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AVLIS

Production Plant

Waste Management Plan

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MASTER

AVLIS
Production Plant
Waste Management Plan

Lawrence Livermore National Laboratory

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Prepared by the AVLIS Program with major contributions from Bechtel National, Incorporated.

Bechtel National Incorporated

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DOCUMENT OUTLINE DESCRIPTION

1. EXECUTIVE SUMMARY

1.1. BACKGROUND

The background of the document is presented to provide the scope and objectives of the Waste Management Plan, the overall conclusions, the methodology employed to establish the plan, and the implementation of the results.

1.2. WASTE MANAGEMENT PLAN DOCUMENT SUMMARY

A summary of each section of the plan is presented, highlighting the main assessment topics listed below:

- o Performance objectives.
- o Waste characterization.
- o Waste management design criteria.
- o Waste management plan description.
- o Waste management plan implementation.

2. WASTE MANAGEMENT FACILITIES DESIGN OBJECTIVES

2.1. PERFORMANCE OBJECTIVES

The waste treatment and disposal design objectives are specified, providing the essential parameters for the design of Waste Management facilities and describing the Waste Management philosophy with regard to regulatory compliance.

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The commitment of the APP program to protect the general public and operating personnel is expressed in this section.

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This section describes the origin; the physical, chemical and hazardous properties; and the quantities of each waste stream generated during the operation of the AVLIS Production Plant.

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A system for generic classification of AVLIS plant-specific waste streams is developed and each of the plant waste streams is assigned a classification to facilitate planning.

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The design criteria for overall waste management facilities development are formulated from AVLIS Production Plant performance objectives, regulations, and design standards.

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Overall design criteria for the treatment and disposal of gaseous waste are detailed in this section.

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Overall design criteria for the treatment and disposal of liquid waste are detailed in this section.

4.4. SOLID WASTE MANAGEMENT DESIGN CRITERIA

Overall design criteria for the treatment and disposal of solid waste are detailed in this section.

5. WASTE MANAGEMENT PLAN DESCRIPTION

5.1. INTRODUCTION

Based on the AVLIS Production Plant waste management performance objectives described in Section 2, the waste stream characterizations developed in Section 3 and
the waste management criteria assessed in Section 4, the overall AVLIS Production Plant waste management planning is described in this section.

5.2. WASTE MANAGEMENT PROCESSES

A discussion of available waste treatment and disposal approaches for each waste classification is first presented, followed by a survey of technologies and methodologies.

5.3. WASTE MANAGEMENT PLAN

A matrix is presented, indicating the AVLIS Production Plant waste management for each specific waste stream. Here, the treatment and disposal approach is detailed for each of the identified facility waste streams.

6. WASTE MANAGEMENT PLAN IMPLEMENTATION

6.1. PLAN IMPLEMENTATION

Specific waste treatment and disposal facility requirements for implementing the plan are described.

6.2. GREEN-FIELD PLANT

Conceptual designs addressing waste management for the AFP Green Field Facility are presented.

GLOSSARY

Air Quality Standards	The level of pollutants in the atmosphere that cannot be exceeded legally during a specified time in a specified area, as regulated by the DOE, EPA, NRC and the State of Tennessee Department of Health.
AVLIS	Atomic Vapor Laser Isotope Separation.
Biodenitrification	Treatment of liquid waste, with high nitrate concentration, by biodegradation to nitrogen and oxygen.
Burial Ground (Shallow Land Burial)	Tract of land where radioactive waste packages are buried in shallow trenches or holes.
Discharge	The accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of waste into or on any land, water or air.
Dispersion	Release of radioactive materials or pollutants into the atmosphere or water, followed by mixing and transport.
Disposal	The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters.
DOE	Department of Energy.
Green-field	Development of the AVLIS Production Plant as a stand-alone facility, on a new and undeveloped site.
Immobilization	Same as Solidification. See below.

Landfill	A disposal facility or part of a facility where sanitary waste is placed in or on the land.
Low level waste	Radioactive waste not classified as high-level waste, transuranic waste, spent fuel, or uranium mill tailings.
Monitoring	Process whereby the level and quality of factors that can affect the environment and/or human health are measured periodically in order to regulate and control potential impacts.
Monolith	A massively solid, freestanding, uniform casting of material (e.g., concrete, glass or fused salt).
Pollutants	The addition of any undesirable agents to an ecosystem in excess of the rate at which they can be degraded, assimilated, or dispersed by natural processes.
Sludge	Insoluble salts and complex colloidal material in alkaline ("neutralized") aqueous solutions that settle out on standing in storage.
Solidification	Conversion of dispersible radioactive or hazardous wastes (normally, but not necessarily, liquid) to a dry, stable solid bound in a matrix material.
Waste form	The waste package less the container, if any, and the low-level waste either treated or untreated, including any inert fillers, as presented for disposal.
Waste Package	The assemblage of low-level waste that is disposed; it normally includes the container plus the contained material.

AVLIS PRODUCTION PLANT
WASTE MANAGEMENT PLAN

1. EXECUTIVE SUMMARY

1.1. BACKGROUND

1.1.1. AVLIS Project Assessment Objectives

The waste management plan is written as a project assessment document, and is a part of the overall documentation to support the credibility of the planning and the initial design of the AVLIS Production Plant. The objective of the Waste Management Plan is to provide an assessment of treatment and disposal approaches which comply with all governing and applicable regulations and standards for the particular waste types generated by the AVLIS Production Plant. The Waste Management Plan also includes brief discussions on its implementation, in view of the proposed location of the AVLIS Production Plant. However, design description of the waste management facilities are not within the scope of this document; they can be found in the Design Report Documents. The level of completeness and the thoroughness of the assessment is commensurate with the current planning for development of the AVLIS Production Plant.

1.1.2. Assessment Conclusions

The assessment concluded that all AVLIS Production Plant wastes can be treated and disposed, complying with applicable Environmental Protection Agency, DOE, and State regulations in a conservative manner, by applying current, proven and acceptable technologies that are in wide use at nuclear fuel cycle facilities. The development of the AVLIS Production Plant at the current proposed site, i.e., located within the Oak Ridge Gaseous Diffusion Plant site, will allow the sharing of the existing waste management facilities used by Oak Ridge Gaseous Diffusion Plant.

1.1.3. Assessment Methodology

The assessment of the overall waste management approach was accomplished by performing the tasks outlined in Table 1-1.

Table 1-1. Waste management assessment tasks.

BNI Tasks	Supporting Organization(s)
Establish waste management objectives for designs, considering the alara concept.	Martin Marietta Energy Systems
Waste characterization.	Martin Marietta Energy Systems, Stone and Webster Engineering Corporation
Waste classification by type.	
Review applicable regulations and design standards.	Martin Marietta Energy Systems
Establish design criteria by waste class.	
Survey waste treatment and disposal technologies.	
Development of waste management matrix from results of all of the above tasks.	
Develop plant-specific implementation for the waste management plan.	Martin Marietta Energy Systems

1.1.4. Assessment Results Implementation

The assessment is a project planning document. Project planning documents are used to develop subsequent lower-echelon design documents and cost estimates that detail the designs and the development of the AVLIS Production Plant. Included among these documents are the AVLIS Production Plant technology and design bases documents, the design reports and the capital and operating cost estimates. The requirements of the Waste Management Plan will be reflected in all subsequent project planning, design, and cost documents.

1.2. DOCUMENT SUMMARY

1.2.1. Introduction

The AVLIS Production Plant process and support operations will generate gaseous, liquid, and solid wastes which will require responsible management over the life of the facility. The primary goal of the Waste Management Plan for the AVLIS Production Plant is to furnish a comprehensive waste management approach in support of the selection and design of the AVLIS Production Plant waste management facilities. The major topics covered in the Waste Management Plan are:

- Waste Management Facilities Design Objectives.
- AVLIS Production Plant Wastes.
- Waste Management Design Criteria.
- Waste Management Plan Description.
- Waste Management Plan Implementation.

The discussions in this document delineate the application of the AVLIS Production Plant waste management philosophy, the performance objectives, and the design criteria in the development of a waste management action plan. The Waste Management Plan specifies the appropriate methodology for the treatment and disposal of the various AVLIS Production Plant waste streams.

Since the AVLIS Production Plant will be located within the same site as the existing Oak Ridge Gaseous Diffusion Plant, the possible use of existing waste treatment and disposal facilities on or in the vicinity of the Oak Ridge Gaseous Diffusion Plant site will be considered. Such consideration allows a significant reduction in capital costs. Since existing waste management facilities were designed to process waste currently generated at Oak Ridge Gaseous Diffusion Plant and other DOE facilities, the feasibility of treating and disposing of AVLIS Production Plant wastes was assessed according to the flexibility and capacities of these facilities for handling the AVLIS Production Plant-specific wastes.

However, even though these facilities may be feasible for use in AVLIS waste management, their presence will not supplant the need to address waste management for the AVLIS Production Plant as a stand-alone facility. The planning for waste management will include the flexibility to support the so-called Green-field facility as well as the initial increment of production (5 MSWU/yr facility) up through the fully activated plant, (13 MSWU/yr facility).

1.2.2. Waste Management Facilities Design Objectives

The AVLIS Production Plant will adhere to the practice of as low as reasonably achievable discharges for the treatment and disposal of radioactive and/or hazardous waste streams. The waste management design objectives for the waste treatment and disposal facilities, shall satisfy all regulatory requirements of the Federal, State and local agencies that have jurisdiction over the design, construction and operation of such facilities. Waste management design objectives were established to protect the health and safety of operating personnel and the general public as well as providing for the protection of the environment.

Specifically, the AVLIS Production Plant design objectives calls for the following waste management approach philosophy:

- o As low as reasonably achievable design to maintain effluent releases to uncontrolled areas less than 10% of Federal and State regulatory limits.

- Use of active treatment methods to limit waste concentrations in effluents, as opposed to allowing credit for dispersion/dilution.
- Shared site release limits for effluents discharged from co-located, existing and planned waste treatment facilities on the Oak Ridge Gaseous Diffusion Plant site.
- Immobilization of dispersable low level radwaste streams (including, but not limited to, fluoride bearing materials, sludges, and incinerator ash) prior to shallow land burial disposal.
- Neutralization, solids removal, and consolidation of liquid waste streams to provide uncontaminated effluents for discharge.

Waste management objectives for conventional, non-contaminated waste streams shall be in accordance with accepted industrial and municipal type practices.

1.2.3. Waste Streams Characterization

Waste are generated in each of the uranium processing, enrichment, and support facilities associated with the operation of the AVLIS plant. These waste streams were characterized as to their origin, composition, and estimated generation rates in order to plan for their treatment and disposal.

These waste parameters, as derived from the best available information, are addressed in this planning. Future revisions to the plant design are anticipated to involve only the waste generation rates and will not significantly impact the waste identities. For this reason, the overall waste treatment/disposal methods will not be greatly affected by future changes or expansion of the AVLIS Production Plant facilities. Conversely, the capacities of the treatment and disposal methods provided by co-located, existing facilities required assessment for their functional adequacy.

The most significant AVLIS Production Plant waste streams are summarized in Table 1-2. The first waste quantities listed in Table 1-2 are for the initial production increment of 5 MSWU/yr; the second quantity (in parentheses) represents the fully activated plant production rate of 13 MSWU/yr.

Table 1-2. Most significant AVLIS Production Plant: Gaseous wastes.

Waste stream	Origin	Estimated generation rate[a]
HF	Feed conversion HF recovery condenser offgas	10.6 (28) Metric tons per year (MTY)
HF and F_2	Product conversion fluorination UF_6 cold trap offgas	8.0 (20.8) MTY HF 35 (91) MTY F_2
HF and F_2	Uranium recovery fluorination UF_6 cold trap offgas	123 (320) MTY
HF and F_2	Fluorine generation electrolyte cells	1 (2.6) MTY
Spent laser dye solution	Dye lasers system	15000 (39000)gpy
Anhydrous HF	Feed conversion, excess HF from HF recovery	252 (655) MTY
Miscellaneous chemical wastes	Wet U-recovery operation	65000 (170000) gpy
Decontamination solution wastes	Decontamination operation	65000 (170000) gpy
Volatile alloy compounds as distillation waste	Product conversion UF_6 purification operation distillation process	9000 (23000) gpy
Unclassified contaminated excess MgF_2 slag	Dry uranium recovery facility	3092 (8039) MTY
Classified MgF_2 diluent	Product conversion fluorination fluorinators	210 (546) MTY
Classified MgF_2 diluent	Classified melting/casting stream in the dry uranium recovery facility	74 (192) MTY

Table 1-2. (Continued)

Waste stream	Origin	Estimated generation rate[a]
Contaminated CaF_2	KF conversion; KF contaminated solution treatment $2KF + Ca(OH)_2$ CaF_2 + $2KOH$	700 (1820) MTY[b]
Melting/casting spent graphite crucibles	Feed preparation melting/casting operation	12 (31) MTY
Classified contaminated graphite	Separator systems pod refurbishment	2.8 (7.3) MTY
Miscellaneous contaminated material and equipment	Overall facility	20000 (50000) ft^3/yr

[a] 5 MSWU/yr plant quantities; fully activated plant quantities (in parentheses), approximately 2.6 times values listed

[b] This quantity is based on the assumption that the excess HF is treated as a waste. The applicable waste treatment facility, i.e. KF conversion, is sized to treat all of the excess HF. If the excess HF is sold as a commodity, the CaF_2 waste quantity will decrease to 175 (445) MTY.

1.2.4. Design Criteria

Regulatory requirements and nuclear fuel cycle design standards were used to establish design criteria for the design waste management facilities.

Those DOE regulations used to establish waste management design criteria and specified in the following applicable regulations:

- DOE Order 5480.2, "Hazardous and Radioactive Mixed Waste Management."
- DOE Order 5820.2, "Radioactive Waste Management."
- DOE Order 5480.1A, "Environmental Protection, Safety, and Health Protection Program for DOE Operations."

In addition to the requirements imposed by the DOE, the AVLIS Production Plant waste management criteria also adheres to the requirements in the following documents:

- o 10 CFR 20 "Standards for Protection Against Radiation", U.S. NRC.
- o Clean Air Act Amendment of 1977, Public Law 95-95, 91 Stat. 685, 42 U.S.C. 7401.
- o U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards", Federal Register 36(84):8186-8201(1971).
- o Tennessee Air Pollution Control Regulations, Department of Public Health, Division of Air Pollution, Nashville, Tenn., December 1972, Chapter 1200-3-3.
- o Federal Water Pollution Control Act, (as amended) by the Clean Water Act of 1977, Public Law 95-217), 33 U.S.C. 1251, 1341.
- o 40 CFR Parts 260 thru 267, U.S. Environmental Protection Agency *Standards for Management of Hazardous Wastes*.
- o 49 CFR Parts 171 thru 189, Department of Transportation Regulations for Handling and Transport of Hazardous Materials.

Specific design areas of interest are plant discharge limits, need for redundancy in design, controls and instrumentation, and waste-effluents monitoring. Only those regulations imposed by the DOE, the Environmental Protection Agency, the Department of Transportation, and the State of Tennessee Department of Public Health will be considered strictly binding for AVLIS Production Plant waste management. Related regulatory requirements and design standards that were provided by other agencies were used as planning guidelines.

1.2.5. Waste Management Plan

Table 1-3 represents a comprehensive approach to satisfying the waste management needs of the AVLIS Production Plant, within the bounds of the waste management performance objectives. These objectives are more conservative than required by applicable regulations.

The matrix presented in Table 1-3 lists all AVLIS Production Plant waste streams initially characterized, and summarizes their planned treatment and disposal. Included in the matrix are the waste stream identifications, origins, estimated generation rates, planned treatment and disposal methods, and type of facility required.

1.2.6. Waste Management Plan Implementation

Waste management facilities must be furnished for the AVLIS Production Plant to implement the Waste Management Plan set forth in this document Since the initial AVLIS Production Plant will be located at the existing Oak Ridge Gaseous Diffusion Plant site, taking into consideration that the gaseous diffusion operations are expected to be phased out as the AVLIS Production Plant is deployed, the general approach in providing waste management facilities for AVLIS Production Plant considered not only the need for new facilities but also the feasibility of using existing and/or planned facilities that are, or will be, utilized by Oak Ridge Gaseous Diffusion Plant.

Comphrehensive radioactive and hazardous waste management-studies performed by DOE for its operating installations in the Oak Ridge Reservation and other enrichment plants, have resulted in the upgrading of existing Oak Ridge Gaseous Diffusion Plant facilities and in the planned provision of several new waste management facilities. New facilities to be used by Oak Ridge Gaseous Diffusion Plant include the Central Neutralization Facility, the Concrete Fixation Facility, the Central Incineration Facility, and the Central Waste Disposal Facility. Since these and other conventional waste facilities were generally designed to accept wastes generated either by Oak Ridge Gaseous Diffusion Plant or a number of the existing DOE facilities, the feasibility of using them for the treatment and disposal of AVLIS Production Plant wastes was assessed with the flexibility and capacities of these facilities for handling the AVLIS Production Plant-specific wastes. The assessment revealed that the above facilities, as well as the existing Oak Ridge Gaseous Diffusion Plant Decontamination Facility (Building K-1420), Sewage Treatment Plant (Building K-1203), and the Classified Burial Ground, are all suitable for AVLIS Production Plant use at both the initial increment and the fully activated

Table 1-3. AVLIS Production Plant waste management matrix.

Waste stream	Origin	Estimated generation rate: initial increment of production[a]	Planned treatment	Planned disposal	Facilities
	Feed Conversion				
UF_4 reduction tower reactor off gas	U-processing, H_2 reduction reactor offgas	1064 MTY (metric tons per year) HF 8 MTY H_2 156 Kg/yr UF_6	Chemical traps, for UF_6 removal; HF recovery by KOH packed column, HF scrubbing: H_2 burner	Discharge clear effluent to atm. after treatments	Process offgas treatment equipment in Feed Conversion Facility
Activated carbon trap material	U-processing; feed conversion UF_4 production, offgas treatment chemical traps for UF_6 removal	880 kg/yr	U-recovery in wet U-recovery process, incineration of spent carbon, concrete fixation of ash	Shallow land disposal (burial) of immobilized waste	Wet U-recovery process; incinerator concrete fixation and burial facilities
KOH packed column liquid waste, from HF scrubbing, KF contaminated solution	UF_4 production, HF recovery offgas treatment	124 MTY	Convert KF to CaF_2 solids, concrete fixation of CaF_2	Shallow land disposal (burial) of immobilized waste	KF conversion, concrete fixation, and burial facilities
Excess Anhydrous HF	UF_4 production offgas, HF recovery product	270 MTY	Commercial resale or, if handled as waste, convert to CaF_2 solids, concrete fixation of CaF_2	Shallow land disposal (burial) of immobilized waste	KF conversion concrete fixation, and burial facilities
High-efficiency particulate air and pre-filters	Feed Conversion Facility HVAC, hood and process filtration system	1 MTY	Shredding and compaction or incineration; fix ash in concrete	Burial of packaged or immobilized waste in shallow land burial	Compaction or incineration facility. Fixation and burial facilities
MgF_2 slag	*Mg reduction of UF_4 removed from derby production by slag processing*	*See U Recovery operations*	*Sent to U Recovery*	See Uranium Recovery operation for disposition of waste	Uranium Recovery Facility
	Feed Preparation				
Scrap graphite crucibles	Melting and casting process	12 MTY	Incineration, concrete fixation of ash	Burial of immobilized ash waste	Incineration, fixation, burial facility

Table 1-3. (Continued)

Waste stream	Origin	Estimated generation rate: initial increment of production[a]	Planned treatment	Planned disposal	Facilities
Casting slag	Crucible refurbishment	See U recovery operations	Sent to U Recovery Recover Uranium with Dry U recovery process. See U recovery for final disposition.	See Uranium Recovery	See Uranium Recovery
	Laser Isotope Separation				
Vacuum-pump oil	Separators refurbishment	2300 gpy (gallons per year)	Incineration	Discharge clean effluent to atmosphere after treatment	Incineration facility
High-efficiency particulate air and pre-filters	Separator refurbishment Hood exhaust and HVAC	5 MTY	Shredding, and compaction or incineration; Fix ash in concrete	Burial of packaged or immobilized waste in shallow land burial	Compaction or incineration facility. Fixation and burial facilities.
Contaminated water	Separator/Refurbishment Startup testing of emergency blowdown system	Trace	Neutralization, fix sludge in concrete	Discharge clean effluent, burial of fixed sludge	Neutralization, fixation facilities
	Product Conversion				
Off gas from oxidation	U product oxidation vibrating tray kiln	Carried over trace quantity of U particulates	Sintered metal filtration, removal of particulates	Discharge clean effluent to atmosphere after treatment	Process offgas treatment equipment
Fluorination off gas	Fluorinator offgas, downstream of UF_6 cold traps	8 MTY HF 35 MTY F_2	Chemical traps to remove UF_6; KOH packed column to remove HF, F_2 by scrubbing	Discharge clean effluent to atmosphere after treatment	Process offgas treatment equipment in Product Conversion Facility
Solid waste from NaF chemical traps	Chemical traps for fluorination off gas	0.2 MTY	Wet U-recovery process, fix residue in binder	Shallow land burial	Wet U-recovery, concrete fixation and burial facilities
KOH packed column liquid waste from HF, F_2 scrubbing; KF contaminated solution.	Fluorinator off gas KOH packed column scrubbing	189 MTY	Convert KF to CaF_2 solids, concrete fixation of CaF_2	Shallow land burial	KF conversion, fixation and burial facilities

Table 1-3. (Continued)

Waste stream	Origin	Estimated generation rate: initial increment of production[a]	Planned treatment	Planned disposal	Facilities
MgF_2 diluent from product fluorination	Fluorination fluid bed reactors	210 MTY MgF_2 4.9 MTY YF_3	Concrete fixation	Classified burial ground	Fixation, classified burial facilities
Volatile alloy compounds from UF_6 distillation	UF_6 purification distillation column	12 MTY	Pressurized sealed containers, interim vault storage prior to future disposition	Classified burial (ultimate disposition)	Interim vault storage, classified burial facilities
High-efficiency particulate air and pre-filters	Product Conversion Facility HVAC, hood and process filtration systems	1 MTY	Shredding, and compaction or incineration; fix in concrete	Burial of immobilized ash waste	Compaction or incineration facility, fixation and burial facilities
	Lasers				
Spent Laser Dye Solution	AVLIS enrichment process, laser operation	15,000 gpy	Incineration effluent to atmosphere	Discharge clean after treatment	Incineration facility
Spent filters	AVLIS laser dye cleanup system	100 ft3/yr	Concrete fixation	Shallow land burial	Fixation and burial facilities
Spent resins	AVLIS laser dye cleanup system	600 ft3/yr	Same as above	Same as above	Same as above
Laser dye cleaning, demineralizer backflush	Laser dye cleanup system	1,500 gpy	Neutralization, fixation of resulting sludges	Discharge clean effluents, burial of sludges	Neutralization, fixation and burial facilities
Freon decon. sludge	Laser refurbishment Freon recycle system	Trace	Concrete fixation	Shallow land burial	Fixation, burial facilities
Metal sludge	CL cleaning	100 ft3/yr	Same as above	Same as above	Same as above
	Refrubishment				
Freon blast, oxide and spent separator coatings	Separator refurbishment Freon blast waste mixture	90 MTY	Wet U-recovery, fix residues in concrete	Shallow land burial	Wet U-recovery, fixation, burial facilities
Separator coatings	Separator refurbishment excess coating overspray	17 MTY	Recovery coating for reuse	--	--

