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Status of the ORNL Liquid Low-Level Waste Management Upgrades

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MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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ORNL/TM-12299

Chemical Technology Division

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FIGURE

ACRONYMS/BUILDING NUMBERS FOR BUILDINGS THAT GENERATE LIQUID LOW-LEVEL WASTE

Building	Acronym	Description
3019	RPP	Radiochemical Processing Pilot Plant
3517	FPDL	Fission Products Development Laboratory
2531		LLLW evaporator complex consisting of Radioactive Waste Evaporation Building 2531 and W-21, W-22, W-23, C-1, C-2, LLLW Evaporator Service Tanks
3544	PWTP	Process Waste Treatment Plant
7860	NHF	New Hydrofracture Facility
7920/7930	REDC	Radiochemical Engineering Development Center
3525	HRLEL	High-Radiation-Level Examination Laboratory
3028		Isotopes Circle Facilities
3029		Isotopes Circle Facilities
3030		Isotopes Circle Facilities
3031		Isotopes Circle Facilities
3033		Isotopes Circle Facilities
3038		Isotopes Circle Facilities
3110		Isotopes Circle Facilities
7900	HFIR	High-Flux Isotope Reactor
3042/3010	ORR/BSR	Oak Ridge Research Reactor/Bulk Shielding Reactor
3025	IMET	Irradiated Materials Examination and Testing Facility
2533/5304		Cell Ventilation Filter Pit for Building 2531 and Geosciences Laboratory
	HOG	Radioactive (hot) Off-gas Pot Collection
2026	HRLAL	High-Radiation-Level Analytical Laboratory
3026		Segmenting Hot Cells Facility
4500		Complex consists of 4500N, 4500S, 4501, 4505, 4507, and 4508

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PREFACE

This report documents liquid low-level waste (LLLW) generation from 1986 through mid-1990. The report was written and submitted in draft form in 1992; however, it was not published in final form. Information contained within the report is accurate for the time it was written; however, several changes have been incurred in the LLLW system since that time. The report has not been updated to reflect these changes but is submitted *as is* to serve as a companion to report ORNL/TM-12638, *Liquid Low-Level Waste Generation Projections for ORNL in 1993*, which summarizes LLLW generation from 1990 through 1993, and ORNL/TM-11250, *Preliminary Analysis of the ORNL Liquid Low-Level Waste System*, August 1994.

ABSTRACT

The strategy for management of the Oak Ridge National Laboratory's (ORNL's) radioactively contaminated liquid waste was reviewed. The latest information on waste characterization, regulations, U.S. Department of Energy (DOE) budget guidance, and research and development programs was evaluated to determine how the strategy should be revised. Few changes are needed to update the strategy to reflect new waste characterization, research, and regulatory information. However, recent budget guidance from DOE indicates that minimum funding will not be sufficient to accomplish original objectives to upgrade the liquid low-level waste (LLLW) system to be in compliance with the Federal Facilities Agreement compliance, provide long-term LLLW treatment capability, and minimize Environmental Safety & Health risks. Options are presented that might allow the ORNL LLLW system to continue operations temporarily but significantly reduce its capabilities to handle emergency situations, provide treatment for new waste streams, and accommodate waste from the Environmental Restoration Program and from decontamination and decommissioning of surplus facilities. These options are also likely to increase worker radiation exposure, risk of environmental insult, and generation of solid waste for on-site and off-site disposal/storage beyond existing facility capacities. The strategy will be fully developed after receiving additional guidance. The proposed budget limitations are too severe to allow ORNL to meet regulatory requirements or continue operations long term.

