment valving requirements, space, support, shielding, penetrations</td>
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<td>41</td>
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<td>42</td>
<td>Nonirradiated Fuel Handling</td>
<td>Disposal of Radioactive Wastes</td>
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<tr>
<td>12</td>
<td>43</td>
<td>Irradiated Fuel Handling</td>
<td>Disposal of Radioactive Wastes</td>
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<tr>
<td>13</td>
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<td>Radioactive Maintenance</td>
<td>Disposal of Radioactive Wastes</td>
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<td>14</td>
<td>51</td>
<td>Reactor Heat Transport</td>
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<td>15</td>
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<td>Disposal of Radioactive Wastes</td>
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<td>16</td>
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<td>Short Term Irradiation Facility</td>
<td>Disposal of Radioactive Wastes</td>
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<td>17</td>
<td>71</td>
<td>Inert Gas Cell Examination Facility</td>
<td>Disposal of Radioactive Wastes</td>
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<td>18</td>
<td>81</td>
<td>Sodium Receiving and Processing</td>
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<td>82</td>
<td>Inert Gas Receiving and Processing</td>
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† Service required by system.

x Service provided by system.
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<th>Interface Description</th>
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<td>91</td>
<td>Central Control and Data Handling</td>
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<tr>
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<td>93</td>
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<td>Integrate Instruments and Controls</td>
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<tr>
<td>22</td>
<td>96</td>
<td>Radiation Monitoring</td>
<td>Monitoring of Equipment During Handling, Storage Waste Stream and Tank Radioactivity Monitors and Liquid Samplers, Criticality Alarms</td>
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<tr>
<td>23</td>
<td>31</td>
<td>Reactor Core†</td>
<td>Disposal of Radioactive Waste</td>
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</table>

† Service required by system.

x Service provided by system.
APPENDIX D

RADIOACTIVE WASTE SHIPMENT,
AGREEMENTS AND RECORDS

1. Inter-Contractor Radioactive Shipment Agreement
2. Inter-Contractor Agreement
3. Waste Transfer Record (Liquid)
4. Solid Waste Burial Record
5. Standard Radioactive Shipment Procedure
6. Onsite Radioactive Shipment Procedure
7. Radiation Work Procedure
INTER-CONTRACTOR RADIOACTIVE SHIPMENT AGREEMENT

March 15, 1967

Battelle-Northwest
Pacific Northwest Laboratories

ITT Federal Support Services

Isochem Inc.

External Distribution

US Atomic Energy Commission
Attention: Mr. O. J. Elgert 12

Battelle-Northwest
Attention: Mr. R. F. Dickerson 12

ITT Federal Support Services
Attention: Mr. M. F. Rice 12

Internal Distribution

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R. G. Macaulay  J. H. Warren
T. A. McCoy - 6  L. L. Zahn - 6
R. W. McCullugh - 6  Record File
                      Extras - 10
APPENDIX D

Item 1

Inter-Contractor Radioactive
Shipmen Agreement
INTER-CONTRACTOR RADIOACTIVE SHIPMENT AGREEMENT

The purpose of this document is to set forth a common course that Battelle-Northwest, ITT Federal Support Services and Isochem Inc., will employ for the on-site highway transportation of a "large quantity" of radioactive material between the 200 West and 200 East Areas and between the 200 Areas and the 300 Area.

"Large quantity" means a quantity of radioactive material, the aggregate radioactivity of which exceeds that specified in the following table for a transport group as defined in I.A. 16, AEC Chapter 0529.

<table>
<thead>
<tr>
<th>Radionuclide Identification</th>
<th>Transport Group</th>
</tr>
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<tbody>
<tr>
<td>Radioactivity</td>
<td>I</td>
</tr>
<tr>
<td>curies</td>
<td>20</td>
</tr>
</tbody>
</table>

AEC Appendix 0529 I.A. 6

The large quantity shielded casks available and normally used for onsite shipments do not meet the ICC Regulations 49 CFR 71-78, nor the Safety Standards for the Packaging of Radioactive and Fissile Materials, AEC Chapter 0529. Credible hazards anticipated in these types of shipments are those arising out of improper preparation of the package, impact, fire, breakdown of administrative controls, and failure of personnel to carry out assigned duties and responsibilities. It is the intent of the responsible and supporting organizations that all appropriate protective measures be initiated and that all reasonable skill and effort be exercised so that there will be no release of radioactive material from the shielded cask during packaging, handling, and shipment.
The following conditions shall be met without exception:

1. The contractor who packages and originates the shipment is responsible for all phases of the shipment from the shipping dock up to the receiving contractor's dock. The receiving contractor is responsible for the cask and material after it is delivered up to his dock.

2. The responsible contractor will designate a qualified individual (Caravan Director) who will assume responsibility for the shipment, assume responsibility for directing all personnel involved in the shipment, assume responsibility for required emergency action, and who will accompany the shipment from the beginning to the end.