Table 1-3. (Continued)

Waste stream	Origin	Estimated generation rate: initial increment of productiona	Planned treatment	Planned disposal	Facilities
Separator graphite	Separator/Pod Refurbishment	7.8 Kg/yr	Incineration, fix ash in concrete	Classified burial ground	Incineration, fixation, burial facilities
	Uranium Recovery				
Excess MgF_2	U-processing; feed conversion, slag processing	3036 MTY MgF_2 22 MTY Mg	Concrete fixation	Shallow land burial	Fixation, burial facilities
Melting/casting slag from feed preparation	U-processing; feed preparation, melting/casting operation	65 MTY MgF_2	Same as above	Classified burial ground	Fixation system, classified burial facility
Fluorination off gas	Fluorination offgas, downstream of UF_6 cold traps	123 MTY HF and F_2	Chemical traps to remove UF_6; KOH packed column to remove HF, F_2 by scrubbing	Discharge clean effluent to atmosphere after treatment	Process offgas treatment equipment in Uranium Recovery Facility
NaF chemical trap waste	Chemical traps for fluorination off gas	240 Kg/yr	Wet U-recovery process, fix residue in concrete	Shallow land burial	Wet U-recovery, fixation, burial facilities
KOH packed column liquid waste from HF scrubbing; KF contaminated solution	Fluorination offgas HF packed column scrubbing	5521 MTY	KF Conversion to solid CaF_2, concrete fixation	Same as above	KF conversion, fixation, burial facilities
High-efficiency particulate air and pre-filters	Uranium Recovery Facility HVAC, Hood and process filtration systems	1 MTY	Shredding, and compaction or incineration Fix ash in concrete	Same as above	Compaction or incineration facility, fixation burial facilities
	U Processing Support				
KF·2HF electrolyte sludge	Fluorine generation, F_2 electrolyte cells	17 MTY	Fixation in binder	Shallow land burial	Fixation, burial facilities
KOH packed column liquid waste	Fluorine generation, electrolyte cell offgas treatment	10 MTY	KF Conversion to solid CaF_2 concrete fixation of CaF_2 solids	Same as above	KF conversion, fixation, burial facilities

Table 1-3. (Continued)

Waste stream	Origin	Estimated generation rate: initial increment of production[a]	Planned treatment	Planned disposal	Facilities
CaF_2 powder	KF conversion of KOH packed column KF contaminated solution from all KOH scrubbers	700 MTY	Immobilize in concrete	Same as above	Same as above
Ammonia absorption bed regeneration waste	Ammonia dissociation system	Trace	Chemical neutralization, concrete fixation	Same as above	Neutralization, fixation, burial facilities
Aqueous nitrates	Wet uranium recovery, extraction column raffinates	8 MTY	Biodenitrification, fix residues	Same as above	Biodenitrification system
Decontamination solutions	K-1420 decontamination operations, cleaning solutions	2.6×10^6 gpy	Chemical neutralization, concrete fixation	Same as above	Neutralization, fixation, burial facilities
	Facility Support				
Contaminated water (100 ppm sodium chromate)	HX facility, cooling water	650 GPY	Chemical neutralization, concrete fixation	Shallow land burial	Neutralization, burial facilities
Cooling tower blowdown	Cooling towers waste water	600 GPM	Settling ponds, fix sludge	Same as above	Settling ponds, fixation, burial facilities
Decommissioned equipment	Facility wide, failed and/or replaced components	5000 CFY	Decontamination	Shallow land burial or recycle	Decontamination facility
Trash/refuse (operations)	Housekeeping wastes (paper, plastics, wood, etc.)	365 MTY	Incineration, compaction	Shallow land burial	Compaction, incineration, burial facilities
Sanitary liquid effluent	Facility wide	1.2×10^7 gpy	Activated sludge sewage treatment	Discharge clean effluents	Sewage plant
Sludges from waste treatment and sewage	Water sewage plants	3×10^6 ft^3/yr	Collection	Shallow land burial	Sanitary landfill
Storm drains	Facility wide	2.5×10^6 GPH (max. storm)	Oil removal and drainage	Discharge to river	Storm drains system

[a] *Initial increment of production, (5 MSWU); for fully activated plant (13 MSWU), multiply listed quantity by 2.6.*

plant levels of production. The status of these facilities is summarized in Table 1-4. All of the new facilities will be operational by 1987 with most already under construction. Should the Oak Ridge Gaseous Diffusion Plant not be phased out in a manner timely to allow these waste management facilities to receive waste streams from the AVLIS Production Plant, alternate treatment for these streams will be furnished. Other approaches would be development of similar facilities or modification of the existing facilities to allow concurrent waste treatment. The central incinerator facility capacity is such that, once its backlog of waste is processed, it would be able to treat both Oak Ridge Gaseous Diffusion Plant and AVLIS Production Plant combustible wastes concurrently.

Figure 1-1 shows the location of the existing/planned facilities on the Oak Ridge Gaseous Diffusion Plant site.

A flow diagram of overall waste-management planning for the AVLIS Production Plant, based on the use of the Oak Ridge Gaseous Diffusion Plant site waste management facilities and associated Oak Ridge Reservation waste management facilities, is provided by Figure 1-2.

To support the AVLIS production Plant, as a stand-alone facility at a Green-field site, a centralized radiological and hazardous waste treatment facility to support the waste management operations is preferred.
This waste treatment facility is envisioned as a centralized, multi-function building which will house the following operations:

- o Decontamination Operations.
- o Wet Uranium Recovery Process.
- o Liquid Wastes Neutralization.
- o Waste Incineration.
- o Concrete Fixation.
- o Material Handling and Storage (Including recovered UO_3 product storage, truck unloading/loading areas, and material staging and storage areas).
- o Offices and Laboratory.

Table 1-4. Status of waste management facilities required for the AVLIS Production Plant.

Waste management facility	Location[a]	Status
Central neutralization facility	Oak Ridge Gaseous Diffusion Plant	Under construction, in operation in 1986
Concrete fixation facility	Oak Ridge Gaseous Diffusion Plant	Under construction, in operation in 1986
Central incineration facility	Oak Ridge Gaseous Diffusion Plant	Under construction, in operation in late 1986
Central waste disposal facility	Oak Ridge Reservation site (~5 miles from the Oak Ridge Gaseous Diffusion Plant)	In final design, in operation in 1985
Decontamination facility	Building K-1420, Oak Ridge Gaseous Diffusion Plant site	Existing facility, Inactive
Sewage treatment plant	Building K-1203, Oak Ridge Gaseous Diffusion Plant site	Existing facility
Classified burial ground	Oak Ridge Gaseous Diffusion Plant site	Existing 20 acre site, planned expansion to 42 acres

[a] See Figure 1-1 for Oak Ridge Gaseous Diffusion Plant site locations.

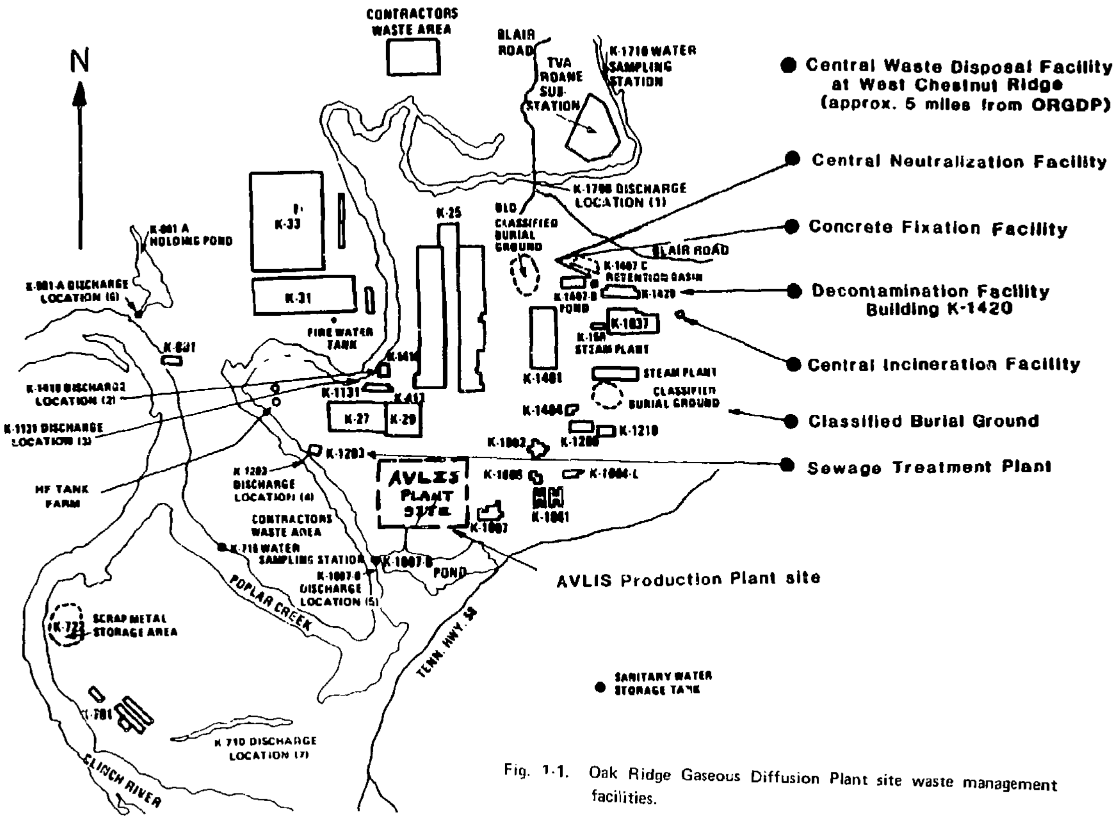


Fig. 1.1. Oak Ridge Gaseous Diffusion Plant site waste management facilities.

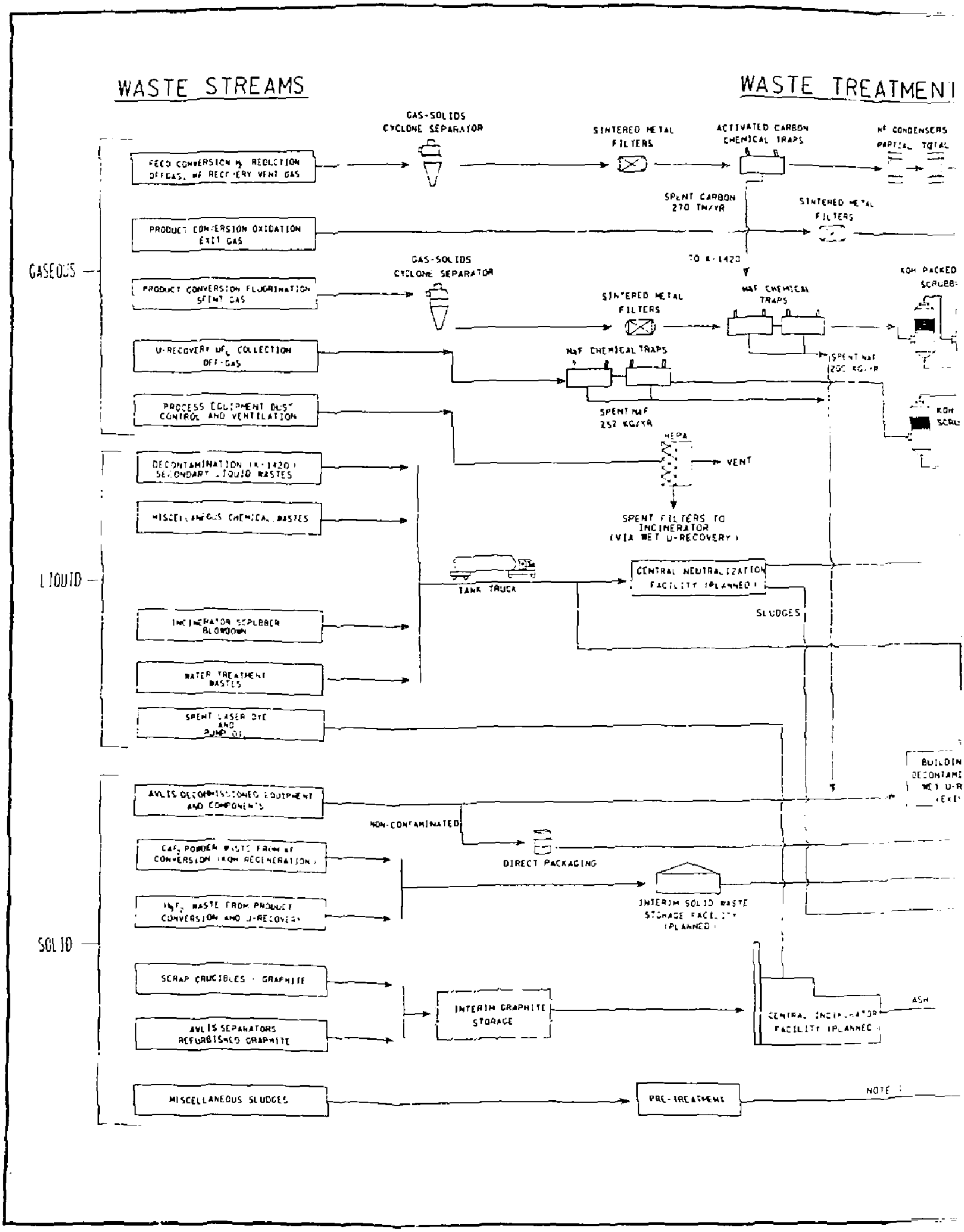
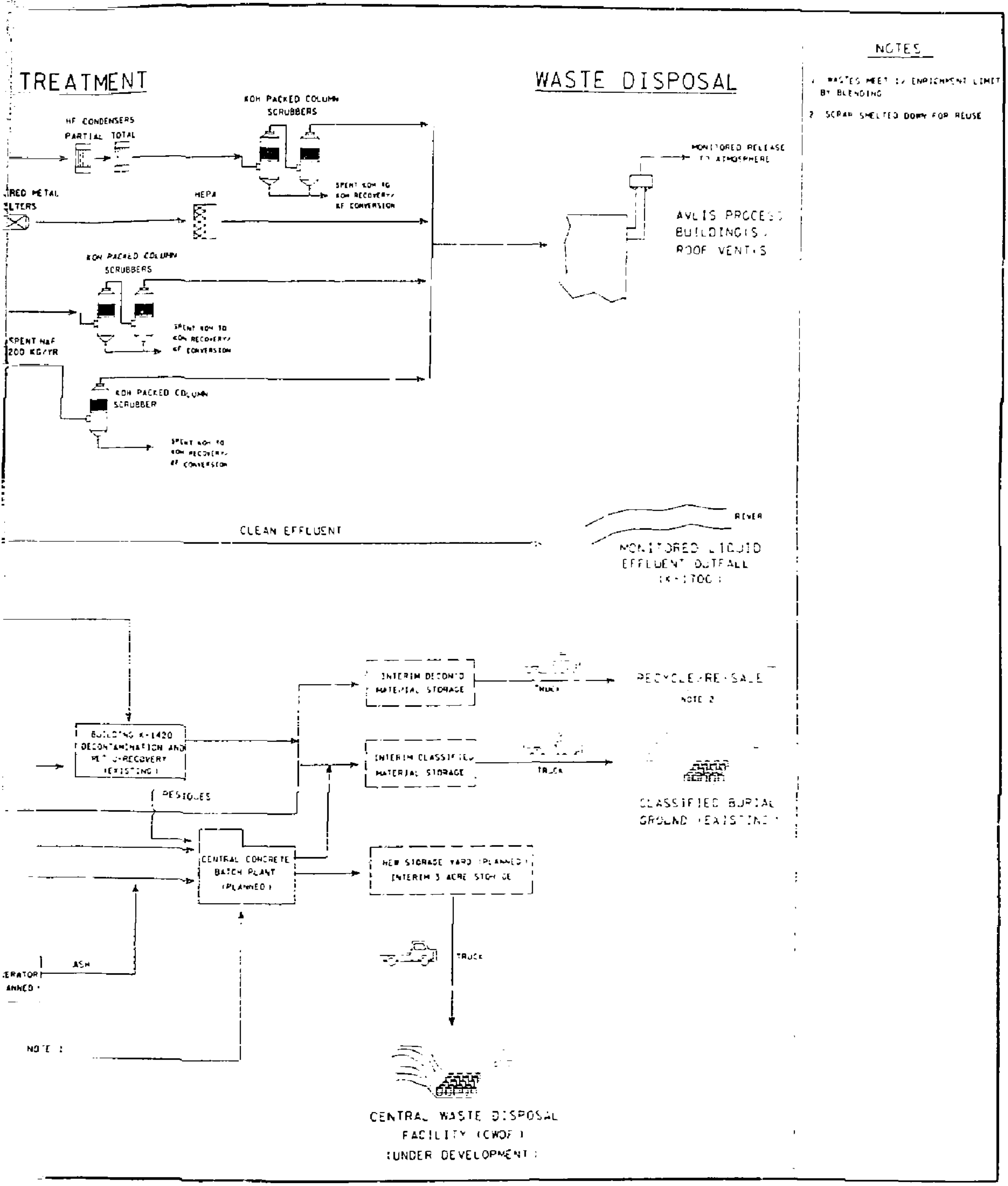


Fig. 1-2. Overall waste management planning for AVLIS Production Plant.



TREATMENT
WASTE DISPOSAL
NOTES
BY BLENDING
2 SCRAP SMELTED DOWN FOR REUSE
KOH PACKED COLUMN SCRUBBERS
HF CONDENSERS
PARTIAL TOTAL
HEPA
SPENT KOH TO KOH RECOVERY/ HF CONVERSION
MONITORED RELEASE TO ATMOSPHERE
KOH PACKED COLUMN SCRUBBER
CLEAN EFFLUENT
RIVER
BUILDING K-1420 DECONTAMINATION AND U-RECOVERY (EXISTING)
INTERIM CLASSIFIED MATERIAL STORAGE
TRUCK
RESIDUES
CENTRAL CONCRETE BATCH PLANT (PLANNED)
ASH
NOTE 2
CENTRAL WASTE DISPOSAL FACILITY (CWDF) (UNDER DEVELOPMENT)

The Central Waste Management Facility and the associated waste treatment systems would be sized to accommodate the fully activated level of plant production.

Figure 1-3 shows a prospective conceptual arrangement for the Central Waste Management Facility. This arrangement considered optimizing waste transfer between operations, better administrative and operational control through consolidated processing of waste streams; and the economy of one common waste treatment facility as opposed to several, independent facilities.

The siting of a shallow, land-burial facility for the disposal of AVLIS Production Plant solid wastes can become an important factor in the selection of an independent Green-field AVLIS Production Plant site. It is advantageous to develop waste burial grounds within the new AVLIS Production Plant site to realize cost savings from reduced transportation requirements. Minimizing transportation also reduces impact to the environment. New burial grounds will need to satisfy requirements DOE Orders 5820.2 and 5840.2, as well as the intent of 10 CFR Part 61, in addition to other applicable regulations.

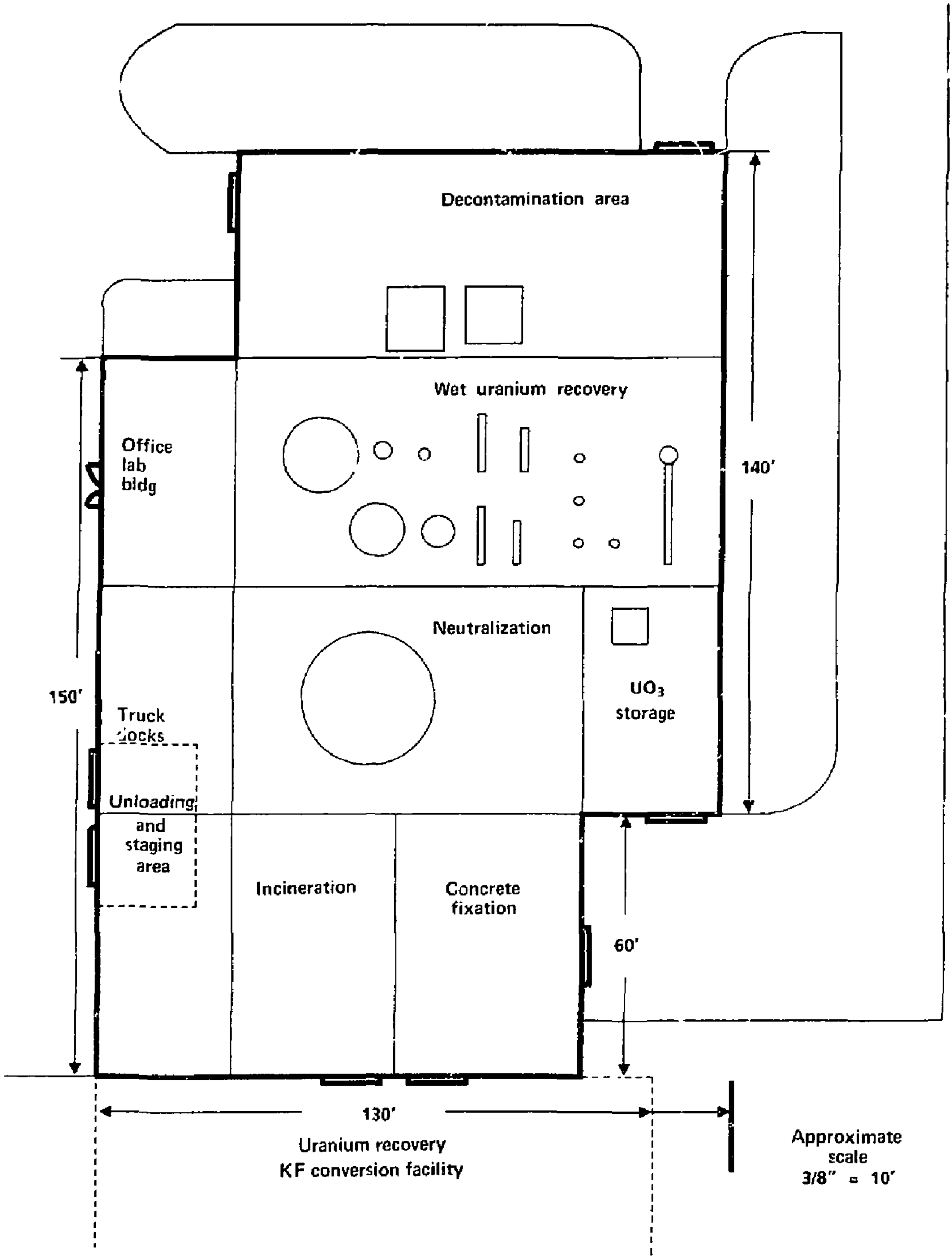


Fig. 1-3. Waste management facilities for green field plant location

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2. WASTE MANAGEMENT FACILITIES DESIGN OBJECTIVES

2.1. PERFORMANCE OBJECTIVES

2.1.1. General

The operation of the AVLIS plant will generate various gaseous, liquid, and solid waste streams. These wastes will include radioactive and/or hazardous chemical waste materials which require responsible management over the life of the facility. The waste management policies will be established in accordance with DOE Orders 5480.2, "Hazardous and Radioactive Mixed Waste Management," and 5820.2, "Radioactive Waste Management." Waste management philosophy shall be based on the concept of reducing radiation exposures to as low as reasonably achievable levels, as defined in the US NRC Regulatory Guide 8.8. The AVLIS Production Plant will use the best available technology economically achievable for the treatment of all wastes. The objectives of the facility waste management performances, including those for collection, confinement, treatment and disposal, are described for each of the general waste streams in the following paragraphs.