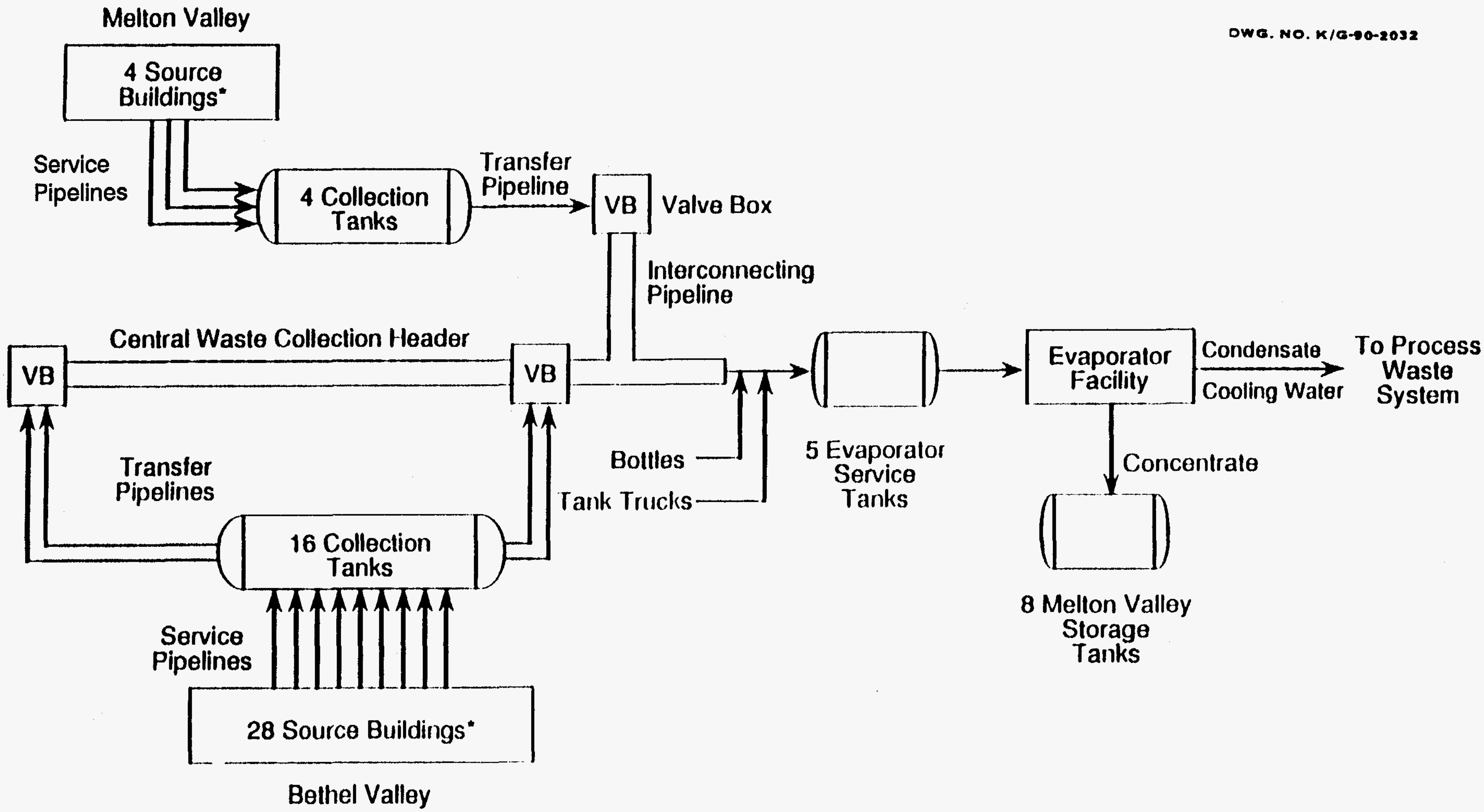
1. INTRODUCTION

The Office of Waste Management and Remedial Actions (OWMRA) operates the Oak Ridge National Laboratory (ORNL) liquid low-level waste (LLLW) system, which collects highly radioactive wastewaters produced by reactor operations, research and development (R&D) operations, Environmental Restoration Program (ERP) activities, and waste operations activities. An ongoing effort to develop and implement improved liquid processing systems has been under way which has the following objectives: (1) provide facilities to treat all present and future wastewaters generated at ORNL, (2) meet applicable regulatory requirements, and (3) improve effluent quality while reducing the amount of secondary waste generated. Efforts were begun in the mid-1980s to develop a consistent, logical approach for upgrading the LLLW system to meet these objectives. A strategy was developed for upgrading the LLLW system, R&D programs and technical assessments were initiated to support these plans, and capital projects were implemented to perform the planned upgrades. This report updates the LLLW management strategy to reflect evaluations of waste characterization/generation data, changes in interagency agreements and regulations, advances in the R&D program to treat LLLW, and recent budget guidance from the Department of Energy (DOE). It also summarizes the status of activities required to implement the strategy.

2. BACKGROUND

Liquid radioactive waste has been generated at ORNL since the inception of Laboratory operations in the 1940s. This waste has been collected in tanks, often neutralized with sodium hydroxide, concentrated by evaporation, and stored for future processing and disposal. Upon cooling, the liquid low-level waste concentrate (LLLWC) separates into sludge and supernatant phases.