3. The shipment will be escorted by Patrol for traffic control criteria specified in Items 9, 10, 11 and 12 of this agreement. Patrol is responsible for providing adequate vehicles and personnel to assure compliance.

4. An RM representative of the responsible contractor will accompany all shipments to provide emergency coverage.

5. Only "tie downs" which have been approved by the three contractors will be used to secure the cask. The shipping contractor is responsible to make sure the "tie down" meets the specification.

6. The time for making shipment will be selected when traffic on the highway is at a minimum. The shipping contractor shall make the final decision.
7. The plant fire station shall be notified by the Caravan Director of the shipment. They will be required to maintain an alert status during the shipment.

8. No shipment shall be made when road conditions are potentially hazardous, visibility limited, roads icy, etc. The shipping contractor shall make the final decision.

9. The transportation vehicles shall be limited to a speed in the range of 15 to 30 miles per hour.

10. All on-coming traffic shall be limited to 40 miles per hour while the shipment is enroute.

11. Vehicles heavier than pickup trucks, and sedans, will not be allowed onto two lane roads while the shipment is enroute.

12. Gasoline trucks, propane trucks, and any other vehicles carrying inflammable solutions or compounds will be stopped until the Caravan passes.

13. The Caravan is to stop at all railroad crossings unless advised to proceed by Patrol.

14. Only qualified, experienced personnel of good health will be selected for the required assignments. A person's latest medical report will determine if he is in good health.

15. The Servicing Contractor's personnel assigned to the team will be instructed by, and receive directions from, the Caravan Director. The Servicing Contractor's personnel are expected to execute such instructions and directions promptly and without additional review.
16. The Caravan Director will specify the route to be taken after conferring with the other contractors.

17. The Servicing Contractor is responsible for the condition of the transportation equipment he supplies. The Servicing Contractor will, upon request, advise the responsible contractor's designee of recent inspection, tests and repairs.

18. The Caravan Director shall be satisfied that all members of the team are qualified.

APPROVALS:

ISOCHEN INC. ___________________________ Date

BATTLE-NORTHWEST _____________________ Date

ITT FEDERAL SUPPORT SERVICES _________ Date
APPENDIX D

Item 2

Inter-Contractor Agreement
INTER-CONTRACTOR AGREEMENT

Transportation of Solid Radioactive Waste Between 300 Area and 200-W Area

This agreement shall apply to all personnel engaged in the generation, collection, transportation, and disposal of solid radioactive wastes (low and intermediate level) of Battelle-Northwest's in the 300 Area.

I. Battelle-Northwest shall:
1. Package all waste to meet ARHCO standards and specifications set forth in ARH-183, or which meets negotiated specifications in the case of unusual shipments.
2. Supply the required waste transfer information.
3. Be responsible for the shipment from the 300 Area to the 200-W burial ground.
4. Make necessary arrangements for drivers and equipment with ITT/FSS.
5. Notify ARHCO of approximate arrival times for waste shipments other than trench waste.
6. Provide radiation monitoring coverage for all waste handling in the Battelle-Northwest 300 Area complex, and on the transport route, as necessary.

II. ITT/FSS shall:
1. Supply qualified drivers and necessary, suitably maintained and inspected equipment as prearranged with Battelle-Northwest.
2. Transport the waste to 200-W via the most direct route or one designated by Battelle-Northwest or Patrol.
3. Transport the waste within 200-W Area via the route established by ARHCO.

III. Atlantic Richfield Hanford Company shall:

1. Accept all Battelle-Northwest waste, for burial, which meets the specifications and standards set forth in ARH-183, or which meets separately negotiated specifications in the case of unusual shipments.
2. Dispose of the waste and return the waste vehicles in conformance with the applicable R.W.P.'s and S.R.S.P.'s.

P. F. X. Dunigan
Manager - Facilities Operation
Battelle-Northwest

R. I. Grob
Manager - Road Maintenance and Heavy Equipment Operation
ITT/FSS

L. W. Roddy
Manager - Waste Management Section, 200 Area Tank Farm Management Sub-Section
Atlantic Richfield Hanford Company
APPENDIX D

Item 3

Waste Transfer Record (Liquid)
## WASTE TRANSFER RECORD

### 340 BUILDING WASTE

<table>
<thead>
<tr>
<th>TANKER</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>VOLUME</th>
<th>SHIPMENT NO.</th>
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<table>
<thead>
<tr>
<th>DESTINATION:</th>
<th>CRIB;</th>
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<table>
<thead>
<tr>
<th>ANALYSES</th>
<th>UCG/GAL</th>
<th>LIMIT</th>
<th>10-BATCH AVERAGE</th>
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<tbody>
<tr>
<td>TOTAL BETA</td>
<td></td>
<td>1000 UCG/GAL</td>
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<tr>
<td>TOTAL ALPHA</td>
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<td>7 UCG/GAL</td>
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<tr>
<td>CS-137</td>
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<td>6 UCG/GAL</td>
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</tr>
<tr>
<td>SR-90</td>
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<td>CO-60</td>
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<td>1 UCG/GAL</td>
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<tr>
<td>pH</td>
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<td>8 MIN.</td>
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<td>ORGANIC</td>
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<td>NON-DETECTABLE</td>
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<tr>
<td>COMPLEXING AGENTS</td>
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<td>NON-DETECTABLE</td>
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<tr>
<td>TOTAL DIVALENT CATIONS</td>
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<tr>
<td>SUSPENDED SOLIDS</td>
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<td>G/GAL</td>
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</table>