2.1.2. Liquid Waste Management

The performance objective of the liquid waste management systems is to collect and treat radioactive and non-radioactive liquid wastes generated during the facility operation and to reduce their radioactivity and chemical concentrations to levels that are as low as reasonably achievable. Liquid waste management systems will be designed using the best technology available for processing so that the radioactive materials in liquid effluents from the facility do not exceed 10% of the limits specified in DOE Order 5480.1A, "Environmental Protection, Safety and Health Protection Program for DOE Operations", as well as satisfying the requirements specified by Title 40, Code of Federal Regulations, Part 190, "Environmental Radiation Protection Standard for Nuclear Power Operations" and the intent of 10 CFR Part 20. Specifically, the concentrations of radioactive materials in liquid effluents released to unrestricted areas will not exceed 10% of the limits in DOE Order 5480.1A, Attachment XI-1, Table II, Column 2.

In addition to the above restrictions in the amount of radioactive effluents allowed for release from the Waste Management Facility, the liquid waste management program will comply with the requirements provided by Title 40, Code of Federal Regulations, Subchapter D - Water Programs; the Clean Water Act, 33 U.S.C. 1251; and the State of Tennessee Department of Public Health for the control of the hazardous and toxic liquid pollutants discharged from the facility, limiting discharge concentrations to 10% of regulatory limits.

The liquid waste treatment systems will be designed to meet all anticipated processing requirements of the facility. Adequate capacity will be provided to process all design basis liquid wastes and to meet design objectives during normal facility operation, as well as having reserve capacity sufficient to function during anticipated off-normal operational occurrences.

2.1.3. Gaseous Waste Management

The performance objective of the gaseous waste management systems is to collect and treat radioactive and non-radioactive gaseous wastes generated during the operation of the facility, and to reduce the wastes' radioactivity and hazardous chemical concentrations to levels that are as low as reasonably achievable for discharge from the facility. Radioactive material in the gaseous effluents from the plant site will meet the requirements of DOE order 5480.1A; 40 CFR Part 190; and the intent of Title 10, Code of Federal Regulations, Part 20. More specifically, the AVLIS design objective will be less than 10% of the limits specified in DOE Order 5480-1A, Attachment XI-1, Table II, Column 1 and Tennessee Air Quality Act, Chapter 1200-3-3. Atmospheric dispersion, due to elevated releases, will be excluded from consideration as a substitution for treatment systems to reduce the gaseous pollutant concentration discharges beyond uncontrolled area boundaries. Only the material removal efficiency of the waste treatment equipment will be considered in the determination of the waste concentrations released from the facility.

In addition to the objectives for radioactive gaseous effluents cited above, the gaseous waste management systems will also be designed to satisfy the requirements of the Clean Air Act, 42 U.S.C. 7401; the U.S. Environmental Protection Agency; and the State of Tennessee Department of Health for the management of hazardous and toxic gaseous pollutants discharged from the facility.

The gaseous waste treatment systems will be designed to meet all anticipated processing requirements of the facility. Adequate capacity will be provided to process all design basis gaseous wastes and to meet design objectives during normal facility operation, as well as having reserve capacity sufficient to function during anticipated off-normal operational occurrences.

2.1.4. Solid Waste Management

The performance objective of the solid waste management systems is to collect, process, package, transport, and dispose of site-generated solid wastes, in compliance with DOE Order 5480.1A, and relevant requirements of 10 CFR Part 20 relating to release of radioactivity in effluents to unrestricted areas, 10 CFR Part 71 relating to packaging of radioactive material, 49 CFR Part 173 relating to the transportation of radioactive material, and 10 CFR 61 relating to shallow land burial disposal sites for low level radioactive waste. All dispersible radiological and hazardous solid waste materials shall be immobilized (fixed) in a binder material to preclude any dispersion into the environment. This objective will furnish a stable, monolithic, liquid-free waste form for final disposal. Performance objectives for the handling, processing and disposal of solid, hazardous wastes will be in compliance with 40 CFR Part 260 through 40 CFR Part 267 as well as DOE Order 5480.2.

2.2. SAFETY OBJECTIVES

The design and operation of the waste management facility systems will minimize the release of radioactive and/or hazardous materials to the environs and in-facility areas. Overall safety objectives are to eliminate factors that could result in undue risk to the health and safety of the general public and/or the facility personnel. The operational and accidental release of radioactive and/or hazardous materials shall be reduced such that radiation and/or hazardous materials exposure to workers and the general public is maintained below facility performance objectives and as low as reasonably achievable.

3. AVLIS PRODUCTION PLANT WASTES

3.1. WASTE CHARACTERIZATION

3.1.1. Introduction

The identification of the AVLIS waste generating operations and the characterization of the waste streams produced by these operations are presented in this section. These waste streams form the bases from which the waste management strategy is developed. Among the essential parameters necessary to assess the waste treatment systems are: the identities of the waste materials, their physical and chemical properties, and their rate of generation. These parameters, as derived from the best currently available information, are addressed here.

Future revisions to the baseline design are anticipated to involve only the waste generation rates and will not significantly impact the waste identities. For this reason, the overall waste treatment/disposal technologies and methodologies will not be greatly affected by future changes or expansion of the AVLIS production facilities. Conversely, the capacities of the treatment and disposal facilities and the usage of co-located, existing facilities will require future re-assessment as to their functional adequacy. The specific processes, operations, and their waste streams are described in the following sections.

3.1.2. Waste Generation Operations

The characterization of AVLIS waste streams is presented here according to operations within the work breakdown structure (WBS). Figure 3-1 presents a breakdown of individual AVLIS operations by work breakdown structure, identifying those processes that generate a significant amount of wastes. Wastes generated in uranium processing, as well as the laser and separator systems operations, have a special safety significance. This is due to their radioactive and hazardous constituents, and require special handling treatment and disposal practices. Other, more conventional wastes, (such as sewage,

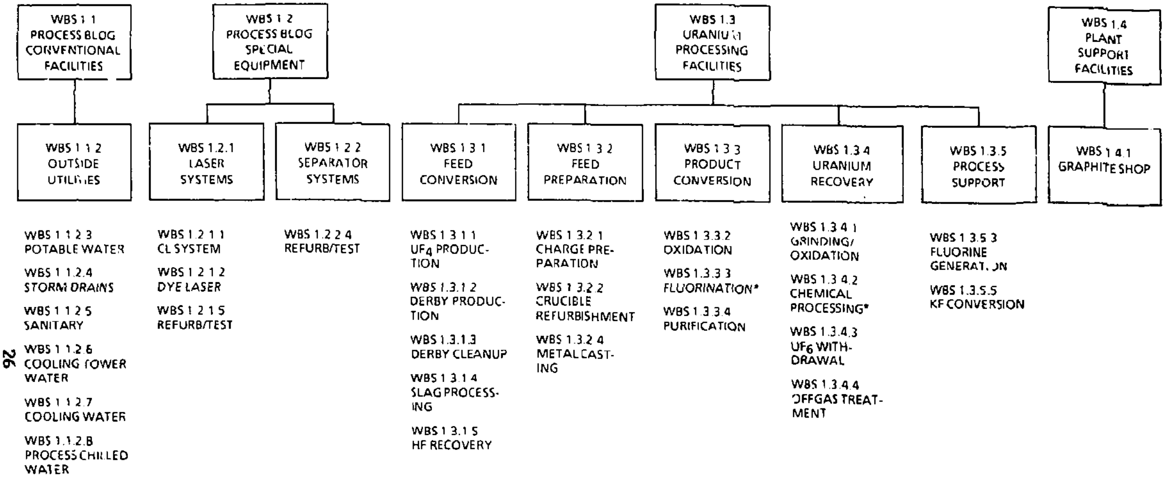

Fig. 3-1. AVLIS waste generation operations (identified by work breakdown structure).

* MAJOR PROCESS WASTE CONTRIBUTOR

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trash, storm drains), will be processed and disposed of in a conventional manner.

3.1.3. Waste Stream Descriptions

All quantities estimated for the waste management processing operations refer to the initial increment of production. A conservative scaling factor of 2.6 can be applied to all of these initial quantities to estimate the waste generated by the fully activated plant. This factor is based on the ratio of the fully activated plant production capacity of 13 MSWU/yr to the initial increment of production capacity of 5 MSWU/yr.

3.1.3.1. Outside Utilities Wastes (WBS 1.1.2). Table 3-1 shows the outside utilities waste characterization, and provides the estimated quantities and description of wastes generated by these outside-utility facilities. Included among these waste streams are sanitary wastes, cooling tower blowdown, storm runoff, and the secondary wastes produced in the treatment of potable, cooling, and chilled process waters. These streams do not contain radioactive material and could possibly contain some hazardous material. The majority of these wastes will be liquids containing small concentrations of suspended solids. There will also be some sludges generated as secondary wastes from the treatment of these waste streams.

The chemical composition of the waste streams will include several different types of organic and inorganic materials. Since an exact characterization of these compositions will not be available until the actual operation of the plant these streams were assumed to be similar in nature to those generated by the Oak Ridge Gaseous Diffusion Plant.

Based on the discharges from the Oak Ridge Gaseous Diffusion Plant sewage treatment facility K-1203, the treated sanitary waste streams are expected to contain ammonia, coliform bacteria, and dissolved and suspended solids. The water treatment wastes are expected to contain precipitates of calcium, magnesium, sulfate and chloride compounds. Storm drains runoff is expected to contain suspended soil particles.

Table 3-1. Outside utilities waste characterization.

Waste	Waste Form	Origin	Estimate Quantity
Sanitary effluent	Liquids and Slurries	Overall facility	1.2×10^7 gpy
Demineralizer backflush	Liquids	Water treatment	5000 gpy
Water and sewage treatment secondary wastes	Sludges	Water and sewage treatment plants	3×10^6 CFY
Chemically contaminated water	Liquid w/<100 ppm sodium chromate	Heat exchangers	650 gpy
Cooling tower blowdown	Liquid	Cooling towers	5×10^7 gpy
Storm drains	Liquids	Facility wide	2.5×10^6 gpy (max storm)

3.1.3.2. Laser and Separator Wastes (WBS 1.2.1 and 1.2.2). There are several waste streams generated by the AVLIS enrichment processes. These wastes are associated with the laser operations, the separator operations, and support operations for these processes. To summarize these waste streams, their composition, origin, and generation rate, Tables 3-2 and 3-3 show the expected AVLIS enrichment process waste streams for solid and liquid wastes, respectively. The most significant of these waste streams is 15000 gal/yr of spent laser dye solution.

The tails material composition will be a classified uranium alloy. The material will be cast in cylindrical form between 6" and 8" diameter and 36" to 48" long. It will contain small amounts of classified processing materials. Each cylinder will weigh 500 kg. Approximately 10400 cylinders will be generated each year of plant production, or 30 per day assuming continuous operation.

The spent laser dye solution is a flammable liquid waste. Its composition is an alcohol based liquid solvent containing a rhodamine-type dye material. Since this rhodamine, (EH) a slightly toxic agent (EH) is present in very small concentrations, the spent dye solution will be considered as a flammable liquid waste only. Depending on the final method selected for the treatment and recycling of the laser dyes, their annual wastes quantity may range from a few hundred gal/yr to over 15000 gal/yr.

In addition to these two major operational waste streams, there will also be smaller waste contributions from contaminated cleanup equipment, such as high-efficiency particulate air filters and spent ion exchange resins.

Waste generated during the refurbishment of separator pods and of the lasers will include several liquid and solid streams. Table 3-4 summarizes these solid refurbishment wastes and Table 3-5 summarizes these liquid refurbishment wastes. The most significant of these waste streams include the 75 MTY of mixed oxides and of spent coatings from the separators refurbishment.

These refurbishment operations will also produce spent pre-filters and high-efficiency particulate air filters containing various concentrations of uranium contaminants.

3.1.3.3. Uranium Processing Facilities Wastes. The uranium processing facilities will generate the greatest quantities of the AVLIS Production Plant process wastes. These wastes are associated with the various operations for converting the gaseous uranium hexafluoride to appropriate metal alloy form for introduction into the isotope separation process and then converting the enriched uranium metal product withdrawn from the separation process back to the UF_6 form. The uranium processing facility wastes consist of: feed conversion wastes; feed preparation wastes; product conversion wastes; uranium recovery wastes; and uranium processing support operations wastes. There wastes are explained in the following pages.

Feed Conversion Wastes. The Feed Conversion operations convert uranium hexafluoride (UF_6) to metallic uranium "derbies" used to cast billets for the AVLIS separator feed. The process consists of two basic steps, as shown in Fig. 3-2. The first step is hydrogen reduction of UF_6 vapor to uranium tetrafluoride (UF_4) powder. The second step is the Mg reduction of UF_4 to uranium. The molten uranium metal is obtained by blending UF_4 powder with magnesium granules and by heating the mixture to auto-ignition temperature in

Table 3-2. AVLIS waste enrichment process solid wastes.

Waste type	Waste form	Origin	Uranium contaminated	Estimated quantity
Prefilters and High-efficiency particulate air filters	Filter assembly	Separator/plant operations	Yes[a]	5 MTY
Spent filters	Cartridges	Dye system filtration	No	100 CFY
Spent resins	Resin slurry	Dye system demineralizers	No	600 CFY

[a] Contains slightly enriched uranium (<5 w/o assay).

Table 3-3. AVLIS enrichment process solid wastes.

Waste type	Waste form	Origin	Uranium contaminated	Estimated quantity
Vacuum pump oil	Oil	Separators refurb.	Yes (75% by volume)[a]	2800 gpy
Water	Liquid	Separator preop functional testing of emergency cooling system	No	Trace
Spent laser dye solution	Alcohol Based dye solution (rhodamine-type dye agent)	Lasers	No	15000 gpy

[a] Contains slightly enriched uranium (<5 w/o assay).

Table 3-4. Refurbishment solid wastes.

Waste type	Waste form	Origin	Uranium contaminated	Estimated quantity
Blast grit	Abrasive Granules	Separator refurb./ Standby off-line Equipment	Yes[a]	Trace
Freon blast residues, mixed oxides, and spent coating	Sludge	Freon pod cleaning recycle residues	Yes[a]	90 MTY
Graphite	Carbon	Pod refurb.	Yes[a]	2.8 MTY
High-efficiency particulate air filters	Filter assemblies	Separarator refurb.	Yes[a]	1 MTY
Metal sludges	Wet solids	CL (sopper laser) cleaning	No	100 CFY

[a] Contains slightly enriched uranium (<5 w/o assay)

Table 3-5. Refubishment liquid wastes.

Waste type	Waste form	Origin	Uranium contaminated	Estimated quantity
Coatings	Liquids	Separ. refurb. excess coating	No	17 MTY
Freon decon. residues	Liquids and wet solids	Laser refurb. misc. cleaning	No	700 gpy

a reactor vessel lined with magnesium fluoride (MgF_2). After the cooling and solidification of the uranium, the reactor vessel is opened and the derby is separated from the slag, cleaned, and sent to feed preparation.

A third operation, which supports the above process is slag processing. MgF_2 slag, from Mg reduction, is crushed and screened to separate uranium pellets not incorporated in the derby, then classified into three fractions:

1. A fines fraction recycled for reactor lining material.
2. A fines fraction for inert filler in the product fluid bed fluorinator.
3. Balance to uranium recovery for processing preceding disposal.

Uranium pellets recovered from the MgF_2 during slag processing are remelted into ingots which are sent to feed preparation as a secondary source of clean uranium metal.

A fourth support operation is HF recovery. Hydrogen fluoride (HF) produced in the hydrogen reduction step is condensed and used for feed to the fluorine generation facility.

Waste streams generated by the feed conversion operations include: H_2 reduction offgases; carbon trap materials from the HF recovery; the MgF_2 slags that contain recoverable materials, uranium oxides from roasting of derbies, H_2 generation wastes; and the secondary waste streams from offgas cleanup systems.

H_2 Reduction offgas contains excess HF and UF_6. These materials need to be extracted for recovery and recycle. The HF is to be returned to the fluorine generation facility and the UF_6 is to be trapped by activated carbon. Aside from their planned recovery, each of these materials needs to be removed prior to discharge of vent gas to the atmosphere. This is due to the radiological hazard of the UF_6, as well as the environmental hazard of the fluorine compounds.

Figure 3-3 shows the material flow sheet for the HF recovery process used to process the reduction offgases. These treatments provide for removal of the HF from the offgases. The gaseous HF is then returned as feed material to

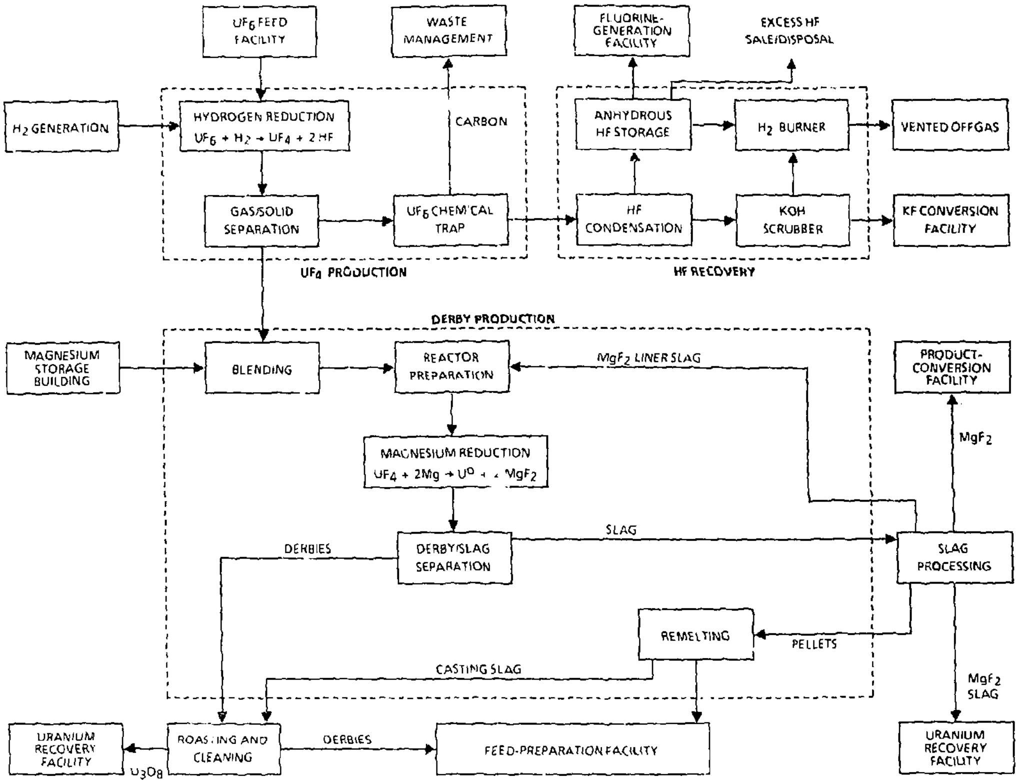

Fig. 3-2. Feed conversion flow sheet.

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the fluorine generation facility. The initial treatment of the offgas is filtration through activated carbon traps to remove any unreacted UF_6 passed on from the H_2 reduction process. The gas stream is then chilled to condense the HF from the offgas stream. Ninety-nine percent of the HF is recovered by the condensers. The remaining traces of gaseous HF are removed by passing the offgas through KOH packed columns. Prior to discharge to the atmosphere, an atmospheric flare is used to burn off any hydrogen remaining in the offgas.

Since more HF is generated in reduction of UF_6 than is required for fluorine generation, excess quantities of HF are available. The plant design provides for disposal of this material as a waste by reacting it with KOH. However, this anhydrous HF is a valuable material and a commercial use for this stream is likely.

If the excess HF were treated as a waste, an additional 270 MTY of must be processed. The treatment of this HF is estimated to generate approximately 540 MTY of KF after reaction with KOH. The KF solution would be sent to the KF conversion process where it will be reacted with lime to produce CaF_2 for final disposal.

The secondary wastes produced in the HF recovery process will include: spent activated carbon trap materials, offgas treated by the KOH packed columns, and KOH scrubber liquid wastes containing KF generated in the KOH packed columns.

The spent activated carbon trap material is basically UF_6-contaminated carbon. Approximately 880 kg of solids would be generated per year in the initial increment of production. The activated carbon is transferred to the wet uranium recovery process in Building K-1420 to extract the UF_6 collected.

The second waste stream -- the UF_6 condensation offgas which is treated by the KOH packed columns -- contains the excess gaseous HF not recovered by the condensers and a small concentration of UF_6 that bypasses the activated carbon. Approximately 10.6 MTY of gaseous HF and a trace (<1 kg/yr) of gaseous UF_6 will need to be treated by the packed columns.