From 1964, the LLLWC was stirred into a homogeneous mixture, mixed with grout, and disposed of underground via hydrofracturing. Since the discontinuation of hydrofracturing in 1984, LLLWC has been accumulated in the LLLW evaporator service tanks and the Melton Valley Storage Tanks (MVSTs), which have a limited storage capacity. A diagram of the liquid waste system is shown in Fig. 1.



*Generator tanks located at buildings.

Fig. 1. Existing LLLW collection, transfer, and treatment system.

In 1987, a planning team was established to determine a strategy for the disposal of LLLWC that has been stored since the shutdown of the hydrofracture disposal facility. The recommended action plan[1] contained near-, intermediate-, and long-term treatment plans.

The near-term management plan for treatment of LLLWC consisted of three phases: (1) reduce waste generation by identifying and evaluating LLLW sources and treatment systems, (2) remove excess water from the stored waste by evaporation, and (3) solidify MVST supernatant in a concrete matrix to provide operational flexibility of the current LLLW system prior to removal of the bulk of the transuranic (TRU) waste. The intermediate-term management plan for LLLWC was to process existing TRU waste sludge and the associated supernatant for disposal at the Waste Isolation Pilot Plant (WIPP), the deep geologic repository that DOE is establishing as the disposal site for all DOE-generated TRU waste. The long-term management plan recommended the development of a treatment flowsheet that would produce a solid waste form for on-site disposal of newly generated LLLWC and minimize the production of TRU waste and other solid waste requiring off-site disposal.

A treatment facility[2] is being designed to process the MVST waste for disposal. The primary mission of the liquid-handling facilities in the Waste Handling and Packaging Plant (WHPP), which is proposed to be built at ORNL, is to remotely process accumulated LLLWC to produce a homogenous salt cake for shipment to WIPP. The WHPP slurry process will mobilize supernatant and sludge from the MVSTs, evaporate the excess water from the resultant slurry using a thin-film evaporator, and melt the sodium nitrate salt using a microwave system. Upon cooling, the mixture forms a solid monolith that will meet the current WIPP waste acceptance criteria.

Development studies[3,4] performed in the late 1980s to define flowsheets for treatment of LLLWC for disposal indicated that supernatants in the MVSTs could possibly be treated to avoid disposal at WIPP. Supernatant treatment studies were based on the fact that the supernatant contains mostly nonradioactive salts. The volume of solid waste generated from processing of LLLWC could be significantly reduced if the supernatant were decontaminated to meet the waste acceptance criteria for the process waste system where it could be treated for discharge to the environment. This would allow the radionuclides to be concentrated in smaller volumes of segregated waste, while the bulk material could be disposed of with less risk and expense. Results from scouting studies indicated that chemicals might be added to the liquid/solid separation tanks to precipitate cesium and strontium from the supernatant. The treated supernatant could then be discharged to the Process Waste Treatment Plant (PWTP) for additional treatment.

Since the sludge presently stored in the MVSTs is TRU waste, it would need to be processed to meet the waste acceptance criteria for WIPP. If source treatment could be implemented to remove TRU from the centralized LLLW system, the remaining newly generated sludges could be processed for disposal as non-TRU waste.

Based on the above information, additional treatment options have been added to the WHPP design to increase the flexibility of the plant and to extend the life of the facility to allow processing of non-TRU waste after WIPP closes. The capability to add a binder to the solidification system is being included in the design so that a nonsoluable (potentially leach-resistant) waste form can be produced should the WIPP waste acceptance criteria change and/or to produce waste forms acceptable for on-site storage/disposal. Treatment capabilities are also being included in WHPP to allow supernatants to be discharged to the process waste system for additional treatment.

This basic approach for managing LLLW is still applicable. However, some adjustments are necessary as a result of constraints imposed on ORNL and recent advances in development efforts initiated to support the strategy implementation. This report summarizes the source of the additional constraints, the results of the technical evaluations and development studies performed recently, and the resulting strategy modifications.

3. WASTE CHARACTERIZATION STUDIES

Better waste characterization studies were needed to efficiently implement the LLLW management strategy. Waste characterization studies have been focused in two areas: (1) characterization of the LLLWC that has been stored in the MVSTs since 1984 and (2) identification of the source, volume, and composition of waste to be generated in the future at ORNL.