**BATTELLE SHIPPER: /s/**

**DATE**_________ **TIME**_________

**ISOCHM RECEIVER: /s/**

**DATE**_________ **TIME**_________

(Note: 10-BATCH AVERAGE VALUE REQUIRED ONLY WHEN A SINGLE BATCH EXCEEDS THE LIMIT.)
APPENDIX D

Item 4

Solid Waste Burial Record
<table>
<thead>
<tr>
<th>NUMBER OF PACKAGES</th>
<th>TYPE</th>
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<tbody>
<tr>
<td>TOTAL VOLUME (ft³)</td>
<td>Pu (Grams)</td>
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<tr>
<td>URANIUM (Grams)</td>
<td>ENRICHMENT</td>
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<tr>
<td>ACTIVITY OTHER THAN U OR Pu (Curies)</td>
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</tr>
<tr>
<td>PRINCIPAL ACTIVITY DESCRIPTIONS (If known Pu, U, Sr, Cs, etc.)</td>
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</tr>
<tr>
<td>REMARKS ON PACKED ITEMS OR SPECIAL CONDITIONS</td>
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</tr>
</tbody>
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**SIGNATURE OF NEW SHIPPER**

**SIGNATURE OF ARCO RECIPIENT**

**DATE**

**TIME**

**DISTRIBUTION**

- **Copy 1** - ARCO
- **Copy 2** - ARCO
- **Copy 3** - ARCO
- **Copy 4** - BMW Snipper
- **Copy 5** - BMW WD&D

**BY SHIPPER - SIGN ALL COPIES AND FORWARD TO:**

- **Copy 1** - BMW Waste Disposal & Decontamination, 325 Fld.
- **Copy 2** - Retain
- **Copy 3** - Retain

**AB-13007-07L (12-67)**

**D-13**
APPENDIX D

Item 5

Standard Radioactive Shipment Procedure
### Standard Radioactive Shipment Procedure

#### Radiation Protection Records

**Battelle-Northwest**  
Richland, Washington

**Standard Radioactive Shipment Procedure**

- **Issued By:**  
- **No.:**  
- **Rev. No.:**  
- **Valid From:**   
- **To:**

#### For the Shipment of

- **Between:**  
  - No inspection due to radiation level.  
  - Normal inspection permitted.

#### Radiation Conditions

- **Protective Clothing Requirements**

- **Monitoring Requirements**

- **Packaging Requirements**

**Instructions**

1. **X** The shipment shall be marked with the radiation symbol, and stored in a radiation zone when not enroute.
2. **X** Preparation for shipment, loading and unloading shall be accomplished under RWP control.
3. **X** In case of accident or spill, notify RM immediately.
4. **X** Personnel beta-gamma badge dosimeter required.
5. **X** Other dosimeter required, type ____________________.
6. **X** A copy of this procedure shall accompany each shipment.
7. **X** Notify RM on arrival at destination.
8. **X** Vehicle shall be surveyed for contamination by RM before release.
9. **X** The shipment shall not be left unattended enroute.

**Approvals**

**Operations**

**Radiation Monitoring**

---

BR-1200-043 (10-67) ACRE BRL. RICHLAND WASH
APPENDIX D

Item 6

Onsite Radioactive Shipment Procedure
RADIATION PROTECTION RECORDS
ONSITE RADIOACTIVE SHIPMENT PROCEDURE

FROM (NAME) | DEPARTMENT AND SECTION | AREA AND BUILDING | PHONE
TO (NAME) | ORGANIZATION AND OPERATING COMPONENT | AREA AND BUILDING | PHONE

☑ INSPECTION PERMITTED ☐ NO INSPECTION ☐ CLASSIFIED ☐ UNCLASSIFIED

DESCRIPTION OF MATERIAL

RADIATION CONDITIONS

STANDARD INSTRUCTIONS:
1. THE SHIPMENT SHALL BE MARKED WITH THE RADIATION SYMBOL, AND STORED IN A RADIATION ZONE WHEN NOT ENROUTE.
2. PREPARATION FOR SHIPMENT, LOADING AND UNLOADING SHALL BE ACCOMPLISHED UNDER RWP CONTROL.
3. THE SHIPMENT SHALL NOT BE LEFT UNATTENDED ENROUTE.
4. PERSONNEL DOSIMETERS REQUIRED.
5. IN CASE OF ACCIDENT OR SPILL, NOTIFY RM IMMEDIATELY.