The third waste stream -- the MgF_2 from the slag processing step -- feeds into the uranium recovery operation. The MgF_2 slag is an insoluble, granular material, approximately 100 to 200 mesh in size. The

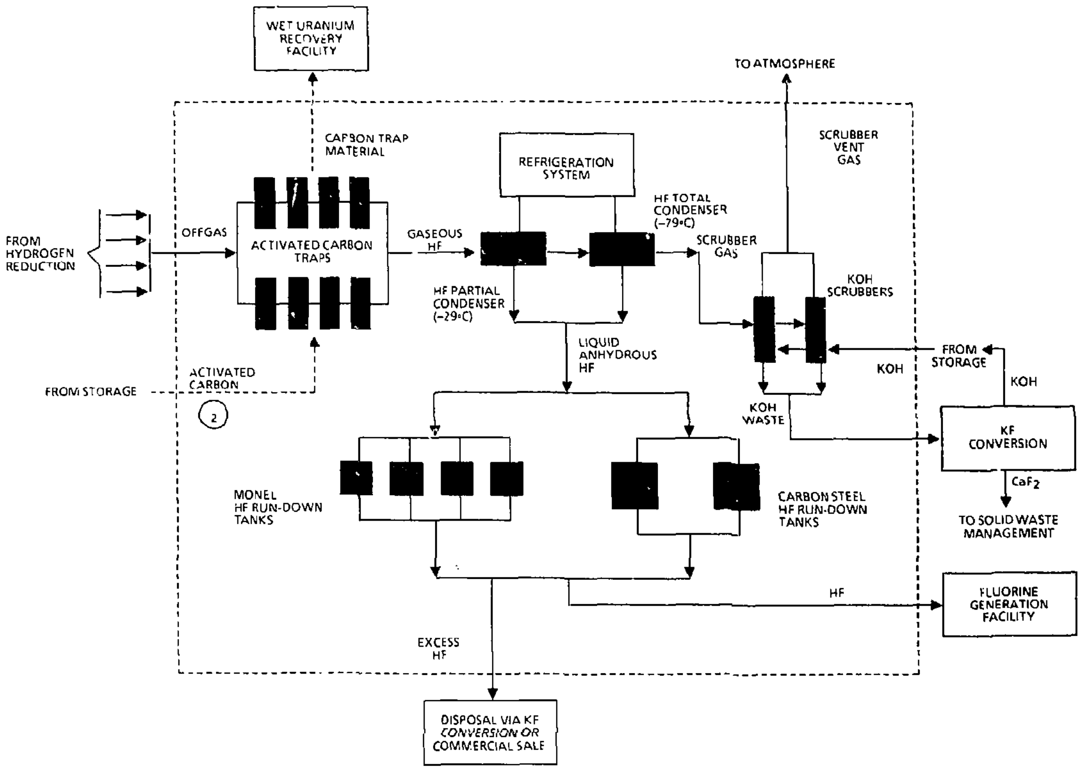

Fig. 3-3. Feed conversion operation HF recovery flow sheet.

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toxicity of this material is not yet determined, however this material is not listed by the Environmental Protection Agency as a hazardous substance.

The MgF_2 slag sent to uranium recovery will contain 3036 MTY of MgF_2 containing 103 MT of uranium metal and 22 MT of Mg.

The fourth waste stream is from the cleaning of the surface of the derbies which is done by oxidizing the outer surfaces of the derbies and removing the uranium oxide that is formed. The derby-cleaning debris is loose U_3O_8 oxide material that is readily brushed off the surface of the derbies. The annual quantity of this loose insoluble oxide is expected to be 108 metric tons.

The Hydrogen Generation operation, which feeds the hydrogen reduction step, is based on an anhydrous ammonia dissociation process, which involves passing ammonia vapor through a suitable catalyst at high temperature, causing the ammonia to break down into its component elements. Wastes from the fifth waste stream will include approximately 200 kg/yr of liquid NH_3 from a molecular sieve regeneration.

The sixth waste stream -- the KOH-packed columns liquid effluent -- contains the KF generated during the offgas treatment to remove the remaining HF and other fluoride compounds prior to atmosphere discharge. This waste stream is routed to the KF conversion process, where lime is added to produce KOH for recycling to the packed columns. Approximately 21 MTY of KF in the scrubber blowdown is expected to be processed for recycling.

Feed Preparation Wastes. The Feed Preparation process serves to produce appropriate feed material for the AVLIS separator modules. The separators require feed of uranium alloy with specified purity and consistent shape, suitable to be fed through a special feeding mechanism. These requirements define the major process to be performed when casting the purified metal alloy into consistent shapes suitable for separator feed. This is done under a protective argon blanket to prevent oxidation of the uranium.

The melting of uranium derbies is traditionally performed in graphite crucibles. Uranium, at the high temperatures involved, is very corrosive and the crucibles must be prepared for each melting cycle by applying an yttria coating to the inside surface to prevent the formation of uranium carbide when molten uranium contacts the graphite. The refurbishing of the crucibles is also accomplished in the feed preparation process. The wastes generated in these operations are casting slag and scrap graphite crucibles.

The melting/casting slag will contain U_3O_8, yttrium oxides from the crucible coatings, graphite, MgF_2, and some classified metal alloy materials. This waste stream basically will be a metallic oxide material.

Approximately 232 MTY of the U_3O_8, containing 65 MTY of MgF_2, 1.9 metric tons of Y_2O_3 and 1.3 metric tons of graphite, are expected to be processed from this stream. This final waste stream will contain MgF_2 and some classified materials associated with alloy preparation and must be considered a classified waste. NOTE: Because the alloy composition is assumed to be de-classified by the time AVLIS Production Plant becomes operational, waste streams contaminated with alloy will then be managed similarly to the natural enrichment uranium contaminated wastes. Declassification of the alloy composition will have a minimal impact on the design and costs of the waste management facilities and operations.

Should the alloy and alloy composition be declassified by the time AVLIS Production Plant becomes operational, these waste streams will be managed similarly to the natural assayed uranium contaminated waste. This reclassification is not expected to impact the overall designs and facility costs significantly. The only difference in managing the classified and declassifed waste stream is in the disposal facility, e.g. classified burial ground vs low-level waste burial ground.

The last waste stream, scrap crucibles, will be essentially graphite, with trace quantities of U_3O_8 and Y_2O_3. With the estimated disposal rate of 28 crucibles per year, the expected generation rate of this waste is approximately 12 MTY.

Product Conversion Wastes. The Product Conversion Processes convert the metal alloy discharged from the separators into UF_6 at a quality and assay suitable for nuclear fuel manufacture. Five basic processing steps are used: 1) size reduction, 2) oxidation, 3) fluorination, 4) UF_6 purification, and 5) assay blending. Figure 3-4 shows the Product Conversion material flows. Waste streams will come from the oxidation and fluorination steps, and from the offgas treatment and distillation in the UF_6 collection step.

The oxidation process will have exit gases which have some carryover of U_3O_8 particulates. These trace quantities will need to be collected prior to discharge to the atmosphere.

The fluorination process will generate MgF_2 wastes, contaminated with classified materials. The MgF_2 slag will be similar in nature to those generated in the Feed Conversion process. The expected production of these slags will be approximately 210 MTY of MgF_2, contaminated with about 4.9 metric tons of classified materials.

Wastes produced by the UF_6 collection operations include the wastes generated in the NaF chemical traps and KOH packed columns used for offgas treatment and the solid wastes generated in the distillation process. The offgas treatment is expected to generate approximately 0.2 MTY of UF_6 and HF contaminated NaF solids; 96 MTY and 93 MTY of KF and KOH liquid wastes, respectively, from the KOH packed columns; and MTY of classified solid wastes from the distillation operation. The distillation waste stream contains volatile alloy compounds which must be kept under pressure to remain in liquid form.

Spent NaF will be generated as a secondary waste in the offgas treatment of fluorination vent gases. This dry powder material will be sent to the wet uranium recovery process at the Decontamination Facility in Building K-1420 to extract enriched uranium.

Uranium Recovery Wastes. Two separate uranium recovery facilities will be available for the AVLIS Production Plant. They are designated as the Uranium Recovery Facility and the Decontamination Facility. In general, the slightly enriched, uranium-bearing wastes, chemically trapped, and solutioned uranium wastes will be processed through the wet-uranium recovery process in the Decontamination Facility. An existing facility, known as the K-1420 Decontamination Facility at the Oak Ridge Gaseous Diffusion Plant, will be activated and upgraded for the AVLIS plant wet uranium recovery process. This facility is primarily used to decontaminate process equipment from the Oak Ridge Gaseous Diffusion Plant. The recovery process used in Building K-1420 is semicontinuous and involves the dissolution of the uranium compound in the waste materials followed by solvent extraction, evaporation and denitration. All equipment in this facility, including storage containers, are geometrically safe to preclude a nuclear criticality incident.

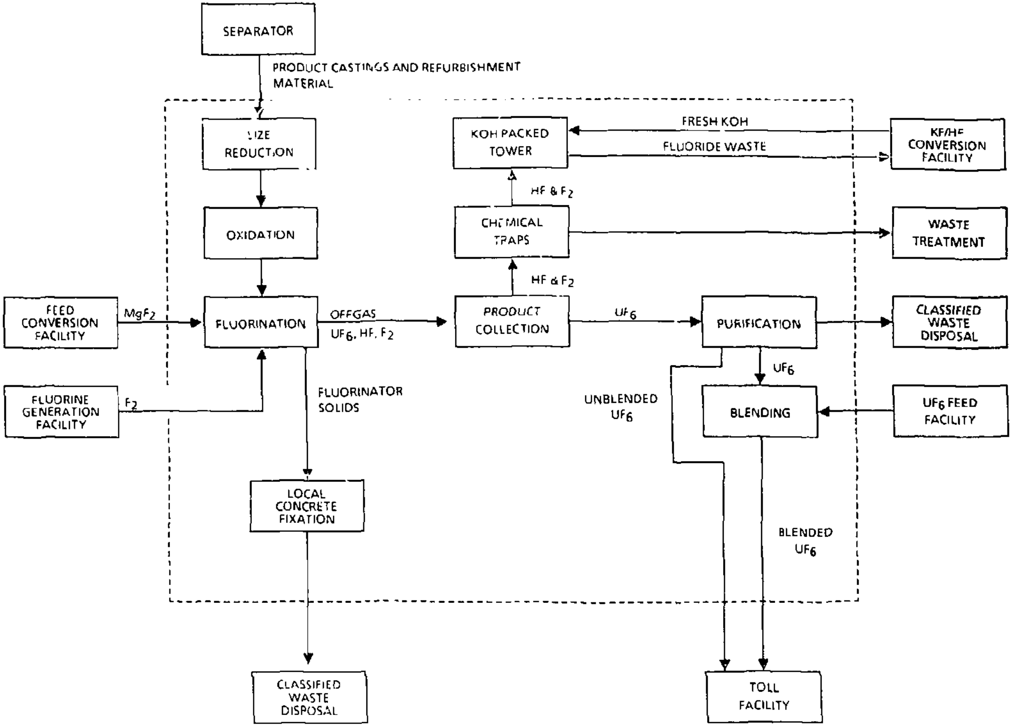

Fig. 3-4. Product conversion process flow sheet.

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The uranium recovery process is described in Fig. 3-5. The basic process is the preparation of UF_6 by continuous fluorination of uranium and its oxides with fluorine gas using a fluidized bed reactor. The process consists of four distinct operations: milling and oxidation fluorination, product collection and offgas treatment.

Gaseous waste streams from this operation are processed by the offgas treatment system. This treatment includes the use of NaF chemical traps to remove UF_6, and KOH packed columns to remove HF from the offgas. The secondary wastes to be managed by this operation include the spent NaF chemical trap media, and KOH packed column wastes. The expected quantities of the chemical trap wastes are 232 kg/yr NaF, contaminated with 0.7 kg of UF_6 and 8.5 kg of HF. The expected wastes from the KOH packed columns are 50.6 MTY of KF, containing 6.6 metric tons of KOH in solution.

The uranium recovery operation will process uranium bearing streams from the feed conversion, and feed preparation. The MgF_2 solid-waste streams associated with uranium recovery are from the feed conversion processes. This waste stream is the MgF_2 slag discharged from the dry uranium recovery fluorination reactors.

The expected quantity of the non-classified MgF_2 from feed conversion, via uranium recovery, which requires disposal is approximately 3036 MTY.

The feed preparation casting slag contains some percentage of special, uranium alloy material processed concurrently with a separate fluorination train. This stream contains about 249 metric tons of classified materials and will require classified disposal to keep this material secured.

The wet uranium recovery operations, planned to be provided in the reactivated facility in Building K-1420, will produce liquid wastes containing a high concentration of nitrates. Generation of these liquid wastes is estimated to be approximately 65,000 gal/yr, with the main constituent nitric acids, and other nitrates, and dissolved metals from solvent extraction processes used in wet uranium recovery.

Uranium Processing Support Operation Wastes. Uranium processing support operations include fluorine generation and KF conversion.

Fluorine is commonly generated by electrolysis in the chemical industry. The feed to the electrolytic cells is HF, forming an anhydrous fused

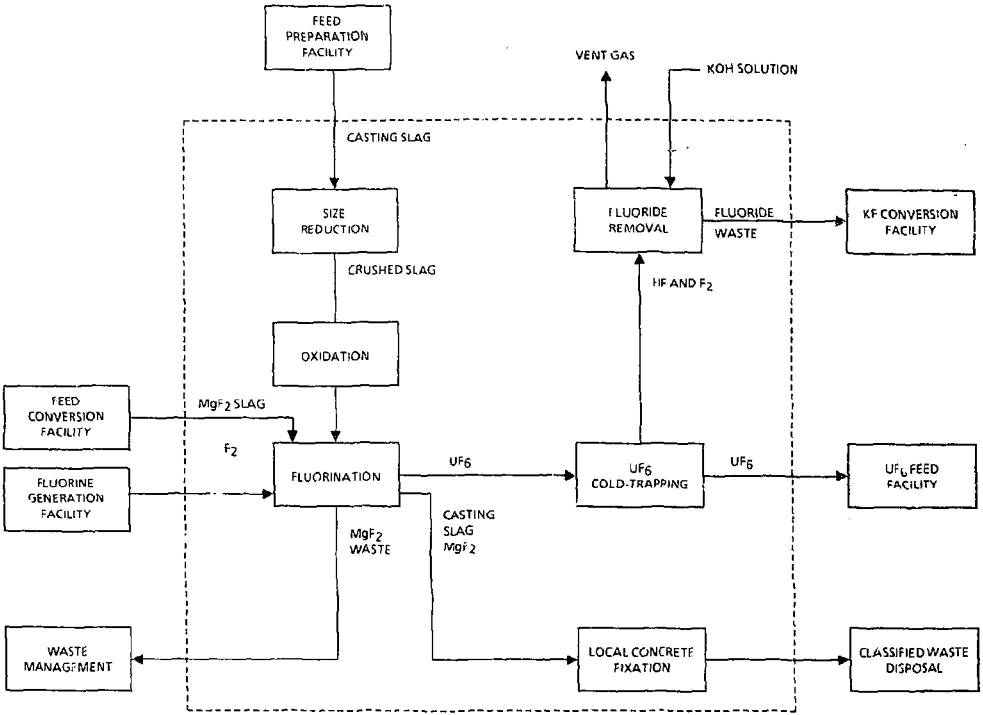

Fig. 3-5. Uranium recovery flow sheet.

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electrolyte (KF.2HF) in the cell. When direct current is passed through the electrolyte, the HF dissociates and fluorine is collected around the anode in a separate compartment. Meanwhile, hydrogen collects around the cathode above the surface of the electrolyte. The gases are piped off and the electrolyte is continuously replenished in HF.

The Fluorine Generation operation will generate approximately 17 MTY of KF.2HF electrolytic sludge in the electrolysis cells. Other wastes are HF, F^2 and H_2 gases which will be treated by a KOH packed column and hydrogen burner. Approximately 75 MTY of KF and 60 MTY of KOH secondary liquid wastes from this packed column will need to be processed.

All waste gas streams containing HF are taken through scrubbers where diluted KOH interacts with the HF, producing KF in a diluted form dissolved in the scrubber effluent.

The KF solutions are received in a surge tank from which it is pumped into the KF conversion tank. Here lime is added in a measured quantity to the KF solution. The ensuing chemical reaction will yield KOH and CaF_2. Calcium fluoride is insoluble in water and will precipitate out. The precipitate is filtered out in the CaF_2 filter and then dried in an electrically heated dryer. The dry CaF_2 powder will be the only waste stream produced from the process. The KF conversion process, which is used to recycle KOH to the packed columns, will generate a solid powder CaF_2 waste stream. The expected generation of this waste will be 700 MTY if excess HF is processed as a waste material. If excess HF is collected for resale, the estimated generation of CaF_2 will be 175 MTY.

3.1.4. Plant Support Facilities Waste (WBS 1.4)

Various conventional waste streams which will require management will be generated by plant support facilities operations. This will include such streams as the graphite shop wastes, decommissioning and decontamination wastes. Table 3-6 summarizes these plant support wastes, their origin, nature and expected generation rates.

3.2 WASTE CLASSIFICATION

3.2.1. Waste Categories

In general, the specific regulatory requirements, as well as the treatment and disposition for various waste streams, are related to their physical form and characteristics. For planning purposes, the various AVLIS waste streams can be classified into waste categories in accordance with their physical and chemical characteristics. The management of various types of waste can be conveniently addressed in a more generic manner through the use of these waste categories, as opposed to addressing the treatment schemes to specific individual waste streams.

The waste categories are established based on the general type, hazardous nature, and physical properties of the wastes. They can be grouped under four levels:

Level 1 - Waste stream type.
Level 2 - Radiological properties.
Level 3 - Hazardous properties.
Level 4 - Physical properties.

Level 1 defines the general waste type of a given stream. The three primary categories of waste streams under level 1 are the gaseous, liquid, and solid classifications.

Gaseous wastes include those streams whose primary constituent is in the gaseous phase. These gases may contain purely gases, suspended solids, airborne liquid vapors or any combination of these materials.

Liquid waste streams will mainly consist of liquid solutions, though they may contain suspended solids and/or dissolved solids and gases. Liquid waste streams will also include slurries (greater than 0.1 weight percent of insoluble solids).

Table 3-6. Facility support operations wastes.

Waste type	Waste form	Origin	Uruanium contaminated	Estimated quantity
Refuse (operations)	Paper, plastics, wood	Housekeeping	Yes (10% of total volume)[a]	365 MTY
Decommissioned equipment	Pumps, motors piping, process components	Facility wide	No	5000 CFY
Graphite	Carbon	Graphite shop	No	280 Kg/Yr

[a] Contains small amounts of slightly enriched uranium (<5 w/o assay).

Solid waste streams will consist primarily of dry, solid materials, though some liquid-bearing materials will be classified as a "wet" solid material. These latter wastes would be solids that contain residual traces of liquids, as well as some dewatered sludges.

Level 2 defines the radiological properties of the waste stream. The secondary categories of wastes are radiological and non-radiological wastes. This refers to whether or not the waste stream is uranium bearing. Radiological wastes can be further categorized as containing either enriched uranium concentrations (>0.711 w/o U235), or natural or depleted uranium concentrations (≤0.711 w/o U235).

Level 3 defines the hazardous nature of waste streams. This waste category involves determining whether the stream contains any material that is considered hazardous by the Environmental Protection Agency. The formal procedures established by 40 CFR part 261, for the identification of hazardous waste materials, is used in determining when waste streams fall under this level of classification. This level is subdivided into those streams that are not Environmental Protection Agency-hazardous, those that are Environmental Protection Agency-hazardous, and those that are potentially Environmental Protection Agency hazardous, (pending an evaluation of whether they would be considered as such by the Environmental Protection Agency).

Level 4 describes the physical nature of the waste stream materials. The categories that fall under the fourth level include:

Combustibles	-	Material readily burned or chemically oxidized.
Suspended Solids in Fluid	-	Includes particulates in gases and insolubles in liquids.
Liquid Solutions	-	Includes mixtures of liquids and/or dissolved solids in liquid solution.
Compactible	-	Dry, bulk materials readily compressed to reduce their volume.
Dry powder	-	Granular, dry materials generally loose and/or friable.
Slag	-	Cinderlike, bulk material; not readily crumbled.
Vapor	-	Gaseous material containing mixture of gaseous and/or liquid vapors.
Wet solids	-	Materials containing slight amounts of free liquids (<1.0 w/o), e.g., "dewatered" sludges and slurries, filter cartridges.

Figure 3-6 presents the waste categories that are used to describe all AVLIS waste streams.

3.2.2. Waste Streams Classification

Each waste stream characterized in Section 4.1 is assigned with a waste classification notation which describes each of the properties of the waste stream. The notation format is a four letter code. Each code letter represents one of the subdivisions within the four levels of waste categories described in Figure 3-6.

A "GDHV" waste stream would be the classification for a fluorination process offgas containing excess HF (hazardous material) and some quantity of natural enrichment uranium-bearing vapors.

The first field identifies this classification as a gaseous waste stream. The second field identifies it as a radiological waste, containing non-enriched uranium. The third field identifies it as an Environmental Protection Agency hazardous stream (due to the presence of HF and F_2). The fourth field identifies this stream as a gaseous vapor bearing waste.

Based on the information expressed by these notations, appropriate waste management requirements can be identified and treatment/disposal methods can be planned.

3.2.3. Classification of AVLIS Production Plant Waste Streams

Based on the classification system discussed above in Sections 3.2.1, and 3.2.2, the AVLIS Production Plant waste streams were assigned a waste classification notation to aid in the subsequent discussions for management of these wastes. These classifications are summarized in Table 3-7.

Level 1	Level 2	Level 3	Level 4
Waste Stream Type	Radiological Properties	Hazardous Properties	Physical Properties

Level 1 — Waste Stream Type

- G – GASEOUS
- L – LIQUID
- S – SOLID

Level 2 — Radiological Properties

- D – NATURAL OR DEPLETED URANIUM BEARING (≤0.711 W/O ASSAY)
- E – ENRICHED URANIUM BEARING (>0.711 W/O ASSAY)
- N – NON-RADIOLOGICAL

Level 3 — Hazardous Properties

- H – EPA HAZARDOUS
- N – NON-EPA HAZARDOUS
- P – POTENTIALLY EPA-HAZARDOUS (UNDER ASSESSMENT)

Level 4 — Physical Properties

- C – COMBUSTIBLE
- F – SUSPENDED SOLIDS IN FLUID
- L – AQUEOUS SOLUTION
- M – COMPACTABLE
- P – DRY POWDER
- S – SLAG
- V – VAPOR
- W – WET SOLIDS

Waste Classification Designation Example

G D H V

LEVEL 1 → G
LEVEL 2 → D
LEVEL 3 → H
LEVEL 4 → V

Stream Designation for a gaseous, vapor natural uranium assay radwaste stream containing an EPA listed hazardous material e.g., excess HF stream from the Feed Conversion Fluorination Process in U-Processing Operations

Fig. 3-6. AVLIS waste classification system waste categories.

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Table 3-7. AVLIS Production Plant waste stream classification.

Waste stream	Originating operation/system (AVLIS WBS number)[a]	Classification[b]
Uranium processing - feed operations		
Activated carbon trap material	U-processing; feed conversion, offgas treatment (1.3.1.5)	SDPC
KOH packed column liquid waste from HF removal	Same as above	LNNL
Excess HF	Same as above	LDHL
High-efficiency particulate air and pre-filters	Same as above	SONC
Excess MgF_2 slag from feed conversion	U-processing; feed conversion Slag Processing (1.3.1.4)	SDPS
Melting/casting slag from alloy preparation	U-Processing; feed preparation (1.3.2.3)	SDPS[c]
Scrap graphite crucibles	U-Processing; feed preparation (1.3.2.2)	SONC[c]
Laser isotope separation operations		
Spent laser dye solution	AVLIS enrichment process, lasers (1.2.1.2)	LNHC
Vacuum pump oil	AVLIS enrichment process,	LNNC
Spent dye cleanup filters	AVLIS laser dye system (1.2.1.2)	SNPW
Spent dye cleanup resins	Same as above	SNPW
Dye cleanup demineralizer backflush	Same as above	LENF
Freon decon. sludge	Laser refurbishment (1.2.1.5)	SNPW
Metal sludge	CL cleaning (1.2.1.5)	SNPW
Spent coatings and mixed oxides from spent blast cleanup	Separator refurbishment (1.2.2.4)	SENP[c]

Table 3-7. (Continued)

Waste stream	Originating operation/system (AVLIS WBS number)[a]	Classification[b]
Separator graphite	Same as above	SENC[c]
High-efficiency particulate air and pre-filters SENC		Same as above
Contaminated water	Separator/refurb. (1.2.2.4) Blowdown (startup testing only)	LENF
<u>Uranium processing - product conversion operations</u>		
Offgas from oxidation vibrating tray kiln	U-processing; product conversion, oxidation step (1.3.3.2)	GENF
MgF_2 solid waste from fluorination reactors	U-processing; product conversion, fluorination step (1.3.3.3)	SEPS[c]
Excess HF	Same as above, HF recovery	GEHV
Solid waste from NaF chemical trap	U-processing; product conversion, offgas treatment (1.3.3.4)	SEPW
KOH packed column liquid waste	Same as above	LEPL
High-efficiency particulate air and pre-filters SENC		Same as above
Solid waste from distillation	U-Processing; Product Conversion, UF_6 Distillation (1.3.3.4)	SENW[c]
<u>Uranium processing - recovery operations</u>		
MgF_2 solid waste to disposal	U-processing; uranium recovery, fluorination (1.3.3.3)	SDPS
MgF_2 solid waste (classified)	Same as above, melting casting slag	SPDS[c]
NaF waste	U-Processing; uranium recovery; offgas treatment (1.3.4.4)	SEPW

Table 3-7. (Continued)

Waste stream	Originating operation/system (AVLIS WBS number)[a]	Classification[b]
KOH packed column liquid waste	same as above	LEPL
High-efficiency particulate air and pre-filters SENC		same as above
<u>Uranium processing - support operations</u>		
Aqueous nitrates	Wet uranium recovery (1 3.6.2)	LENL
KF.2HF electrolyte sludge	fluorine generation (1.3.5.3)	SNHW
KOH packed column liquid waste	Fluorine generation, offgas treatment (1.3.5.3)	LNPL
CaF_2 powder	KF conversion (1.3.5.5)	SNPP
Ammonia removed filters regeneration	Ammonia dissociation	LNNL
Decontamination solutions	K-1420 decontamination (1.3.6.2)	LENF
Trash/refuse (operations)	Housekeeping (1.4.4)	SNNC/M SDNC/M SENC/M
Decommissioned equipment	Facility wide (1.0)	SNNC/M[c] SDNC/M[c] SENC/M[c]
Sludges from waste treatment and sewage	Water sewage plants (1.0)	SNNW
Contaminated water (100 ppm sodium chromate)	HX facility (1.1.4.10)	LNNF
Cooling tower blowdown	Cooling towers (1.4.4.6)	LNNF
Sanitary effluent	Facility wide (1.4.4)	LNNF
Storm drains	Facility wide (1.4.4)	LNNF

[a] See Fig. 3-1.

[b] See Fig. 3-6.

[c] Contains classified materials.

4. WASTE MANAGEMENT DESIGN CRITERIA

4.1. GENERAL OVERVIEW

This section provides the regulatory and technical design criteria used for the development of AVLIS Production Plant waste management strategy such that standards, performance requirements, and facility design objectives are properly accounted for in the overall waste-management planning.

The following sections address the specific overall management requirements set forth in governmental regulations and management system design requirements that are applicable to each of the waste stream classifications.

4.2. GASEOUS WASTES MANAGEMENT DESIGN CRITERIA

4.2.1. Applicable Federal and State Regulations

For the AVLIS Production Plant gaseous wastes streams that are classified as radiological materials, the Federal regulations that apply to the health and safety aspects of handling these radioactive materials are those promulgated by the DOE. This self-regulation of AVLIS Production Plant, a DOE-owned, contractor-operated facility, derives primarily from Section 110(a) of the Atomic Energy Act of 1954 as amended (40 USC 2011 et seq.), wherein these facilities are excluded from licensing and other regulatory functions of the U.S. Nuclear Regulatory Commission. This exclusion also applies to the Nuclear Regulatory Commission "agreement states" that have derived authority from Nuclear Regulatory Commission to carry out certain regulatory functions.

In the development of design criteria for AVLIS Production Plant waste-management planning, the regulatory requirements of the DOE will be considered the primary criteria. However, applicable regulations at the United States Nuclear Regulatory Commission and the State of Tennessee Department of Health were also taken under consideration. In order to provide as low as reasonably achievable practices for waste management, the DOE design requirements will be used in the development of the AVLIS Production Plant Waste Management gaseous waste management design criteria with the intent of other agency regulations given due consideration.

Those Federal and State regulatory documents which are pertinent to the AVLIS Production Plant radiological gaseous waste management are listed below:

- DOE Order 5480.2, Hazardous and Radioactive Mixed Waste Management.
- DOE Order 5820.2, Radioactive Waste Management.
- 10 CFR 20 "Standards for Protection Against Radiation", U.S. Nuclear Regulatory Commission.

In addition to radiological constituents, those AVLIS Production Plant gaseous waste streams classified as containing hazardous materials (GOH, CEH) will be subject to the following Federal and State regulations:

- Clean Air Act Amendments of 1977, Public Law 95 95, 91 Stat. 685, 42 U.S.C. 7401.
- U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards", Federal Register 36(84):8186-8201(1971).
- Tennessee Air Pollution Control Regulations, Department of Public Health, Division of Air Pollution, Nashville, Tenn., December 1972, Chapter 1200-3-3.

4.2.2. Plant Discharge Limits

Gaseous waste that contains uranium material, either natural, enriched or depleted assay, is a radiological stream and is thus addressed by DOE order 5820.2 and DOE order 5480.1A. These streams will be managed to support the AVLIS Production Plant as low as reasonably achievable design objectives. The exposure of the general public to these materials is maintained below 10% of the maximum permissible airborne concentrations (MPCs), as specified by DOE 5480.1A Attachment XI-1, and 10 CFR Part 20, Appendix B. Where these tables have conflicting values, the most conservative limits are used.

The values of interest for the AVLIS Production Plant are the limiting concentrations for the two uranium nuclides present in the AVLIS Production Plant waste streams: U-238 and U-235. Their MPCs values are summarized in Table 4-1, which also includes Note 1, describing how MPC values are determined for mixtures of the two nuclides. This method will be used in determining the design regulatory limits for the waste streams where the assay content is known. For cases where assay content is uncertain, a conservative value of 5 w/o assay will be used for enriched waste streams and 0.711 w/o assay for depleted/natural streams.

Gaseous discharges will be controlled so that the controlled area atmosphere does not contain greater than 0.2μg of uranium per cubic meter of air.

Concentrations of uranium in offsite gaseous effluents shall be limited so that the exposure to the general public from all gaseous waste contributions is kept below 10% of the maximum permissible airborne concentrations. Specifically, this value will be 0.7μg uranium per cubic meter of air at any off-site location.

The Environmental Protection Agency hazardous materials in the gaseous waste streams will also be managed such that concentrations in effluents are controlled so that all AVLIS Production Plant contributions to unrestricted areas are less than 10% of DOE, Environmental Protection Agency and State of Tennessee Department of Health limits. These limits are specified by the Environmental Protection Agency in the "National Primary and Secondary Ambient Air Quality Standards" and by the State of Tennessee in the identical "Air Pollution Control Regulations" specified by the Tennessee Department of Public Health, Division of Air Pollution Air Quality Act Chapter 1200-3-3. The State of Tennessee Standards for ambient air quality are summarized in Table 4-2. The primary hazardous pollutants of concern from AVLIS Production Plant operations are HF and F_2. The fluoride design value used is the Tennessee State limit of 2.9μg/m^3, averaged over a 24 hour period. To satisfy the AVLIS Production Plant design criteria, 10% of this value, i.e. 0.29μg/m^3, is used for the design of gaseous waste management systems for fluoride bearing waste streams. For the UF_6 waste streams, which contain

Table 4-1. Most conservative regulatory requirements for concentrations in air and water above natural background.

Isotope[9]		Table I		Table II	
		Col. 1-Air (uCi/M1)	Col. 2-Water (uCi/M1)	Col. 1 (uCi/M1)	Col. 2-Water (uCi/M1)
U 235	S[4]	5×10^{-10}	1×10^{-4}	2×10^{-11}	4×10^{-6}
	I	1×10^{-10}	8×10^{-4}	4×10^{-12}	3×10^{-5}
U 238	S[4]	7×10^{-10}	2×10^{-5}	3×10^{-12}	6×10^{-7}
	I	1×10^{-10}	1×10^{-3}	5×10^{-12}	5×10^{-5}

9 Soluble (S)
Insoluble (I)

NOTES:

Table I – Controlled Areas
Table II – Uncontrolled Areas

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

Example: If radionuclides A, B, and C are present in concentrations C_A, C_B and C_C, and if the applicable MPC's are MPC_A, MPC_B and MPC_C respectively, then the concentrations shall be limited so that the following relationship exists: $(C_A/MPC_A) + (C_B/MPC_B) + (C_C/MPC_C) \leq 1$.

Table 4-2. Tennessee air pollution rules.

Table 1

Tennessee ambient air quality standards for suspended particulates, sulfur dioxide, carbon monoxide, ozone, non-methane hydrocarbons, nitrogen dioxide, and lead.

Contaminants	Primary standard concentration (ug^3)	Primary standard concentration (ppm by vol)	Averaging interval	Secondary standard concentration (ug^3)	Secondary standard concentration (ppm by vol)	Averaging interval
Suspended	75	--	AGM[3]	60	--	AGM[8]
Particulates	260	--	24 hr	150	--	24 hr
Sulfur	80	0.03	AAm[4]	1,300	--	3 hr
Dioxide	365	0.14	24 hr		--	
Carbon	10,000	9.0	8 hr	10,000	9.0	8 hr
monoxide	40,000	35.0	1 hr	40,000	35.0	1 hr
Ozone[9]	235	0.12	1 hr	235	0.12	1 hr
Hydro-[7]	160	0.24	3 hr	160	0.24	3 hr
Carbons			6-9 a.m.			6-9 a.m.
(non-methane)						
Nitrogen	100	0.05	AAM	100	0.05	AAM
Dioxide						
Lead	1.5	--	Calendar	1.5	--	Calendar
			quarter			quarter.

Notes:

1. All values other than annual values are maximum concentrations not to be exceeded more than once per year.
2. PPM values are approximate only.
3. All concentrations relate to air at standard conditions of 25°C temperature and 760 millimeters of mercury pressure.
4. ug/m^3--micrograms per cubic meter.
5. AGM--Annual geometric mean.
6. AAM--Annual arithmetic mean.
7. These hydrocarbon values are to be used as a guide to achieve the oxidant standards.
8. This value of 60 for an AGM for particulate matter is a guide to be used in addressing implementation plant to achieve the 24-hr standard.

Table 4-2. (Continued)

9. The standard is attained when the expected number of days per calendar year with maximum hourly concentration above 0.12 ppm (235 ug/m^3) is equal to or less than 1 as determined be the Federal Register, Volume 44, No. 28, February 8, 1979, Part V, Appendix H.

Table 2

Tennessee ambient air quality standards for gaseous fluorides expressed as HF.

Primary standards			Secondary standards		
Concentration		Averaging	Concentration		Averaging
ug/m^3	ppb by vol.	interval	ug/m^3	ppm by vol.	interval
1.2	1.5	30 days	1.2	1.5	30 days
1.6	2.0	7 days	1.6	2.0	7 days
2.9	3.5	24 hr	2.9	3.5	24 hr
3.7	4.5	12 hr	3.7	4.5	12 hr

Notes:

1. All values are maximum not to be exceeded more than once per year.
2. Concentrations in micrograms per cubic meter (ug/m^3) are approximately only.
3. All conditions relate to air at standard conditions of 25°C temperature and 760 millimeters of mercury pressure.
4. All averaging intervals are consecutive time periods.

both radiological and hazardous waste components, the more restrictive concentration, i.e., the fluoride value of 0.29$\mu g/m^3$ is used as the design criterion.

4.2.3. Process Offgas Treatment Systems Design Criteria

Waste management systems which treat the offgas vented from AVLIS process equipment will be designed to provide sufficient treatment to satisfy the design objectives specified in Sections 2.1.3 and 4.2.1.

Guidance in determining the process offgas treatment systems design criteria is provided by the following, topically related documents:

- o ANSI/ASME Standard N509 "Nuclear Power Plant Air Cleaning Units and Components."
- o ANS/ANS 55.4 American National Standard "Gaseous Radioactive Waste Processing System for Light Water Reactors."
- o US Nuclear Regulatory Commission Standard Review Plan 11.3 "Gaseous Waste Management Systems."
- o US Nuclear Regulatory Commission Standard Review Plan 11.5, "Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems."
- o US Nuclear Regulatory Commission Regulatory Guide 1.140 "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants.
- o US Nuclear Regulatory Commission Regulatory Guide 3.13 "Guide for Acceptable Waste Storage Methods at UF_6 Production Plants."
- o US Nuclear Regulatory Commission Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures and Components in Light Water Reactors."

In addition to reducing the concentration of uranium and hazardous waste materials in the gaseous waste streams, to preclude the potential for explosion hazards, due to hydrogen/oxygen mixtures, these gas treatment systems shall maintain hydrogen and oxygen concentrations at less than 4 and 5% by volume, respectively, under all operating conditions.

These systems will be designed to allow full-capacity operation under all normal plant design parameters as well as having reserve capacity to function during anticipated off-normal conditions.

Adequate capacity will be provided to process gaseous waste during periods of excess waste generation. To meet these design requirements, shared systems, redundant equipment, and reserve storage capacity are to be considered in process offgas treatment system design.

System design will provide redundant components, as warranted, such that only one each of the support equipment components is required for normal operation. The additional components will be present in a "ready standby" status.

The need for redundancy will be based on the expected reliability of components, types of failure, effects of component failure, and economics of providing redundancy. If the component outage history indicates a component failure during operation, without sufficient warning to allow maintenance or replacement, then an economic evaluation should be made to determine if redundancy is justified to support the system availability.

These gaseous treatment systems will provide for filtration of particulates and hazardous materials from gases prior to release, using high-efficiency particulate air filters with a minimum efficiency of 99.97% for 0.3μm particulates and in accordance with ANSI/ASME N509 and Reg. Guide 1.140.

4.2.4. Controls and Instrumentation

Gaseous waste treatment systems will be designed with sufficient controls and instrumentation such that they can be started, operated, switched to use of spare components, and shut down from a central control room. However, systems may have local panels, as necessary, to facilitate operation and maintenance. Instrumentation show that the equipment is operating properly, and help determine equipment malfunctions.

4.2.5. Gaseous Effluent Monitoring

Gaseous discharges to the environment will be measured for their content of radioactive and hazardous materials (basically uranium and fluoride content). Design guidelines for these systems are provided in Regulatory Guide 1.21, Standard Review Plan 11.5, and ANSI/ANS Standard 55.4. Isokinetic sampling provisions will be made to assist in determining system performance and to monitor effluent concentrations.

4.2.6. Gaseous Waste Treatment Secondary Wastes

Provisions for collecting, handling, disposal, and replacement (as required) will be made for the management of secondary wastes generated in gaseous waste treatment systems. These wastes will be managed according to their characteristics and compositions and will be recycled or discarded, as appropriate.

4.3. LIQUID WASTE MANAGEMENT DESIGN CRITERIA

4.3.1. Applicable Federal and State Regulations

Similar to the regulatory requirements for gaseous wastes, the AVLIS radioactive liquid waste streams design criteria will satisfy the requirements of *DOE Order 5480.1A* and *10 CFR Part 20*. *In the case of uranium materials in* liquid wastes discharged to uncontrolled areas, limiting values are provided in 10 CFR Part 20, Appendix B, Table II, Column 2. (See Table 4-1) The AVLIS Production Plant design objective is to reduce uranium concentrations in liquid waste effluents to 10% or less of these concentrations in order to provide as low as reasonably achievable releases.

For the hazardous and/or regulated chemical pollutants in the liquid waste effluents, those Environmental Protection Agency regulatory requirements (as specified by the current National Pollutant Discharge Elimination System permit issued for the Oak Ridge Gaseous Diffusion Plant facility liquid effluents) will be the preliminary design criteria for management of similar

AVLIS Production Plant liquid wastes. As necessary, the Tennessee Department of Public Health Water quality standards will be used to supplement the National Discharge Elimination System limits. The most restrictive of these regulations will be used in planning for the AVLIS design.

4.3.2. Plant Discharge Limits

The concentrations of pollutants discharged from the facility will be limited to 10% of regulatory values. As discussed in 4.3.1, the uranium discharged limits are summarized in Table 4-1. Two typical K-25 pollutant discharge points limits are, based upon the National Pollutant Discharge Elimination requirements for the existing Oak Ridge Gaseous Diffusion Plant, summarized in Tables 4-3 and 4-4.

The values provided in these two tables are for only two of several Oak Ridge Gaseous Diffusion Plant-specific liquid effluent discharge locations. Since the actual regulatory limits, pertinent to each of the AVLIS Production Plant liquid waste discharge points, will need to be provided in the development of the AVLIS Production Plant-specific National Pollutant Discharge Elimination permit, the typical limits that apply to the existing Oak Ridge Gaseous Diffusion Plant facility are used as guidelines only. The design limits for AVLIS Production Plant liquid waste management will use the representative numbers provided here as the preliminary design basis for treatment of liquid waste streams. These design limits will be assessed, once the exact nature of the AVLIS Production Plant liquid wastes requiring treatment is finalized, prior to the application to the Environmental Protection Agency for the AVLIS Production Plant National Pollutant Discharge Elimination permit.

4.3.3. Process and Disposal Systems Design Criteria

Liquid waste treatment systems shall be designed such that they satisfy the design release limits and provide as low as reasonable releases. There are many equipment combinations which can meet these performance objectives. As specified in the facility waste management performance objectives, active

Table 4-3. Pertinent water quality data for the K-1700 pond effluent (1984) operation). Data for the current (1978) operation, if different from 1984, are shown in parentheses.

	Average background concentration (mg/liter)[a]	Average concentration in discharge (mg/liter)	Maximum monthly concentration in discharge (mg/liter)	Applicable standard or guideline (mg/liter)
(pH	8.0	6.6–7.8 (6.0–9.0)	7.8 (9.0)	6.0–9.0[b])
COD	6.8	22	32	
Aluminum	0.75	0.5	1.0	1.0[b]
Arsenic	<0.01[c]	<0.01	<0.01	1.0[d]
Cadmium	<0.005	<0.005	<0.005	0.01[d]
Chromium (total)	0.005	0.02 (0.03)	0.04 (0.05)	0.05[b]
Copper	0.015	0.02 (0.04)	0.09	1.0[d]
Cyanide	0.001	0.004	0.007	0.03[d]
Fluoride	<0.10	0.91	1.3	20.0[d]
Lead	0.02	0.02	0.04	0.1[d]
Manganese	0.04	0.19	0.32	10.0[d]
Mercury	<0.0009	0.002	0.004	0.005[d]
Nickel	0.009	0.28	1.86	3.0[d]
Nitrate	3.7	10 (49)	15 (88)	90.0[b]
Sulfate	37.5	140	500	1400.0[d]
Zinc	0.03	0.14	1.2	2.0[d]
Suspended solids	10.1[e]	19[e]	56[e]	30.0[b,e]
Dissolved solids	187.3	420 (600)	790 (900)	
Dissolved oxygen	7.5–13.0	7–11	11	
Betz Polynodic 562[f]		7.1	10	
Betz 35A[f]		1.8	2.5	

[a]Background concentrations are determined from samples collected in 1977 from the Clinch River above ORGDP.
[b]Current National Pollutant Discharge Elimination System (NPDES) permit limit for the K-1700 pond effluent.
[c]The symbol "<" indicates that concentrations are below detectable limits, which are listed.
[d]Tennessee Department of Public Health, *Guidelines for Effluent Criteria for Sewage and Industrial Wastewater*, 1973.
[e]NPDES limits and reported data are for times of no precipitation only.
[f]Industrial corrosion inhibitors.

Table 4-4. Oak Ridge Gaseous Diffusion Plant representative sewage plant National Pollution Discharge Elimination System discharge limits.

Pertinent water quality data for the large (K-1203) Oak Ridge Gaseous Diffusion Plant sewage treatment facility (1984 operation)[a]

	Average monthly concentration (mg/liter)	Applicable EPA standards[b] (mg/liter)
BOD_5	5–10	15
Suspended solids	5–15	30
Ammonia nitrogen	0.4	5
Dissolved oxygen	≥ 5.0	≥ 5.0
Clorine residual	0.5–2.0	0.5–2.0
Total phosphorus	0.90	
Potassium	2.8	
Nitrates	3.8	
Dissolved solids	190	
(Flow, gpm	420)	
(pH	6.8–8.0	6.0–9.0)

[a]Data for current (1978) operation are essentially the same as shown here for 1984, except for BOD_5, which is 5–15 mg/liter.

[b]Current NPDES limits for the K-1203 effluent, monthly average.

treatment methods will be pursued to meet design objectives, rather than relying on passive methods such as dilution. Liquid wastes can be treated such that non-contaminated effluent streams will be released to the environment.

Non-contaminated liquid wastes (i.e., no regulated pollutant contents) will be directly discharged to the environment. Guidance for liquid waste system design criteria is provided in the following, topically related documents:

- o ANSI/ANS 55.6 American National Standard "Liquid Radioactive Waste Processing System for Light Water Reactors."
- o US Nuclear Regulatory Commission Standard Review Plan 11.2, "Liquid Waste Management Systems."
- o US Nuclear Regulatory Commission Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light Water Reactors."
- o US Nuclear Regulatory Commission Standard Review Plan 11.5" Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems."

Similarly to the design criteria for gaseous waste treatment systems, the liquid waste management systems will be designed to allow full capacity operation under all normal plan design conditions, as well as having reserve capacity to function under anticipated off-normal conditions. An assessment for providing redundant components, as discussed in Section 4.2.2, will be made for each of the waste treatment systems selected to process AVLIS Production Plant liquid wastes.

Those concentrated secondary wastes that result from liquid waste treatment (e.g., spent re ins, sludges, spent filters) will be considered to be wet solid wastes. These wastes will be treated in accordance with waste design criteria and performance objectives for solid waste streams.

4.3.4. Liquid Effluent Monitoring

Liquid effluents discharged from the facility will be monitored to determine the effectiveness of liquid waste treatment and to ensure regulatory requirements are satisfied. Sampling stations will be provided at each of the liquid discharge points to determine the concentrations of hazardous and radiological materials. Design guidelines for these systems are provided in Regulatory Guide 1.21, Standard Review Plan 11.5 and ANSI/ANS Standard 55.6.