SPECIAL INSTRUCTIONS:
☐ NOTIFY RM ON ARRIVAL AT DESTINATION.
☐ VEHICLE SHALL BE SURVEYED FOR CONTAMINATION BY RM BEFORE RELEASE.

SURVEYED BY | DATE

APPROVAL TO SHIP

FOR OPERATING SECTION | DATE | FOR RADIATION MONITORING | DATE

DISTRIBUTION: WHITE – (RECORD COPY) TO RM AT ORIGIN.
CANARY – ACCOMPANY SHIPMENT TO RECEIVER.

84-1200-072 (12-66)
APPENDIX D

Item 7

Radioactive Work Procedure
RADIATION PROTECTION RECORDS

RADIATION WORK PROCEDURE

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>SUPERSEDES NO.</th>
<th>VALID FROM</th>
<th>TO</th>
<th>REQUESTED BY</th>
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LOCATION

DESCRIPTION OF JOB

RADIATION CONDITIONS

SURFACE CONTAMINATION

- TYPE: [ ] LOW [ ] MEDIUM [ ] HIGH
- POTENTIAL: [ ] LOW [ ] MEDIUM [ ] HIGH
- OTHER:

AIRBORNE CONTAMINATION

- TYPE: [ ] LOW [ ] MEDIUM [ ] HIGH
- POTENTIAL: [ ] LOW [ ] MEDIUM [ ] HIGH
- ESTIMATED MAX:

PERSONNEL DOSE RATES

- TYPE: [ ] γ [ ] β [ ] η

PROTECTIVE EQUIPMENT REQUIREMENTS

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<th>PERSONNEL DOSIMETERS</th>
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<th>FEET</th>
<th>HANDS</th>
<th>HEAD</th>
<th>RESPIRATORY</th>
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<tr>
<td>FILM BADGE</td>
<td>NO PERSONAL OUTER CLOTHING</td>
<td>SHOE COVERS</td>
<td>CANVAS GLOVES</td>
<td>CAP</td>
<td>HALF MASK</td>
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<tr>
<td>NEUTRON BADGE</td>
<td>ONE PAIR COVERALLS</td>
<td>CANVAS BOOTS</td>
<td>SURGEONS GLOVES</td>
<td>HOOD</td>
<td>ASSAULT MASK</td>
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<tr>
<td>GAMMA PENCILS</td>
<td>TWO PAIR COVERALLS</td>
<td>RUBBERS</td>
<td>WATERPROOF GLOVES</td>
<td>WATERPROOF GAUNTLET</td>
<td></td>
</tr>
<tr>
<td>SELF READING PENCILS</td>
<td>WATERPROOF OUTER LAYER</td>
<td>BRITISH LEGGINGS</td>
<td>WATERPROOF HOOD</td>
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<td></td>
</tr>
<tr>
<td>FINGER RINGS</td>
<td>LAB COAT</td>
<td>HIP BOOTS</td>
<td>LEATHER GLOVES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RADIATION MONITORING REQUIREMENTS

- CONTINUOUS MONITORING REQUIRED UNTIL:
- RELEASE SURVEY ON AREA OR EQUIPMENT REQUIRED
- OTHER:

SPECIAL INSTRUCTIONS

- HAND COUNT WHEN LEAVING ZONE
- PERSONAL SURVEY WHEN LEAVING ZONE
- OBSERVE DUAL STEREO PAD PROCEDURE
- OBSERVE GENERAL FACILITY RADIATION WORK PROCEDURE
- PROTECTIVE CLOTHING TO BE SURVEYED PERIODICALLY
- SPECIAL PROTECTION FOR CUTS, ABRASIONS, IRITATIONS OR INFECTIONS
- MASKS TO BE WORN AS REQUIRED BY RM
- IN CASE OF INJURY, FLUSH WOUND WITH CLEAN RUNNING WATER, NOTIFY RM IMMEDIATELY

APPROVALS

OPERATIONS

RADIATION MONITORING
APPENDIX E

FFTF RADIOACTIVE WASTE MANAGEMENT POLICY
APPENDIX E

FFTTF RADIOACTIVE WASTE MANAGEMENT POLICY

I. RADIOACTIVE LIQUID WASTE

A. Waste Categories

The categories of radioactive liquid waste are based upon the definitions and data presented in AECM-0524\(^1\) and RL Appendix-0510.\(^2\) There are three categories of aqueous waste and one of organic waste; personnel exposure limits are considered during storage and disposal operations. Liquid Waste categories are as follows:

1. Low level aqueous waste (disposal and controls in accordance with AECM-0524)
2. Intermediate level aqueous waste (<100 \(\mu\)Ci/ml)
3. High level aqueous waste (>100 \(\mu\)Ci/ml)
4. Organic waste

B. Sequence of Operation

The handling of radioactive liquid wastes is based upon a batch operation having the following sequence:

1. Drain radioactive liquid wastes to appropriate receiving tanks located in the reactor support buildings and containment building.
2. Sample receiving tank contents prior to discharging.
3. Pump receiving tank contents to appropriate storage tank (low, intermediate or high activity level aqueous waste, or organic waste) located in the Radioactive Liquid Waste Facility.

---

1. Refer to References, Appendix A, Item 8.
2. Refer to References, Appendix A, Item 6.
4. Sample storage tank contents prior to discharging
   (add neutralizing agents to intermediate level waste, as required, to achieve pH of 8 or greater).

5. Discharge low level radioactive aqueous waste to the process sewer crib for disposal at the reactor site.

6. Discharge intermediate level aqueous waste to a tank car.

7. Discharge high level aqueous waste to shielded casks.

8. Discharge radioactive organic waste to either tank car or shielded casks per personnel exposure limits.

9. Arrange for transfer of wastes to the 200 Area with ITT Federal Support Services and for disposal with Atlantic Richfield Hanford Co. (ARHCO).

The following is a brief description of the radioactive liquid waste system operation. (Refer to Section 4 for a more detailed description of the system and its operation.)

1. Receiving tanks are provided for radioactive aqueous and organic wastes generated in the reactor support buildings and the reactor containment building. Separate receiving tanks are provided for high, intermediate, and low level aqueous waste and for organic waste in the reactor support building. Valved connections to each waste category receiving tank are provided in those spaces where decontamination of equipment and fuel cleaning are carried out. Other waste sources in the reactor support building drain to a general drainage tank. A receiving tank is also provided in the containment vessel to accommodate
potential radioactive liquid wastes from air conditioning coil condensate and decontamination solutions from cells and work areas.

All tanks are installed in shielded cells for personnel protection. Sampling and monitoring equipment, and the control panels for the two sets of tanks, are installed in rooms adjacent to the cells.

2. The contents of aqueous waste receiving tanks are sampled before transfer to interim storage tanks. To secure a representative sample, the contents of a tank are thoroughly mixed through use of the tank agitator and recirculation of the tank contents with the discharge pump. The sample is delivered to an Analytical Laboratory for analysis.

3. The contents of a receiving tank is pumped to the appropriate interim storage tank in the Radioactive Liquid Waste Facility after the waste sample analysis results are known. Transfer can occur only after positioning the diversion box jumper to connect the tank discharge line to the interim storage tank inlet line. Transfer valving and pump operation are controlled from the Radioactive Liquid Waste Facility master control panel. These two procedures minimize inadvertent discharge of waste to a lower category storage tank. To further assure that aqueous wastes will not be discharged to a lower category storage tank, the tank inlet line monitor automatically shuts off the tank inlet valve.
4. The interim storage tanks are sampled, in a manner similar to the sampling of the receiving tanks, prior to being discharged. Neutralizing agents can be routed to all interim storage tanks; however, only the intermediate level category of aqueous waste is required to meet a pH of 8 or greater by the waste recipient, Atlantic Richfield Hanford Co. (ARHCO). No neutralization treatment is required for organic or high level aqueous waste.

5. Low level radioactive aqueous waste is discharged to the process sewer crib, but only after sampling of the storage tank contents assures that the AECM-0524 limits are not exceeded. To assure that there is no leakage of aqueous waste into the process sewer line, discharge to the process sewer crib requires the installation of a jumper from the waste tank discharge line to the process sewer crib line. After completion of the transfer operation, the jumper is removed and blank connector heads are installed on the tank discharge line and process sewer line connectors.

6. Intermediate level aqueous waste is discharged to a tank car for transporting to the 200 Area disposal site. Even though the tank contents are sampled and analyzed prior to discharge, the discharge line is continuously monitored to assure that activity limits are not being exceeded.

7. High level aqueous waste is discharged to shielded casks for transporting by a low boy truck to the

---

1. Refer to References, Appendix A, Item 8.
2. Refer to Drawings, Appendix G, SK-3-14114 and SK-3-14116.
200 Area disposal site. To minimize contamination spread, should an improper connection be made or a line break, the casks are vacuum filled. The vacuum is created by a steam jet at the high level aqueous storage tank.

8. Organic waste is discharged to either casks or railroad tank cars in accordance with personnel radioactivity exposure limits. Casks are vacuum filled in a manner similar to high level aqueous waste. The addition of steam condensate by the steam jet increases the cost of disposal and should be kept to a minimum. Other than economic considerations, the addition of the condensate has no effect on the waste. Tank cars are filled by a steam jet by a pumping action rather than a vacuum fill action. The tank cars are not designed for a negative pressure so require a pumping action type fill.

9. All waste is transported to the disposal site by ITT Federal Support Services at the request of FFTF. Arrangements for disposal are made by FFTF with ARHCO.