4.4. SOLID WASTE MANAGEMENT DESIGN CRITERIA

4.4.1. Radiological Solid Wastes

4.4.1.1. Applicable Federal and State Regulations. The management of the radiological (uranium bearing), classifications "SDN", "SDP", "SEP", and "SEN", (see Fig. 3-1) solid wastes generated by the AVLIS Production Plant facility will be self-regulated by the DOE under the DOE order 5480.1A, "Requirements for Radiation Protection", DOE Order 5480.2 "Hazardous and Radioactive Mixed Waste Management and DOE order 5820.2, "Radioactive Waste Management". These regulations specify the allowable radionuclide concentrations in the environment and discuss considerations for waste form acceptance and disposal criteria at a DOE waste disposal facility. Solid waste treatment and disposal will satisfy the requirements for these final waste forms, such that they will be acceptable at a DOE managed waste disposal site. Handling and transport of these wastes will be in compliance with the Department of Transportation regulations specified in 49 CFR Parts 170-189.

The solid waste form requirements will be supplemented with the design criteria specified in 10 CFR Part 61, Section 61.56, and the performance objectives of the AVLIS Production Plant Waste Management Plan. These additional requirements are provided in order to satisfy the overall performance objectives for AVLIS Production Plant solid waste management.

4.4.1.2. Radiological Wastes Treatment and Disposal. Those waste streams containing uranium bearing material will be processed for the recovery of enriched uranium materials and will be subjected to general decontamination methods in order to reduce the quantities, of radioactive wastes requiring disposal, to as low as reasonably achievable levels. Treatment and packaging of solid radiological waste materials will provide controls to maintain non-critical configurations of fissile uranium materials.

The final waste form for uranium contaminated material will be fixed in a binder material to produce a homogeneous, free-standing matrix with no encapsulated liquids. Waste forms (which include any waste containers) will satisfy the design criteria for DOE operated low-level waste disposal sites. These criteria are specified in DOE Order 5820.2 "Radioactive Waste Management" and will meet the intent of 10 CFR Part 61.

Guidelines for radiological solid waste treatment and disposal design criteria are provided in the following, topically related documents:

- DOE Order 5480.2 "Hazardous and Radioactive Mixed Waste Management."
- DOE Order 5820.2 "Radioactive Waste Management."
- U.S. Nuclear Regulatory Commission Branch Technical Position ETSB 11-3, "Design Guidance for Solid Radioactive Waste Management Systems Installed in Light Water Reactors."
- ANSI/ANS Standard 55.1 "Solid Radioactive Waste Processing Systems for Light Water Reactors."
- U.S. Nuclear Regulatory Commission Standard Review Plan 11.4 "Solid Waste Management Systems."

Design of waste treatment systems must provide a final waste form acceptable for disposal at a DOE managed disposal facility. These facilities are conservatively anticipated to be shallow land burial sites with engineered waste barrier features to prevent migration of waste constituents. Hence, the requirement for the solidification (fixation) of radiological and/or hazardous materials addresses the need to immobilize these materials. Design criteria for the AVLIS final waste forms (e.g., leachability, compression strength, resistance to biodegradation) will address the requirements presented in 10 CFR Part 61 for final solidified forms.

4.4.1.3. Solid Radiological Wastes Accountability. Solid radiological waste streams will be assayed to determine the content of uranium materials. These waste streams will be included in the AVLIS Production Plant special nuclear material accountability program.

4.4.2. Non-radiological Solid Wastes

Non-radiological solid waste will include conventional solid wastes and those containing Environmental Protection Agency hazardous materials. Conventional waste streams will include municipal type materials such as trash, refuge and non-hazardous, non-regulated substances. Environmental Protection Agency-hazardous wastes will be those so determined by the procedure provided in 40 CFR Part 261, "Identification and Listing of Hazardous Wastes."

4.4.2.1. Applicable Federal and State Regulations. Regulatory Standards for hazardous waste streams are provided in 40 CFR, Parts 260 through 267. Alternate management of the solid waste material containing hazardous materials will be addressed by either limiting these quantities of hazardous materials requiring disposal (through recovery of materials) or by "delisting" procedures to remove them from the Environmental Protection Agency-Hazardous Materials List.

4.4.2.2. Non-radiological Solid Waste Treatment and Disposal. Non-uranium contaminated wastes, classifications "SNP" and "SNN", will be managed in accordance with whether or not they contain Environmental Protection Agency hazardous wastes. Those solid waste streams which contain Environmental Protection Agency hazardous wastes will be managed to satisfy the design requirements of 40 CFR Part 260, which provides the disposal requirements for solid hazardous wastes. In order to ensure the stability of these hazardous wastes, their final waste form will be a packaged solidified matrix with no freestanding liquids.

Transport of hazardous wastes will follow the guidelines provided by 40 CFR Part 263, "Standards Applicable to Transporters of Hazardous Waste."

Disposal of solid, hazardous waste materials will be by Environmental Protection Agency accepted practices. Environmentally acceptable practices include controlled incineration, secured landfills, recovery, and lined surface impoundments. Design criteria for these methods will meet those specified in 10 CFR 40 Part 264 "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities."

For those non-radiological, non Environmental Protection Agency-hazardous wastes (Classification "SNN"), conventional waste treatment and disposal methods will be used for their management. By conventional, the design criteria refers to techniques commonly employed for the management of municipal and industrial type wastes, (e.g., incineration, sanitary landfill).

Classified materials and process components will be handled separately from non-sensitive waste streams. Provisions for accountability and secured disposition of these materials will be provided in their management.

In the event that the alloy feed material composition is declassified by the time the AVLIS Production Plant becomes operational, these uranium contaminated streams will be managed similarly to the naturally enriched uranium contaminated waste streams. This declassification will have minimal impact on the design and costs associated with the waste management operations.

5. WASTE MANAGEMENT PLAN DESCRIPTION

5.1. INTRODUCTION

Based on the AVLIS Production Plant waste management performance objectives described in Section 2, the waste stream characterizations developed in Section 3, and the waste management criteria assessed in Section 4, the overall AVLIS Production Plant waste-management planning is described in this final section.

A discussion of available waste treatment and disposal approaches for each waste classification is first presented followed by a survey of technologies and methodologies.

A matrix is then presented, indicating the AVLIS Production Plant waste management approach planned for each specific waste stream. Here, the treatment and disposal approach is detailed for each of the initially identified facility waste streams.

5.2. WASTE MANAGEMENT PROCESSES

5.2.1. Gaseous Waste Streams

5.2.1.1. Treatment Processes. Gaseous waste streams from AVLIS Production Plant operations originate as process offgases and from ventilation pathways. These gaseous waste streams, containing uranium-contaminated materials and fluoride compounds as the main pollutants, may be treated by various gaseous waste processing systems.

The three general AVLIS Production Plant gaseous-waste-class types identified were: 1) GDH, which is gaseous waste containing natural or depleted assay uranium and Environmental Protection Agency hazardous material(s); 2) GEH, which is gaseous waste containing enriched assay uranium and Environmental Protection Agency hazardous material(s); and 3) GEN, which is gaseous waste containing enriched assay uranium and no Environmental Protection Agency hazardous material(s).

The choice of treatment equipment for removal of airborne particulates is dependent on the physical composition of the waste feed. The methods available to maintain as low as reasonably achievable emissions from the facility vary with the particular waste class. For example, gaseous streams containing uranium particulates classes "GDHF", "GEHF", and "GENF" may be treated through mechanical processing components such as cyclones and filtration systems in order to physically separate the airborne solids from the gaseous stream. Additional examples of these types of systems would include bag filters, electrostatic precipitators, bed filters, pre-filters, and high-efficiency particulate air filters.

The various characteristics of the different types of gas/solid separators was investigated in the survey for appropriate treatment methods. Dynamic gas/solid separators include settling chambers and cyclone separators. They are generally used as primary filters in a variety of applications because they are simple in design, and they effectively remove particulates from offgas (93% by weight efficient for 20- to 30- μm particles). Dynamic separators such as settling chambers utilize gravitational forces to collect particulates after the gas impacts a baffle. Cyclone separators utilize inertial forces to separate particulates from the gas.

Process filtration systems considered are types commonly used in high temperature applications. Examples of these types are ceramic filters and sintered metal filters. These types of filters are generally considered to have high operating costs due to the maintenance/replacement associated with potential clogging and cracking due to thermal cycling.

Bag filters are used extensively for dry offgas cleanup applications for a large number of industrial applications. Flue gas enters a housing which contains numerous fabric bag filters. The gas passes axially through the fabric bag and upward, thus depositing particulate on the bag. The fabric is generally impregnated with a heat-resistant mineral so that it can withstand offgas operating temperatures. Particulate is removed by shaking the bags or by an air blowback system. Some applications have utilized various types of filter media to precoat bagfilters to improve efficiency. Problems with bag filters have been found when the flue gas is below its dew point. Moisture buildup on the fabric can decrease the efficiency of the filter when the operating temperatures are not high enough to prevent condensation. High tar and soot buildup on bag filters could cause pinhole leaks to form which would also decrease filter efficiency. Bag filters may also become brittle due to temperature cycling or become worn due to physical erosion.

Electrostatic precipitators generally have a 20 to 80 kVDC source to charge electrically a collection element which attracts charged particles in the offgas. These filters have good efficiency for particles as small as 0.01μm, but are costly to operate for small applications such as process offgas treatment. They also require a backup power source in case of primary power interruption and may be subject to eventual corrosion due to the large surface area of exposed metal parts.

Bed filters, such as fiberglass mats, are simple in design. The filtrous materials have low maintenance requirements, are inert to chemical attack, are fire resistant, have good heat transfer properties, and have a wide range of differential pressure. However, the amount of filter material that is used, and the amount that must be disposed of as radioactive waste, makes bed filters economically unattractive for process offgas treatment.

High-efficiency particulate air filters are routinely used as polishing filters in nuclear facility offgas treatment applications because of their low maintenance requirements, high-efficiency for particulates, and low cost. High-efficiency particulate air filters have been designed to have efficiencies of 99.97% for 0.3μm particles. High-efficiency particulate air filters make excellent final filters for process offgas treatment systems. They must be used in conjunction with other offgas components because most high-efficiency particulate air filter designs include filter media that cannot withstand high temperatures or high moisture content, and can become deteriorated by excessive organic vapors. Therefore, high-efficiency particulate air filters are used with offgas cooling and spark arrestors in dry offgas systems, and with condensers and reheaters in wet offgas systems.

Gaseous waste streams that contain gaseous uranium and hazardous waste compounds will be treated by chemical processing systems. These streams would include classes: GDHV, GEHV, and GENV. The chemical processing systems will use components that provide chemical reactions to adsorb radiological and hazardous waste material from the gaseous streams. Examples of these types of systems, which use wet methods for gas cleanup, would include impact scrubbers, high energy venturi scrubbers, and packed column scrubbers. Wet methods for offgas filtration such as scrub systems are widely used in industrial applications. In this concept, flue gases are mixed with atomized water droplets. The water droplets collect particulates and dissolved gases. Some scrubbers have an efficiency of 99% for one to two micron particles, and can absorb gases such as HF. The scrub solution can be recirculated to minimize the amount of clean water injected into the system. This is an important consideration in nuclear applications because, by cleaning the offgas, the scrub solution will absorb contamination from the gas and therefore must be handled as liquid radioactive waste stream.

This requirement affects the economics of the wet scrubber since the solution must be handled by a separate system for liquid radwaste, and/or be immobilized in an acceptable solidification agent prior to disposal. However, wet scrubbers offer other benefits to offset these additional costs. Caustic addition to wet scrubbers during recirculation is an effective method for acid gas (e.g., HF) neutralization. This helps prevent corrosion while removal of entrained particulates prevents erosion of the offgas equipment. In addition, wet scrubbers cool the offgas prior to discharge.

Chemical trap systems are also in wide use at uranium-enrichment facilities for recovery of uranium materials from process offgases. Examples of these systems would include sodium fluoride traps, alumina traps, or activated carbon traps.The NaF traps provide for the sorption of the UF_6 from the waste stream, and through proper valving and heating, the subsequent desorption of the UF_6, which is returned to the uranium-processing operations.

Another chemical trap, widely used at Oak Ridge Gaseous Diffusion Plant, is the alumina trap, employed to remove lower concentrations of uranium, such as those found in the waste streams from maintenance and development facilities. Unlike the sodium fluoride trap, the alumina trap provides for the irreversible sorption of uranium. Therefore, recovery of the uranium collected by these traps requires leaching with nitric acid; this operation is carried out in Building K-1420. Activated carbon material, used as a chemical trap, would perform similar to [illegible] material.

Figure 5-1 illustrates the possible treatment and disposal flow alternatives available for the initially identified AVLIS gaseous waste stream classes.

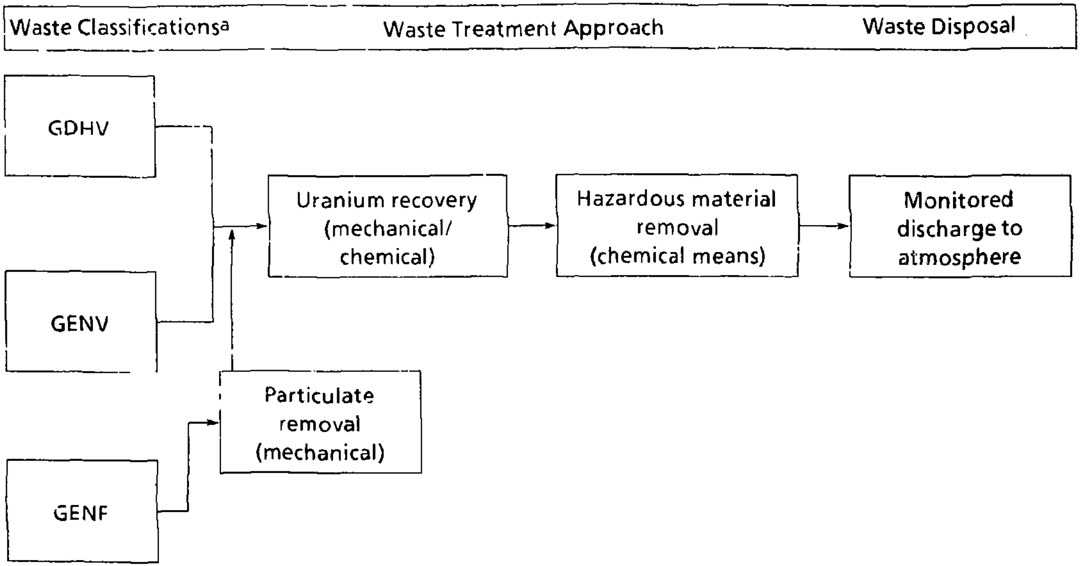
5.2.1.2. Disposal Processes. Gaseous waste streams will be provided with sufficient treatment such that gaseous effluents discharged from the facility will meet the waste-management-plan design and performance objectives. These objectives call for the gaseous waste contributions to the uncontrolled areas of off-site effluent streams to be equal to or less than 10% of regulatory maximum permissible concentrations. Thus, effluents will be treated to the point where they are not considered to need any further treatment before they are discharged. These discharges will be from common, monitored roof vents, which serve the process buildings. Credit for the dispersion and dilution provided by the elevated releases will be based on conservative models for gaseous release calculations.

Gaseous-waste treatment will, however, generate secondary wastes that will require treatment and disposal. These wastes will include spent filter material, spent chemical trap media, and spent solutions from chemical scrubber systems. The treatment and disposal methods for these waste streams will be included in the discussion of waste management processes for liquid and solid waste streams.

5.2.2. Liquid Waste Streams

5.2.2.1. Treatment Processes. Liquid waste streams from the AVLIS Production Plant operations originate from wet uranium recovery and decontamination operations in the Decontamination Facility, secondary liquid wastes from gaseous waste treatments, laser and separator refurbishment, and conventional wastes such as sanitary and water treatment wastes. Six general types of waste classes were identified for the AVLIS liquid waste streams:

- LDN - Liquid waste containing natural or depleted assay uranium and no Environmental Protection Agency hazardous material.



[a] See Fig. 3-1 for waste category definition.

Fig. 5-1. AVLIS gas[illegible] classes management methodologies.

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- o LEN - Liquid waste containing enriched uranium material and no Environmental Protection Agency hazardous material.
- o LEP - Liquid waste containing enriched uranium material and potentially Environmental Protection Agency hazardous material.
- o LNH - Liquid waste containing no radiological material and some Environmental Protection Agency hazardous material.
- o LNP - Liquid waste containing natural assay uranium and potentially Environmental Protection Agency hazardous material)
- o LNN - Liquid waste containing no radiological or Environmental Protection Agency hazardous materials.

Treatment methods for liquid wastes also fall into the two approaches of mechanical or chemical processing or some combination of these methods.

Mechanical processing could include filtration, settling (clarifying), reverse osmosis, or evaporation. Filtration is the process of passing a liquid stream through a porous medium or mass to filter out suspended matter. The types of filters are numerous, including those that are backflushable, non-backflushable, disposable, reusable, and precoat or non-precoat. Settling processes include the use of clarifier or thickener tanks to precipitate suspended solids or the use of settling ponds or lagoons to allow settling. Reverse osmosis treatment is used for the treatment of low-suspended-solid, liquid wastes by filtration through a semi-permeable membrane. Evaporation involves the boiling away of water from a liquid solution or slurry. Many types of evaporators are used in various industrial applications for concentration of materials suspended or dissolved in liquid streams.

Chemical treatment methods can include ion exchange (demineralization), incineration and biodegradation. Ion exchange involves the process of removing dissolved minerals and other ions from a solution by passage through an organic demineralizer resin bed. Demineralizers are used extensively to remove water impurities including chlorides, and metallic ions. Incineration of liquid wastes provides for combustion of flammable materials by complete oxidation of wastes in excess oxygen. Biodegradation processes use micro-organisms to break down waste products to less hazardous constituents.

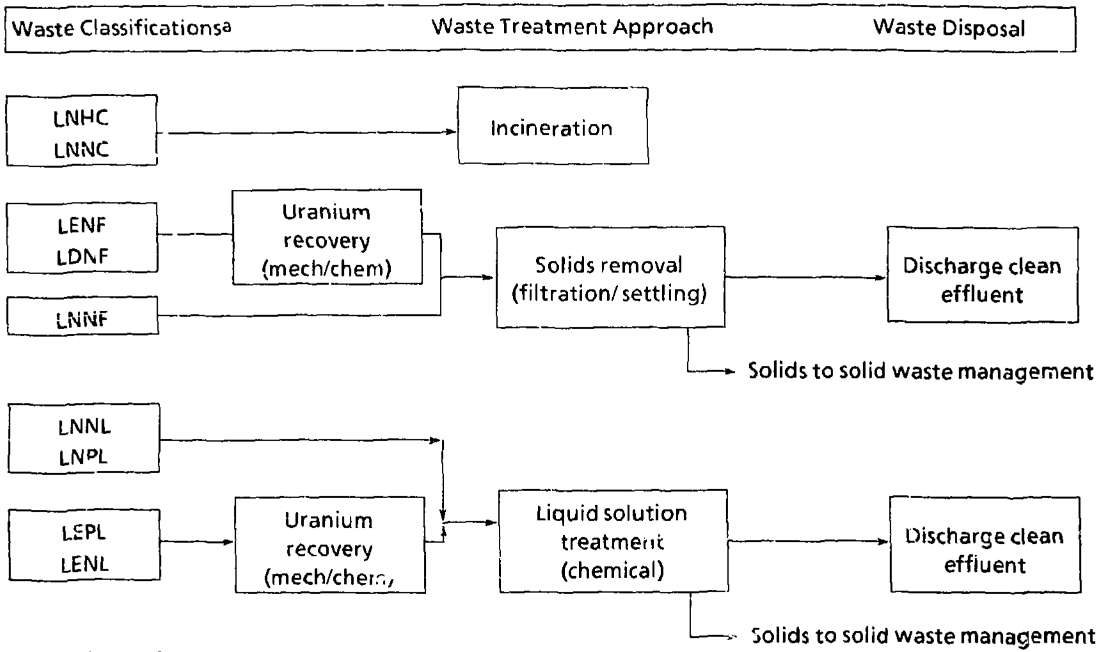
A combination of these mechanical and chemical methods would be the addition of flocculants to a liquid waste stream to promote precipitation. These methods were also assessed in determining the appropriate treatments for the AVLIS Production Plant specific waste-stream classes.

The management planning for these liquid waste streams will take into consideration the existing and/or planned liquid waste treatment facilities and systems on the Oak Ridge Gaseous Diffusion Plant site. These facilities include a planned central neutralization facility, which will provide centrifuges, neutralizer tanks, clarifier tanks and support equipment in order to process both non-contaminated and uranium/hazardous material contaminated liquid waste streams; a planned central incineration facility for the incineration of hazardous liquid and/or solid wastes; existing and planned liquid waste settling ponds; and the existing sewage and water treatment plants.

Also considered were the secondary waste streams that would be generated in these liquid waste treatments and their required waste management. These secondary streams will consist of such materials as spent filters, exhausted ion exchange resins, sludges and other wet-solid materials that will be managed as solid-waste streams.

A variety of treatment methods can be used to meet the facility design objectives. The treatment and disposal alternatives for processing liquid waste streams are shown on Fig. 5-2. This figure indicates various possible process combinations in order to assist in the planning of waste management for AVLIS liquid waste streams.

<u>5.2.2.2. Disposal Processes</u>. Once AVLIS Production Plant liquid waste streams have been treated to reduce the concentrations of pollutants to below design objective values, they will be discharged to the environment from a liquid discharge outfall. This outfall will be a monitored, controlled environmental discharge, such that effluent releases are measured to confirm regulatory compliance and the effectiveness of treatment methods. Sufficient treatment will be provided for liquid waste so that credit for dilution will



[a] See Fig. 3-1 for waste category definition.

Fig. 5-2. AVLIS liquid waste classes management methodologies.

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not be necessary to satisfy design objectives. Disposal of secondary solid wastes generated during liquid waste treatment will be discussed in the following section.

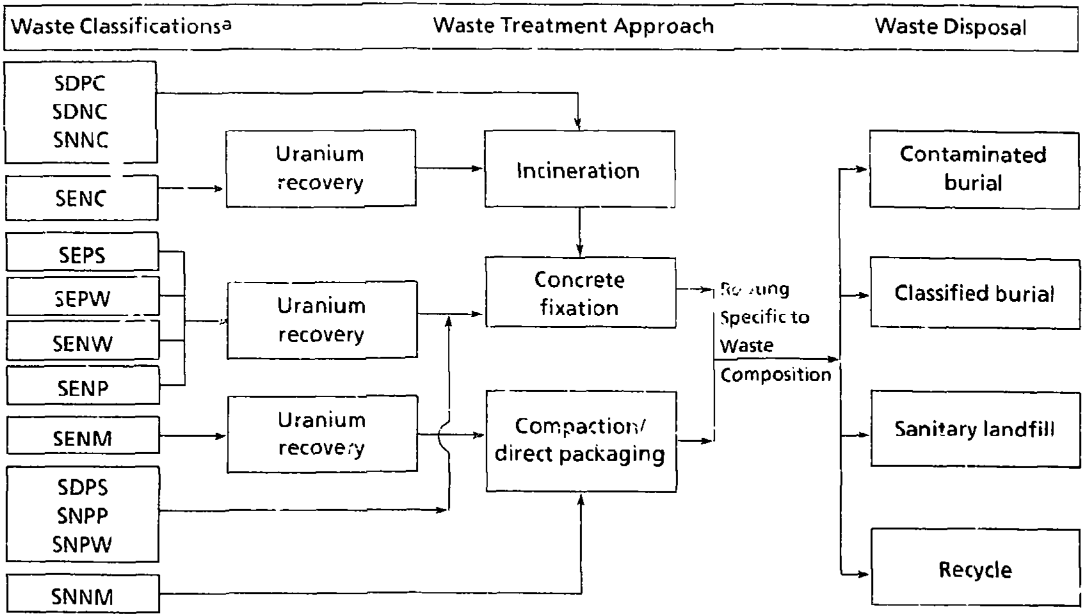
5.2.3. Solid Waste Streams

5.2.3.1. Treatment Processes. Depending upon the nature of the solid waste streams, several treatment methods may be possible for their management. Six general types of waste classes were identified for the AVLIS Production Plant solid waste streams.