C. Radioactive Liquid Waste Facility

Interim storage tanks for low, intermediate, and high level aqueous waste and for radioactive organic waste are located in a Radioactive Liquid Waste Facility. The building also houses a railroad tank car loadout station and a shielded cask loadout station. A separate facility is provided to minimize the effects of contamination release on overall plant operation should a waste spill occur during loadout. If the reactor support building housed the
radioactive liquid waste system storage tanks and loadout stations, a spill could cause the spread of contamination to the rest of the support building. As a result, fuel transfer operations might be curtailed and new fuel might become contaminated. Other support building activities would be jeopardized also.

D. Decontamination Procedure

Pipelines within the reactor support building and the reactor building can be backflushed with decontamination solutions from the diversion box. A special connector head and decontamination equipment piping are required for the cleaning operation. The decontamination solution drains from the diversion box to the receiving tank of the line being decontaminated. Through use of the tank agitator and recirculation of tank contents, the receiving tank can be decontaminated. The tank contents are then discharged to the appropriate interim storage tank via the diversion box jumper. The lines leading to the storage tanks from the diversion box are similarly decontaminated. Decontamination connections are provided in the Radioactive Liquid Waste Facility for cleanup of piping and interim storage tanks. All receiving and storage tanks are provided with process water spray headers for final washdown.

E. Waste Disposal

1. Disposal Policy - The disposal requirements of BNW radioactive aqueous wastes by ARHCO are described in document ISO-982. This document specifies the

1. Refer to References, Appendix A, Item 7.
requirements and limits for wastes which may be discharged to underground cribs. If these specifications are not met, the wastes are routed to waste storage tanks for later concentration and solidification. Specifications and standards are also established for tank storage of wastes that do not meet limits for crib disposal.

Wastes containing separable organic phase, as detected by visual inspection, are not permitted in either cribs or storage tanks.¹

Storage for small amounts of organic wastes in 55-gallon drums is available. Installation of an organic waste burning facility is under consideration by ARHCO, but the operational date is uncertain.

2. Waste Disposal Costs - Several factors are involved in arriving at the final costs of aqueous waste disposal such as solids content, presence and type of salts, and activity level. The following are current average costs:
   a. Crib disposal
      - Construction costs are charged to BNW
      - Approximately $100 per tank car unloading cost
   b. Concentration (intermediate level)
      - Approximately 10¢/gallon
   c. Cask waste (high level)
      - Approximately $5/gallon

Currently, there are no facilities budgeted for storage of high level organic wastes. Low level organic wastes placed in 55-gallon drums can be stored in 200 Area facilities at the following rate:

¹ Refer to References, Appendix A, Item 7.
Approximately $4/gallon plus analysis charges resulting in total rate of approximately $6-$8/gallon.

3. Waste Transfer
   
a. Diversion Boxes - Diversion boxes are provided at the reactor support services building and at the Radioactive Liquid Waste Facility. At the reactor support services building, the receiving tanks are discharged only after tank contents analysis has determined the appropriate storage tank. Inappropriate routing through incorrect valving is minimized by the required use of a jumper installed between the receiving tank discharge line and the appropriate interim storage tank inlet line. Upon completion of the waste transfer, the jumper is removed and blank connectors are installed on the line nozzles.

Low level wastes can be transferred to the process sewer from the Radioactive Liquid Waste Facility only through jumpers in a diversion box. The procedure is the same as described above for receiving tank waste transfer.

b. Railroad Tank Car - Intermediate level aqueous waste is discharged from the interim storage tank to a railroad tank car at the loadout station in the Radioactive Liquid Waste Facility. Arrangements are made with ARHCO for disposal and with ITT Federal Support Services for transportation to the 200 Area disposal site. Prior to shipment, the Waste Transfer Record must be filled out.

Unloading of the tank car contents and car cleanup is performed by ARHCO. The empty tank car is returned to the Radioactive Liquid Waste Facility by ITT-FSS.

Low and intermediate level organic waste may be transported to the disposal site by railroad tank car provided storage accommodations are available. Radioactive reacted sodium (sodium hydroxide solution) is routed from the Sodium Disposal Facility directly to a railroad tank car in the Radioactive Liquid Waste Facility. A 50 percent solution, by weight, is acceptable to ARHCO at the disposal site. The shipping procedures are the same as those described for intermediate level aqueous waste.

c. Shielded Cask - High level aqueous waste is discharged from the interim storage tank to a cask (or casks) at the loadout station in the Radioactive Liquid Waste Facility. Filling of the cask is accomplished by a steam-jet-produced vacuum. This minimizes contamination spread should a leaking connection or broken line occur. Arrangements are made with ARHCO for disposal and with ITT Federal Support Services for transportation. The cask is loaded on an ITT-FSS low boy truck trailer by the building crane. The cask is transported by convoy to the 200 Area for waste disposal and returned in accordance with established procedures.

---

1. Refer to Radioactive Waste Shipment Agreements and Records, Appendix D, Items 1, 3, 5 (or 6).
High level organic waste is transported to the 200 Area disposal site in shielded casks. Filling and disposal procedures are identical with those described for high level aqueous wastes above.