- SDP - Solid waste containing natural/depleted uranium materials and potentially Environmental Protection Agency-hazardous materials.
- SDN - Solid waste containing natural/depleted uranium materials and no Environmental Protection Agency-hazardous materials.
- SEN - Solid waste containing enriched uranium materials and no Environmental Protection Agency-hazardous materials.
- SEP - Solid waste containing enriched uranium materials and potentially Environmental Protection Agency-hazardous materials.
- SNN - Solid waste containing no uranium materials and no Environmental Protection Agency-hazardous materials.
- SNP - Solid waste containing no uranium materials and potentially Environmental Protection Agency-hazardous materials.

The treatment and disposal alternatives for solid waste streams are shown on Fig. 5-3.

For combustible solid wastes, the preferred treatment would be incineration. Incinerators and related devices decompose combustible waste materials by thermal oxidation. Combustion or incineration involves complete oxidation of wastes by burning in an excess of oxygen (air). Pyrolysis involves partial oxidation in an oxygen deficient atmosphere. Oxidation can also be accomplished by introducing combustible wastes and air into a bath of molten salt. Acid digesters thermally and chemically oxidize wastes in a hot mixture of concentrated nitric and sulfuric acids.



a See Fig. 3-1 for waste category definition.

Fig. 5-3. AVLIS solid waste classes management methodologies.

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Many types of incinerators, pyrolyzers, and other such devices are being developed for volume reduction of radioactive wastes. Many of the incinerators listed below are being developed by the U.S. Department of Energy for processing TRU waste:

- o Acid digestion.
- o Agitated hearth.
- o Controlled air.
- o Cyclone drum.
- o Electromelt furnace.
- o Fluidized bed.
- o Molten salt.
- o Pathological.
- o Pyrolysis/controlled air.
- o Rotary kiln.

The latter two types of incinerators, pyrolysis/controlled air and rotary kiln, are the most likely candidates for AVLIS Production Plant use. The design selected for the onsite DOE Central Incineration Facility is a rotary kiln. For smaller throughput requirements, a controlled air design incinerator would be preferable.

Several types of controlled air incinerators are either in use or under development at DOE facilities. A demonstration unit at Los Alamos National Laboratory is designed to process TRU contaminated trash at 45 kg/h and is fueled by natural gas. A volume reduction factor of greater than 40 has been attained for trash.

As shown in Fig. 5-4, pre-sorted, shredded trash is charged to the primary chamber which operates at 800-1000°C. The primary chamber operates in a starved air condition. Unburned volatiles and particulates are swept into the upper secondary chamber, which operates at about 1100°C with a light excess of oxygen. The offgas treatment system consists of a quench column, a venturi scrubber, packed columns, and high-efficiency particulate air filters.

Rotary kiln incinerators have been used to process municipal solid waste and industrial solid, liquid, and gaseous wastes including chemical warfare

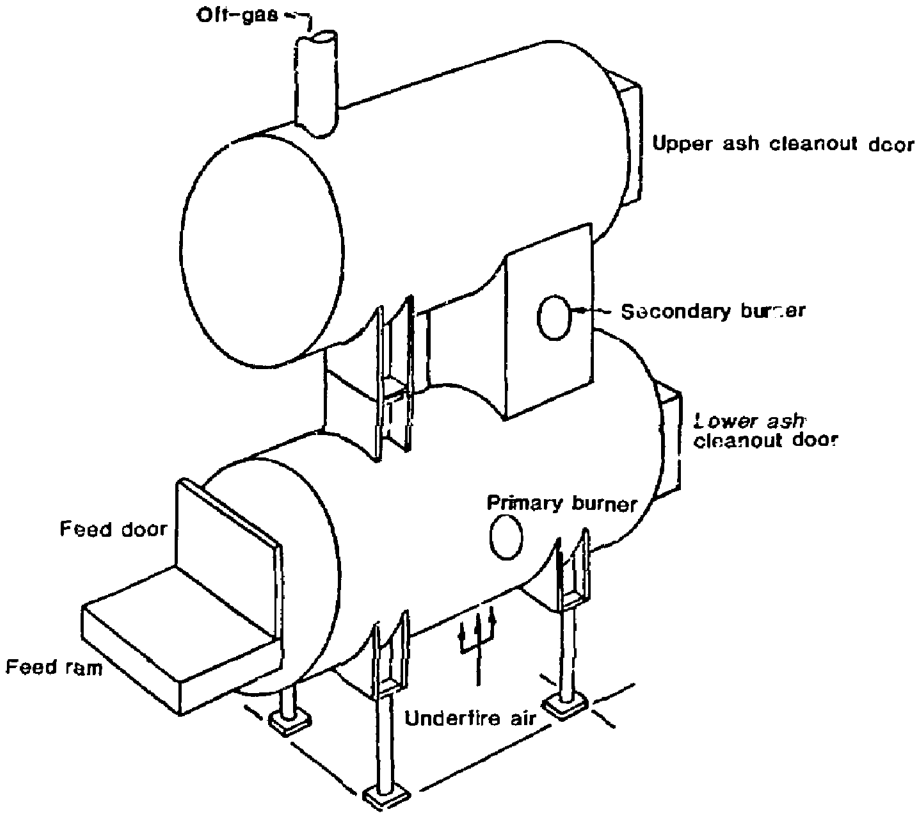


Fig. 5-4. Controlled-air incinerator.

agents. The Department of Energy program to adapt rotary kilns for processing of TRU wastes is now in the production stage. The production unit being installed at Rocky Flats is designed to process trash, organic liquids and ion exchange resins at a nominal rate of 40 kg/h.

As shown in Fig. 5-5, the rotary, refractory-lined kiln is fired by two, axial, diesel-fuel burners, and operates at about 800°C. Liquid wastes are injected through a separate burner while solid wastes are charged with a ram feeder. The afterburner operates at about 1000°C. Offgases are treated by two venturi scrubbers and four stage high-efficiency particulate air filtration. Ash is continuously discharged from the kiln.

Incineration of AVLIS Production Plant combustible solids waste streams could be conducted in a central waste incineration facility designed to handle radiological and/or hazardous waste streams, or in a conventional, municipal-type incinerator for non-contaminated combustible wastes.

This treatment method would provide the best volume reduction for these wastes. Treatment methods for dry solid wastes could also include compaction and/or packaging, prior to disposal. Compactors are frequently used at nuclear facilities to reduce dry solid waste volume; these wastes typically consist of paper, rags, glassware, disposable clothing, etc. Compactors compress these wastes, driving out air as voids are reduced. The amount of void volume and the resiliency of trash materials limit the final volume reduction attained. The use of shredders to pre-treat dry wastes is also being pursued as a method to reduce overall final waste volumes.

Several waste compactors have been used at nuclear installations. These include 55-gallon-drum hydraulic compactors, a double hydraulic ram device which uses a plywood box as the compaction vessel, and a large compactor for use with 96 ft^3 liners.

Although not currently used for compaction of low-level wastes, industrial hydraulic presses of the type used to crush automobiles may be useful for compaction of metal items such as pipes.

Decontamination treatment would be provided for these wastes as appropriate, prior to disposal, to minimize the quantities of waste and to reduce the contamination to as low as reasonably achievable levels.

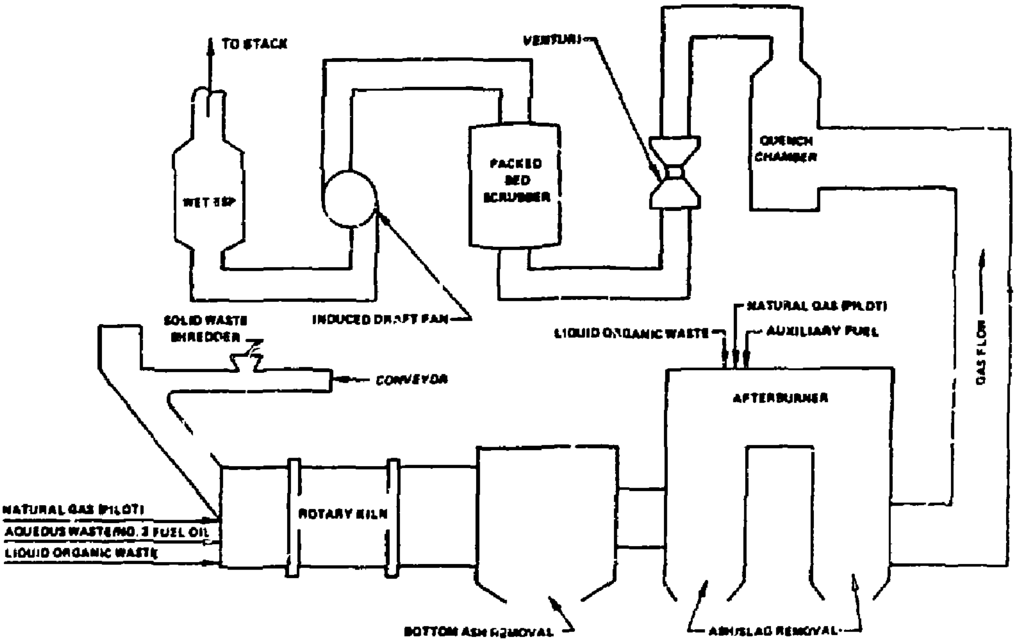


Fig. 5-5. Rotary kiln incinerator.

Pre-treatment of wet solid wastes will be provided to minimize the quantity of free-standing liquids in these waste streams. Dewatering methods could include centrifuging, filtering, drying, and incineration treatments. To minimize the environmental impact of solid wastes disposal, solidification of contaminated waste streams will be provided prior to disposal. Several binder materials and methods are available for waste solidification. Methods considered for use in managing AVLIS Production Plant solid wastes included immobilization in cement concrete or plastic (polymers).
In addition to treating liquid and solid waste streams to bind freestanding liquids, the objectives of low-level radioactive and hazardous waste management are as follows:

- To package the by-product so it is safe for transportation and disposal.
- To provide transportation that protects the public from radiation exposures and hazards in the event of an accident.
- To provide disposal that is safe for the environment.

Means for the stabilization of low-level waste containing free liquids and readily dispersed dry solids are needed to minimize the potential release of radionuclides and hazardous materials to the biosphere during on-site handling, off-site shipment, and disposal. Minimizing the potential for release will guard the public health and safety.

However, to reach these goals a stabilized waste must possess certain qualities. Mechanical strength is of primary importance during in-plant handling, transportation, and disposal. During an accident a waste with poor mechanical properties may fracture and disperse into the environment. Also, because of its increased surface area a fragile waste form would result in increased leachability. The thermal stability of a solidified waste form is a concern primarily because accident conditions involving fire are possible. The accident may cause decomposition, degradation of mechanical properties, and dispersion of radionuclides as gas or aerosol. Also, leachability is a primary concern because in shallow land burial, radionuclide release is principally the result of groundwater interactions. Leachability refers to the removal of radionuclides from the solidified waste package by fluids. Dissolution, diffusion, and chemical reactions may contribute to this release.

There are five solidification agents that are currently considered for use in commercial nuclear facilities. They are as follows:

- o Cement (concrete).
- o Environstone (propietary gypsum material).
- o Bitumen.
- o Polyester resin.
- o Dow system resin.

Absorbent materials such as vermiculite, which had been used extensively in nuclear power stations, are no longer used. When mixed with waste these porous materials will soak up the free water and retain it. This being the case, there is no chemical or physical binding of the waste and the final product is not a monolithic solid. This method of waste fixation is no longer used because of limitations imposed by the burial sites.

Of the five solidification agents listed above, cement and environstone are the only nonorganic binding materials that reacts chemically with the water contained in the waste to form an inert solid product.

Polyester and Dow system agents are thermosetting polymers. Thermosetting polymers are usually stronger at higher temperatures and set irreversibly because they are not softened by increased temperature.

Ordinarily, bitumen behaves as a thermoplastic polymeric material and is sometimes so categorized. Most thermoplastic polymers are synthetic organic materials which can be reversibly softened by heating and formed in the softened state by processes such as extrusion.

Systems using cement have been installed in many United States facilities. Bitumen systems have been used in almost all European facilities.

So far, systems using Dow system resin or polyester have only recently been installed in any United States plants, and their proven feasibility has been limited to prototype systems and isolated special applications.

5.2.3.2. Disposal Processes. Two general alternatives are available for disposal of solid wastes: permanent disposal by shallow land burial and recovery of materials for recycle. In the first process, solid waste materials will be solidified, packaged in waste containers, and emplaced in a near-surface burial ground. The particular burial ground used will depend on the content of the waste packages, i.e., whether they contain radiological, hazardous, or classified wastes or some combination of these materials. Recovery of solid waste materials will involve decontamination of these wastes and possible processing involving smelting of size reduction prior to recycle. Use of planned or existing disposal facilities was factored into solid waste-management planning. The facilities include onsite contaminated and classified burial grounds and an offsite Central Waste Disposal Facility, currently under development.

5.3. AVLIS PRODUCTION PLANT WASTE MANAGEMENT PLAN

The waste-management planning for the AVLIS plant is summarized in the following matrix (Table 5-1). This matrix provides the planned treatment and disposal approach for each of the AVLIS Production Plant waste streams. Included in the matrix are the waste stream identifications, origins, classifications, estimated generation rates, and planned treatment/disposal methods and type of facilities.

This planning provides a comprehensive approach to satisfying the waste management needs of the AVLIS Production Plant. Based on these planned methods for processing the waste streams and the dispositions of the final waste forms, an implementation approach was formulated to define the manner in which the plan will be executed. This implementation details the specific facilities and methods used to make this planning operational for the AVLIS Production Plant.

Table 5-1. AVLIS Production Plant waste management matrix.

Waste Stream (classification)	Origin	Estimated generation rate^a	Planned treatment	Planned disposal	Facilities
Feed conversion					
UF_4 reduction tower reactor off gas (GDHW)	U-processing, H_2 reduction reactor offgas	1064 MTY HF 8 MTY H_2 156 kg/yr UF_6	Chemical traps, for UF_6 removal; HF recovery by KOH packed column, HF scrubbing; H_2 burner	Discharge clean effluent to atm. after treatments	Process offgas treatment equipment in Feed Conversion Facility
Activated carbon trap material (SDPC)	U-processing; feed conversion UF_4 production, offgas treatment chemical traps for UF_6 removal	880 kg/yr	U-recovery in wet U-recovery process, incineration of spent carbon, concrete fixation of ash	Shallow land disposal (burial) of immobilized waste	Wet U-recovery process; incinerator concrete fixation and burial facilities
KOH packed column liquid waste, from HF scrubbing, KF contaminated solution (LHNL)	UF_4 production, HF recovery offgas treatment	124 MTY (metric tons per year)	Convert KF to CaF_2 solids, concrete fixation of CaF_2	Shallow land disposal (burial) of immobilized waste	KF conversion, concrete fixation, and burial facilities
Excess anhydrous HF (LHHL)	UF_4 production offgas, HF recovery product	270 MTY	Commercial resale or, if handled as waste, convert to CaF_2 solids, concrete fixation of CaF_2	Shallow land disposal (burial) of immobilized waste	KF conversion concrete fixation, and burial facilities
High-efficiency particulate air and pre-filters (SDNC)	Feed conversion facility HVAC, hood and process filtration system	1 MTY	Shredding and compaction or incineration; fix ash in concrete	Burial of packaged or immobilized waste in shallow land burial	Compaction or incineration facility. Fixation and burial facilities
MgF_2 slag (SDPS)	Mg reduction of UF_4 removed from derby production by slag processing	See U recovery operations	Sent to U recovery	See uranium recovery operation for disposition of waste	Uranium recovery facility
Feed preparation					
Scrap graphite crucibles (SDNC)	Melting and casting process	12 MTY	Incineration, concrete fixation of ash	Burial of immobilized ash waste	Incineration, fixation, burial facility

Table 5-1. (Continued)

Waste Stream (classification)	Origin	Estimated generation ratea	Planned treatment	Planned disposal	Facilities
Casting slag (SONS)	Crucible refurbisment	See U recovery operations	Sent to U recovery. Recover uranium with Dry U recovery process. See U recovery for final disposition.	See uranium recovery	See uranium recovery
Laser isotope separation					
Vacuum pump oil (LLNC)	Separators refurbishment	2800 gpy	Incineration	Discharge clean effluent to atmosphere after treatment	Incineration facility
High-efficiency particulate air and pre-filters (SDNC)	Separator refurbishment Hood exhaust and HVAC	5 MTY	Shredding, and compaction or incineration; Fix ash in concrete	Burial of packaged or immobilized waste in shallow land burial	Compaction or incineration facility. Fixation and burial facilities.
Contaminated water (LENF)	Separator/Refurbishment Startup testing of emergency blowdown system	Trace	Neutralization, fix sludge in concrete	Discharge clean effluent, burial of fixed sludge	Neutralization, fixation facilities
Product conversion					
Off-gas from oxidation (GENF)	U product oxidation vibrating tray kiln	Carried over trace quantity of U particulates	Sintered metal filtration, removal of particulates	Discharge clean effluent to atmosphere after treatment	Process offgas treatment equipment
Fluorination off gas (GEHV)	Fluorinator offgas, downstream of UF_6 cold traps	8 MTY HF 35 MTY F_2	Chemical traps to remove UF_6; KOH packed column to remove HF, F_2 by scrubbing	Discharge clean effluent to atmosphere after treatment	Process offgas treatment equipment in Product Conversion Facility
Solid waste from NaF chemical traps (SEPW)	Chemical traps for fluorination off gas	0.2 MTY	Wet U-recovery process, fix residue in binder	Shallow land burial	Wet U-recovery, concrete fixation and burial facilities
KOH packed column liquid waste from HF, F_2 scrubbing; KF contaminated solution. (LNNL)	Fluorinator off gas KOH packed column scrubbing	189 MTY	Convert KF to CaF_2 solids, concrete fixation of CaF_2	Shallow land burial	KF conversion, fixation and burial facilities

Table 5-1. (Continued)

Waste Stream (classification)	Origin	Estimated generation rates	Planned treatment	Planned disposal	Facilities
MgF_2 diluent from product fluorination (SEPS)	Fluorination fluid bed reactors	210 MTY MgF_2 4.9 MTY YF_3	Concrete fixation	Classified burial ground	Fixation, classified burial facilities
Volatile alloy compounds from UF_6 distillation (LEP)	UF_6 purification distillation column	12 MTY	Pressurized sealed containers, interim vault storage prior to future disposition	Classified burial (ultimate disposition)	Interim vault storage, classified burial facilities
High-efficiency particulate air and pre-filters (SPNC)	Product conversion facility HVAC, hood and process filtration systems	1 MTY	Shredding, and compaction or incineration; fix in concrete	Burial of immobilized ash waste	Compaction or incineration facility, fixation and burial facilities
<u>Lasers</u>					
Spent laser dye solution (LNHC)	AVLIS enrichment process, laser operation	15,000 gpy (gal/yr)	Incineration	Discharge clean effluent to atmosphere after treatment	Incineration facility
Spent filters (SNPW)	AVLIS laser dye cleanup system	100 ft3/yr	Concrete fixation	Shallow land burial	Fixation and burial facilities
Spent resins (SNPW)	AVLIS laser dye cleanup system	600 ft3/yr	Same as above	Same as above	Same as above
Laser dye cleaning, demineralizer backflush (LENF)	Laser dye cleanup system	1,500 gpy	Neutralization, fixation of resulting sludges	Discharge clean effluents, burial of sludges	Neutralization, fixation and burial facilities
Freon decon. sludge (SNPW)	Laser refurbishment Freon recycle system	Trace	Concrete fixation	Shallow land burial	Fixation, burial facilities
Metal sludge (SNPW)	CL cleaning	100 ft3/yr	Same as above	Same as above	Same as above
<u>Refurbishment</u>					
Freon blast, oxide and spent separator coatings (SNPW)	Separator refurbishment Freon blast waste mixture	90 MTY	Wet U-recovery, fix residues in concrete	Shallow land burial	Wet U-recovery, fixation, burial facilities
Separator coatings	Separator refurbishment excess coating overspray	17 MTY	Recovery coating for reuse	--	--

Table 5-1. (Continued)

Waste Stream (classification)	Origin	Estimated generation rates	Planned treatment	Planned disposal	Facilities
Separator graphite (SENC)	Separator/pod refurbishment	2.8 kg/yr	Incineration, fix ash in concrete	Classified burial ground	Incineration, fixation, burial facilities
Uranium recovery					
Excess MgF_2 (SDPS)	U-processing; feed conversion, slag processing	3036 MTY MgF_2 22 MTY Mg	Concrete fixation	Shallow land burial	Fixation, burial facilities
Melting/casting slag from feed preparation (SDPS)	U-processing; feed preparation, melting/casting operation	65 MTY MgF_2	Same as above	Classified burial ground	Fixation system, classified burial facility
Fluorination off gas (CSHV)	Fluorination offgas, downstream of UF_6 cold traps	123 MTY HF and F_2	Chemical traps to remove UF_6; KOH packed column to remove HF, F_2 by scrubbing	Discharge clean effluent to atmosphere after treatment	Process offgas treatment equipment in Uranium Recovery Facility
NaF chemical trap waste (SEPW)	Chemical traps for fluorination off gas	240 kg/yr	Wet U-recovery process, fix residue in concrete	Shallow land burial	Wet U-recovery, fixation, burial facilities
KOH packed column liquid waste from HF scrubbing; KF contaminated solution (LEPL)	Fluorination offgas HF packed column scrubbing	5521 MTY	KF Conversion to solid CaF_2, concrete fixation	Same as above	KF conversion, fixation, burial facilities
High-efficiency particulate air and pre-filters (SDNC)	Uranium recovery facility HVAC, Hood and process filtration systems	1 MTY	Shredding, and compaction or incineration fix ash in concrete	Same as above	Compaction or incineration facility, fixation burial facilities
U processing support					
KF·2HF electrolyte sludge (SNPW)	Fluorine generation, F_2 electrolyte cells	17 MTY	Fixation in binder	Shallow land burial	Fixation, burial facilities
KOH packed column liquid waste (LNPL)	Fluorine generation, electrolyte cell offgas treatment	10 MTY	KF Conversion to solid CaF_2 concrete fixation of CaF_2 solids	Same as above	KF conversion, Fixation, burial facilities

Table 5-1. (Continued)

Waste Stream (classification)	Origin	Estimated generation rate[a]	Planned treatment	Planned disposal	Facilities
CaF_2 powder (SNPP)	KF conversion of KOH packed column KF contaminated solution from all KOH scrubbers	700 MTY	Immobilize in concrete	Same as above	Same as above
Ammonia absorption bed regeneration waste (LNNL)	Ammonia dissociation system	Trace	Chemical neutralization, concrete fixation	Same as above	Neutralization, fixation, burial facilities
Aqueous nitrates (LENL)	Wet uranium recovery, extraction column raffinates	8 MTY	Biodenitrification, fix residues	Same as above	Biodenitrification system
Decontamination solutions (LDNF)	K-1420 decontamination operations, cleaning solutions	2.6×10^6 gpy	Chemical neutralization, concrete fixation	Same as above	Neutralization, fixation, burial facilities
Facility support					
Contaminated water (100 ppm sodium chromate) (LNNF)	HX facility, cooling water	650 GPY	Chemical neutralization, concrete fixation	Shallow land burial	Neutralization, burial facilities
Cooling tower blowdown (LNNF)	Cooling towers waste water	600 GPM	Settling ponds, fix sludge	Same as above	Settling ponds, fixation, burial facilities
Decommissioned equipment (SNNC) (SENC)	Facility wide, failed and/ or replaced components	5000 CFY	Decontamination	Shallow land burial or recycle	Decontamination facility
Trash/refuse (operations) (SNNC) (SENC)	Housekeeping wastes (paper, plastics, wood, etc.)	365 MTY	Incineration, compaction	Shallow land burial	Compaction, incineration, burial facilities
Sanitary liquid effluent (LNNF)	Facility wide	1.2×10^7 gpy	Activated sludge sewage treatment	Discharge clean effluents	Sewage plant
Sludges from waste treatment and sewage (SNNW)	Water sewage plants	3×10^6 ft^3/yr	Collection	Shallow land burial	Sanitary landfill
Storm drains (LNNF)	Facility wide	2.5×10^6 GPH (max. storm)	Oil removal and drainage	Discharge to river	Storm drains system

[a] Initial increment of production, (5 MSWU); for fully activated plant (13 MSWU), multiply listed quantity by 2.6.