II. RADIOACTIVE SOLID WASTE

A. Waste Categories

The method of handling radioactive solid waste packages and containers is based on the allowable personnel dose rate\(^1\) which is a function of activity level, time, and distance. Since handling of radioactive waste packages is essentially on an individual basis, two categories are arbitrarily listed as follows:

- Low level-waste packages or containers are routinely handled on a contact basis and do not require shielding to maintain acceptable personnel rate.\(^1\)
- High level-waste packages or containers require shielding or special remote handling techniques to maintain acceptable personnel dose rates.\(^1\)

B. Waste Packaging

1. Low Level Waste

Small low level solid wastes are packaged in cardboard cartons by the system generating the wastes. Items larger than the standard cardboard containers are packaged in special containers provided by Operations.

2. High Level Waste - Cask Disposal

Small high level solid wastes are packaged in metal containers, equipped with sealing lids, by the

---

1. Refer to References, Appendix A, Item 11.
system generating the waste. The container, except for the lifting bail, is enclosed in a plastic wrap to minimize contamination; and is then moved into the cask receiving position by the waste generating system. The container is transferred to the cask by the Radioactive Waste System.

3. High Level Solid Wastes - Non-Cask Disposal

High level solid wastes too large for shielded cask disposal are packaged in special shielded burial containers provided by Operations. This type of waste is considered to be non-routine.

C. Waste Interim Storage and Disposal

1. Low Level Waste

Low level solid waste containers are transferred from the source to designated locations at the FFTF by the Radioactive Waste System. After a sufficient number of packages have accumulated to permit economical transportation, the wastes are hauled by truck to the 200 Area for disposal in burial trenches. Arrangements are made with ARHCO for disposal and with ITT-FSS for transportation.

2. High Level Waste - Cask Disposal

The high level solid wastes are normally transported directly from the contributing system to the 200 Area burial grounds in a shielded cask. 1 Arrangements are made with ARHCO for disposal and with ITT-FSS for transportation.

---

1. Refer to Radioactive Waste Shipment Agreements and Records, Appendix D, Items 2, 4, 5 (or 6).
3. High Level Waste - Non-Cask Disposal

The shielded waste package may be transported directly to the 200 Area burial grounds or to an interim storage vault in the reactor support building depending upon waste activity level, availability of transportation, and interruption of other work activities. The interim storage vaults are provided for use during periods when it may be expeditious to replace a certain piece of high activity equipment before disposal arrangements have been made, and are not intended to be used for routine storage of waste. Transportation to the burial grounds may be by either truck or railroad flat cars depending upon size and waste activity. Arrangements are made with ARHCO for disposal and with ITT-FSS for transportation. Waste handling and transfer are in accordance with established procedures.1,2

4. Ion-Exchange Resin Disposal

Ion-exchange resin is buried as solid waste.

BNW experience with PRTR ion-exchange equipment has been that the resin capacity depletes and requires replacement before radioactivity becomes a problem. The resin is placed in plastic sacks and then boxed in cardboard boxes having approximately one cubic foot capacity. Each cardboard box is then wrapped in plastic, and is buried in the 200 Area burial ground.

1. Refer to References, Appendix A, Item 13.
2. Refer to Radioactive Waste Shipment Agreements and Records, Appendix D, Items 2, 4, 5 (or 6).
The resin in a hot cell waste cleanup column is disposed of by removing the complete resin column. The unit is relatively small and has quick-disconnect connectors on the top. Resin foam rubber is poured into the top nozzles and nozzle caps are then installed. The resin unit is loaded into a shielded cask and transported to the 200 Area where it is discharged to a caisson (underground steel tank designed for disposal of high level solid wastes transported in shielded casks).

It is anticipated that the FFTF fuel storage basin wastes ion-exchange resin will be disposed of in cardboard containers as described above. Arrangements will be made with ARHCO for disposal, and with ITT-FSS for transportation.

5. Non-Buriable Sodium-Bearing Wastes

The disposal procedures and requirements for non-buriable sodium-bearing radioactive solid wastes are to be determined by a BNW study.\textsuperscript{1} It is anticipated that sodium-bearing wastes will be produced which are unacceptable for burial in the 200 Area because of the large quantities of sodium that cannot be removed, or the removal costs are prohibitive. Unused Hanford facilities will be surveyed to locate those available for storage. The site will be required to accommodate the largest piece of equipment expected to be stored and must provide shielding and handling equipment.

\textsuperscript{1} Refer to Support Information Requirements, Appendix B, Item 6.
Cold traps and heat exchangers are candidates for storage. Sodium-bearing equipment will have all openings blanked, be encased in plastic wrap, and placed in wooden boxes. High level waste may require the use of shielded boxes. Arrangements will be made with ARHCO for disposal and with ITT-FSS for transportation.
APPENDIX F

RADIOACTIVE LIQUID WASTE SYSTEM TRANSFER CONTROLS
APPENDIX F

RADIOACTIVE LIQUID WASTE SYSTEM TRANSFER CONTROLS

Various valves will be operated by a single control such as a selector switch or push button to minimize incorrect valving during waste transfer. Table F-I illustrates grouping of valve and equipment controls for major radioactive liquid waste transfer operations. All piston operated valves fail in the closed position. In certain instances tank discharge line monitor pumps, or sampler and monitor pumps are actuated by the valving control. This provides a continuous check on the activity of wastes being discharged.