6. WASTE MANAGEMENT PLAN IMPLEMENTATION

6.1. PLAN IMPLEMENTATION

Waste management facilities are required to be designed and developed for the AVLIS Production Plant to implement the Waste Management Plan set forth in this document. Since the AVLIS Production Plant will be located at the existing Oak Ridge Gaseous Diffusion Plant site, and the gaseous diffusion operations are expected to be phased out as the AVLIS Production Plant is deployed, the general approach in developing the AVLIS Production Plant Waste Management Plan considered not only the need for new facilities but also the feasibility of using existing and/or planned facilities that are, or will be, utilized by Oak Ridge Gaseous Diffusion Plant.

Comphrehensive waste-management studies performed by DOE for its operating installations in the Oak Ridge Reservation and other enrichment plants have resulted in the upgrading of existing Oak Ridge Gaseous Diffusion Plant facilities and the planned provision of several new waste management facilities. New facilities to be used by Oak Ridge Gaseous Diffusion Plant include the Central Neutralization Facility, the Concrete Fixation Facility, the Central Incineration Facility and the Central Waste Disposal Facility. Since these waste facilities were generally designed to accept wastes generated by a number of existing facilities, the feasibility of using them for the treatment and disposal of AVLIS Production Plant wastes was assessed with respect to the flexibility and capacities of these facilities for handling the AVLIS Production Plant-specific wastes. The assessment revealed that the above facilities, as well as the existing Oak Ridge Gaseous Diffusion Plant Decontamination Facility (Building K-1420), Sewage Treatment Plant (Building K-1203), and Classified Burial Ground, are all suitable for AVLIS Production Plant use at both the initial increment and the fully activated plant levels of production.

The status of these facilities is summarized in Table 6-1. All of these facilities will be operational by 1987, with most already under construction. The assessment of the ability of these facilities to handle AVLIS Production

Table 6-1. Status of waste management facilities required for the AVLIS Production Plant.

Waste Management Facility	Location[a]	Status
Central neutralization facility	Oak Ridge Gaseous Diffusion Plant	Under construction, in operation in 1986
Concrete fixation facility	Oak Ridge Gaseous Diffusion Plant	Under construction, in operation in 1986
Central incineration facility	Oak Ridge Gaseous Diffusion Plant	Under construction, in operation in late 1986
Central waste disposal facility	Oak Ridge Reservation site (~5 miles from the Oak Ridge Gaseous Diffusion Plant)	In final design, in operation in 1985
Decontamination facility	Building K-1420 on Oak Ridge Gaseous Diffusion Plant site	Existing facility
Classified burial ground	Oak Ridge Gaseous Diffusion Plant site	Existing 20 acre site, planned expansion to 42 acres
Storage treatment plant	Building K-1203 on Oak Ridge Gaseous Diffusion Plant Site	Existing facility

[a] See Figure 6.1-1 for Oak Ridge Gaseous Diffusion Plant site locations.

Plant throughputs is summarized in Table 6-2. The throughput capacities, of each of the waste facilities which serve Oak Ridge Gaseous Diffusion Plant, are adequate to accept the waste volumes generated by the AVLIS Production Plant. Assuming that Oak Ridge Gaseous Diffusion Plant is phased out as the AVLIS Production Plant is deployed, these treatment and disposal facilities will take on the AVLIS Production Plant wastes in lieu of the Oak Ridge Gaseous Diffusion Plant waste streams.

Figure 6-1 shows the location of the existing/planned facilities on the Oak Ridge Gaseous Diffusion Plant site, with the exception of local gaseous waste treatment systems, which are integral to the individual uranium processing systems. A flow diagram of overall waste management for the AVLIS Production Plant, based on the use of the Oak Ridge Gaseous Diffusion Plant site and Oak Ridge Reservation waste management facilities, is provided by Figure 6-2.

This comprehensive waste-management planning was developed to support the overall designs for the AVLIS Production Plant and site-specific conditions used as the basis for the AVLIS Production Plant waste management facility designs.

6.2. GREEN-FIELD PLANT

To support the AVLIS Production Plant as a stand-alone facility (Green-field site), a centralized waste management facility is planned to support waste management.

This waste management facility is envisioned as a centralized, multi-function building which will house the following operations:

- Decontamination.
- Wet uranium recovery process.
- Liquid wastes neutralization.
- Waste incineration.
- Concrete fixation.
- Material handling and storage (including recovered UO_3 product storage, truck loading and unloading area, and material staging and storage areas).
- Offices and laboratories.

Table 6-2. Oak Ridge Gaseous Diffusion Plant waste management facilities throughput capacities.

Waste management facility	Total average design throughput capacity[a]	Percentage total capacity allotted for ORGDP (AVLIS)	Estimated AVLIS Production Plant throughput[a]
Decontamination facility (Building K-1420)	10000 CFY	100	5,000 CFY
Central neutralization facility	52000 GPD	100	26000 GPD
Concrete fixation facility	11000 MTY	100	9700 MTY
Central incineration facility	1400 MTY solids 13000 MTY liquids	3 20	22 MTY solids 68 MTY liquids
Central waste disposal facility	670000 CFY[b]	25	120000 CFY[c]
Classified burial ground	50000 CFY	18500 CFY	
Sewage treatment plant	600000 GPD	330000 GPD	

[a] FAP, fully activated plant throughput requirements.

[b] Currently planned initial CWDF waste disposal rate, based on DOE facilities estimated solid waste outputs. Development of the CWDF phases will need to be accelerated after the first four years of AVLIS Production Plant operation, to serve the AVLIS Production Plant concurrently with the other Oak Ridge Reservation facilities.

[c] Average disposal requirements during the initial four years of AVLIS Production Plant operation. Phased deployment of the AVLIS Production Plant, over the first seven years of development, will increase disposal requirements up to 750000 CFY, for the fully activated plant.

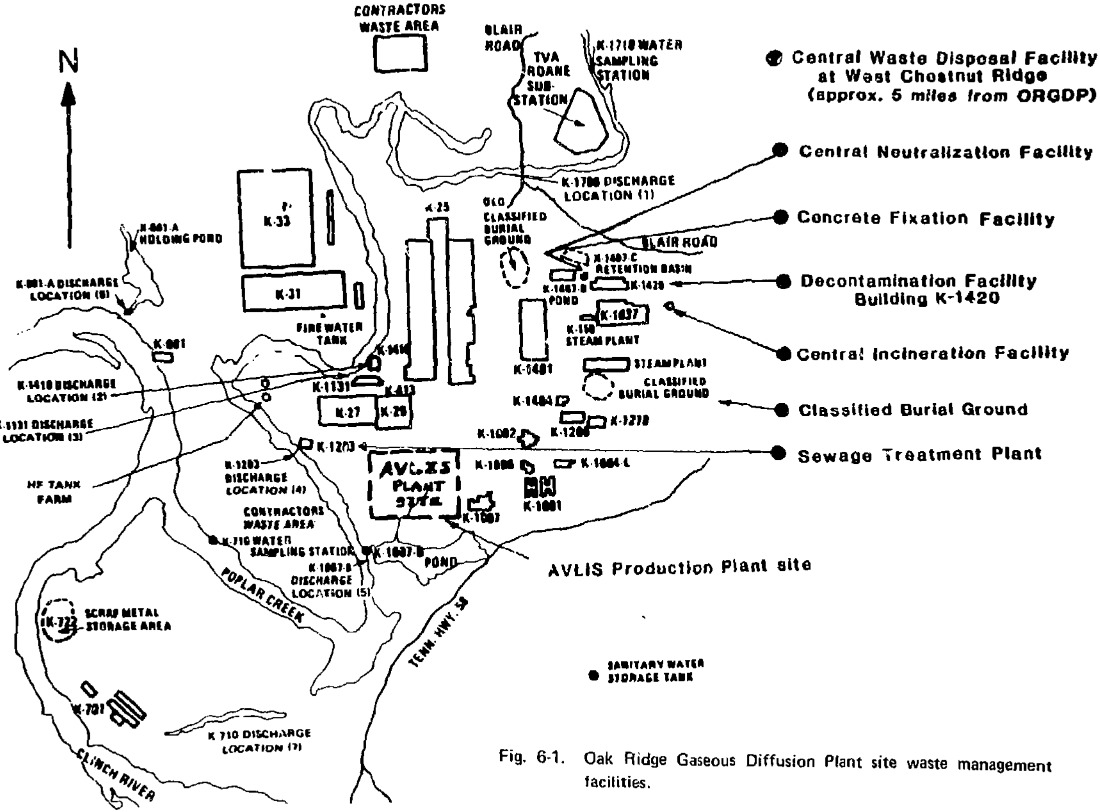


Fig. 6-1. Oak Ridge Gaseous Diffusion Plant site waste management facilities.

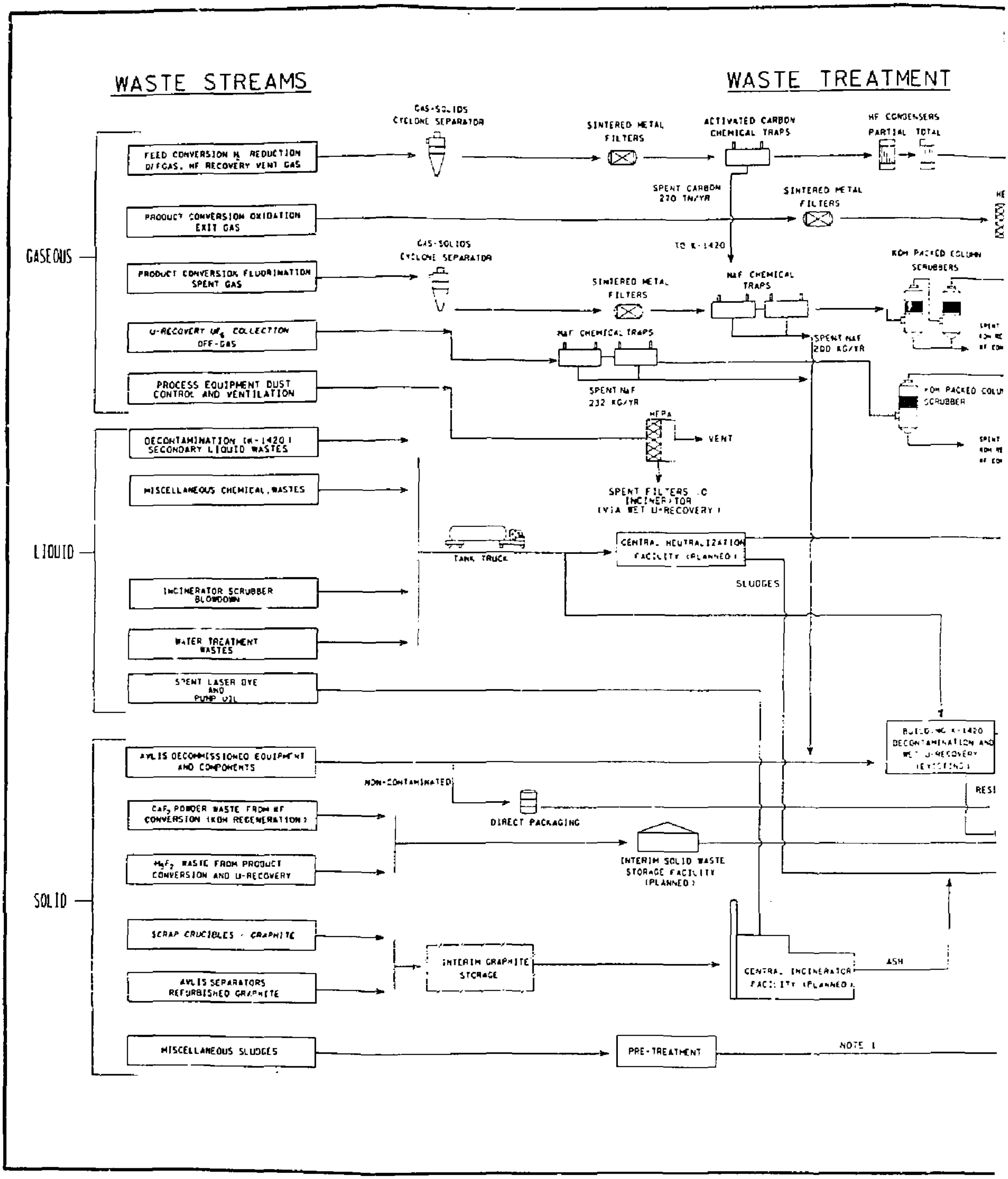
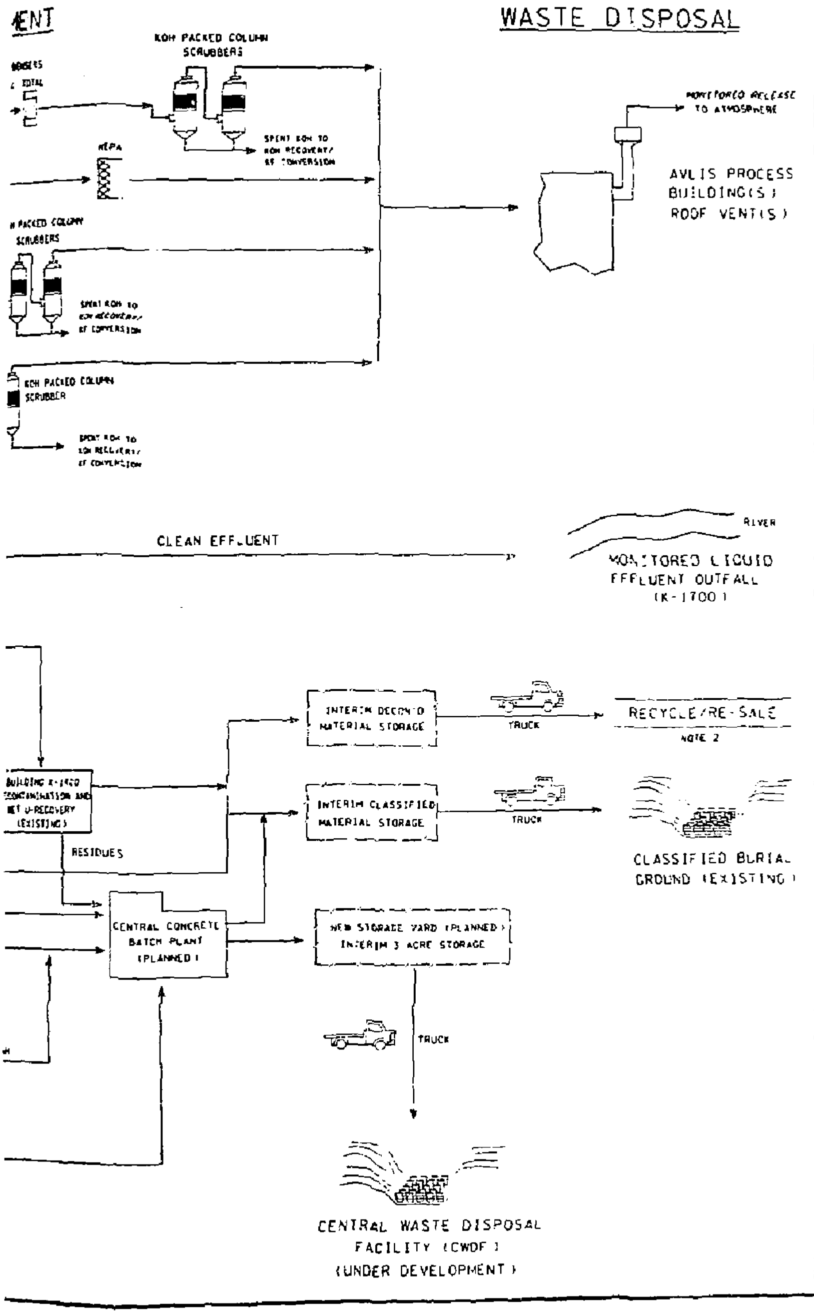


Fig. 6-2. Overall waste management planning for AVLIS Production Plant.



NOTES

1. WASTES MEET 1% ENRICHMENT LIMIT BY BLENDING.
2. SCRAP SMELTED DOWN FOR REUSE.

The Central Waste Management Facility and the associated waste treatment systems should be sized for the initial increment of production, with only minor modifications required for expansion to serve the fully activated plant. Figure 6-3 shows a prospective conceptual arrangement for this facility. This arrangement considered optimizing waste transfer between operations, better administrative and operational control through consolidated processing of waste streams; and the economy of one common waste treatment facility as opposed to several, independent facilities.

The siting of a shallow land burial facility for the disposal of AVLIS Production Plant solid wastes can become an important factor in the selection of an independent Green-field AVLIS Production Plant site. It is advantageous to develop waste burial grounds within the new AVLIS Production Plant site to realize cost savings from reduced transportation requirements. Minimizing transportation also reduces impact to the environment. New burial grounds will need to satisfy requirements of DOE Orders 5820.2 and 5840.2, as well as the intent of 10 CFR Part 61, in addition to other applicable regulations.

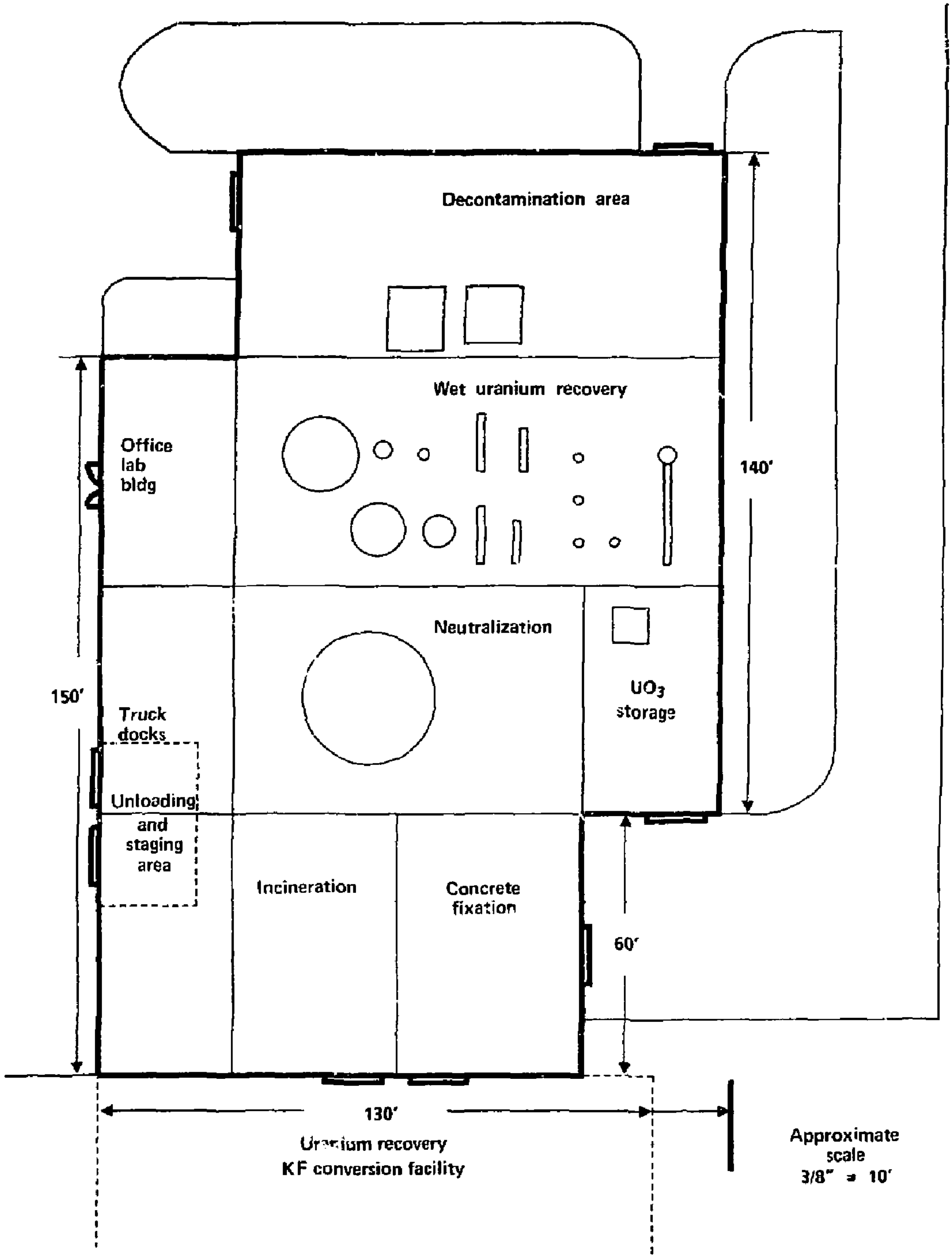


Fig. 6-3. Waste management facilities for green field plant location

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