The combination of controls results in actuation of two valve controls for transfer of liquid wastes from a receiving tank to a storage tank as illustrated in Table F-I. These two are a valve positioning control for filling the appropriate storage tank, and a valve positioning control for discharging the receiving tank. Transfer is not effected until the receiving tank agitator and pump are started separately.

Discharge of the storage tanks follows a similar pattern with the exception of TK-LLW. In this case, where TK-LLW is discharged to the process sewer or to TK-HLW, only one valve control is required. Note that monitoring of wastes discharged from each storage tank is automatically initiated through the valve and storage tank pump controls. The controls do not provide grouping of valves for discharge of storage tanks to locations of lower activity than that designated for the specific storage tank; i.e., TL-ILW has valve control groupings for discharge to a tank car or to a cask, but not to the

1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
process sewer. TK-HLW has valve grouping controls only for discharge to a cask. In all instances these wastes may be discharged to a location designated as lower level, provided it is within these lower activity limits, by positioning the appropriate valves on an individual basis. Wastes may be transferred between storage tanks in a similar manner.
TABLE F-I. Radioactive Liquid Waste Transfer Controls

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Operation and Key Operation</th>
<th>Key</th>
<th>Open Valves No.</th>
<th>Single Control Nomenclature</th>
<th>Agitator No.</th>
<th>Pump No.</th>
<th>Start/Stop</th>
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<td>POV-37 A</td>
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<td>Note: HLW Waste Line Monitor Pump Also Operated by Control &quot;A&quot;</td>
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1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
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1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
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1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
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1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
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1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
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1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
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Note: TK-LLW Monitor and Sampler Pump Also Operated by Control "Q"
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<td>TK-HLW Recirculate</td>
<td>GG POV-101 GG -103 -108 EV-19 EV-20</td>
<td>Note: TK-HLW Monitor and Sampler Pump Also Operated by Control GG</td>
<td>GG A-HLW</td>
<td></td>
<td></td>
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</tbody>
</table>

1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Operation and Key Operation</th>
<th>Single Control Nomenclature Ref. Item Key</th>
<th>Agitator No. Start/Stop</th>
<th>Pump No. Start/Stop</th>
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</thead>
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<tr>
<td>TK-ILW</td>
<td>Recirculate</td>
<td>HH POV-50</td>
<td>HH A-ILW</td>
<td>P-ILW</td>
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<td></td>
<td></td>
<td>POV-51 EV-23</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td>EV-30</td>
<td>Note: TK-ILW Monitor and Sampler Pump Also Operated by Control HH. Pump is Interlocked with Pump P-ILW.</td>
<td></td>
</tr>
<tr>
<td>TK-LLW</td>
<td>Recirculate</td>
<td>II POV-54</td>
<td>II A-LLW</td>
<td>P-LLW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-55 EV-24</td>
<td>Note: TK-LLW Monitor and Sampler Pump Also Operated by Control II. Pump is Interlocked with Pump P-LLW.</td>
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<td>EV-25</td>
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<td>TK-ORGW</td>
<td></td>
<td>JJ POV-105Š</td>
<td>JJ A-ORGW</td>
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<tr>
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<td></td>
<td>-106 EV.21</td>
<td>Note: TK-ORGW Monitor and Sampler Pump Also Operated by Control JJ.</td>
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<td>-109</td>
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</tbody>
</table>

1. Refer to Drawings, Appendix G, SK-3-14071, Sht. 1 and 2; SK-3-14072; and SK-3-14073.
APPENDIX G

Drawings

SK-3-14071 Sht 1
SK-3-14071 Sht 2
SK-3-14071 Sht 3
SK-3-14072
SK-3-14073
SK-3-14113
SK-3-14114 Sht 1
SK-3-14114 Sht 2
SK-3-14116
SK-3-14117
SK-3-14118
SK-3-14119
SK-3-14121
SK-3-14215
SK-3-14216
SK-3-14217
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FOR NOZZLE ARRGT. SEE ENLARGED PLAN

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SECTION A-A

WATER SPARGE NOZZLE FILL & DISCHARGE NOZZLE LIQUID LEVEL NOZZLE TEMPERATURE NOZZLE

VENT & OVERFLOW HEATER CONTROL NOZZLE HEATER NOZZLE

FILL & DISCHARGE LIQUID LEVEL VENT & OVERFLOW

SECTION B-B

CONCEPTUAL

TYPICAL LIQUID WASTE RAILROAD TANK CAR

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