3.1 CHARACTERIZATION OF STORED WASTE

The waste in eight MVSTs and two LLLW evaporator service tanks located in Bethel Valley were sampled[5] in early 1990. The supernatant is approximately 4–5 *M* sodium and potassium nitrate contaminated with soluble radionuclides, primarily ^{137}Cs and ^{90}Sr with lesser quantities of ^{60}Co and ^{134}Cs and trace quantities of ^{14}C, ^{106}Ru, ^{152}Eu, ^{153}Eu, and ^{154}Eu. The supernatant contains essentially no TRU materials. Five of the ten sampled tank liquids had a corrosive pH of greater than 12.5. A total of seven out of ten tanks contained supernatants that are hazardous according to Resource Conservation and Recovery Act (RCRA) definitions because of the corrosivity (>12.5) and/or the presence of toxic metals in slight excess of the limits set by RCRA. The sludges consist of precipitated carbonates and hydroxides, primarily calcium carbonate and magnesium hydroxide. Since radioactive actinides (such as the TRU elements) and most metals are insoluble in alkaline solutions, these constituents are mainly found in the sludge phase. Analytical results show that the sludges contain between 3,310 and 76,200 Bq/g of TRU material. RCRA materials have been detected in all the sludges; however, Toxicity Characteristic Leaching Procedure (TCLP) tests have not been performed on the sludges to determine if the leachates exceed the RCRA limits are thus mixed wastes. TCLP test capabilities were not available at ORNL at the time the characterization studies were performed. Waste classification is important because it affects the type of facility in which the waste can be processed and ultimately how and where the waste can be disposed of.

3.2 LLLW SYSTEMS ANALYSIS

An extensive review of the ORNL liquid waste system has been performed to determine the impact that newly generated waste streams have on the volume and composition of LLLWC. The study evaluated data on the LLLW collection tanks, LLLW evaporator, LLLW concentrate tanks, and rainfall from 1986 through August 1991. In addition, LLLW generator information for 1989, 1990, and 1991 was considered. The results of these studies have been reported in ORNL/TM-11227[6] and ORNL/TM-11250,[7] are summarized in Tables 1 to 4, and are discussed below.

Table 1. Generation rates of dilute LLLW for 1989, 1990, and 1991

Tank or source building	1989 average generation rate (gal/month)	1990 average generation rate (gal/month)	1991 average generation rate (gal/month)[a]	Estimated percentage of waste collected from nongenerator sources[b]
W-1A	4,067	3,884	2,438	100[c]
3039 stack	3,698	3,818	3,638	0
HFIR	3,086	6,169	11,627	0
Bldg. 3026	3,142	2,663	2,334	95[c]
ORR, BSR	2,390	2,433	2,227	55[c]
Bldg. 3525	1,899	1,725	1,315	0
WC-8	1,366	1,189	391	2,999
Bldg. 3517	1,324	979	2,272	40[c]
Isotopes Circle	1,104	610	1,256	40
REDC	992	1,066	1,392	0
4500 area	1,278	756	1,743′	90[c]
3544 Feed	521	311	597	0
Hot Off-Gas Pot	382	881	1,460	100[c]
WC-5 & WC-6	283	344	288	100[c]
3504	117	38	96	0
2026	81	113	282	0
3019	76	95	0	0
3025	26	1	29	0
Other	292	109	125	0
Total	26,124	26,888	33,510	

[a]Generation rates for 1991 are averages for January through August 1991.
[b]Values based on differences between generator estimates and tank measurements.
[c]Tank systems collect waste from vault sumps, filter pit sumps, building floor drains, etc.

Table 2. Calculated generation rates of LLLW concentrate

Tank and/or source building	1989 LLLWC generation rate (gal/year)	1990 LLLWC generation rate (gal/year)	1991 LLLWC generation rate (gal/year)	1989 percent contribution	1990 percent contribution	1991 percent contribution
REDC	4,700	4,700	5,600	30	38	33
PWTP Feed	2,250	900	1,800			
PWTP Conc.	3,700	3,800	5,100	46	38	40
Bldg. 3517	850[a]	100[b]	340	6	< 1	2
Bldg. 3525	650	750	510	5	6	3
ORR, BSR	550	500	480	4	4	3
HFIR	250[b]	1,200[a]	2,600	2	10	15
Isotopes Circle (WC-10)	150	50	100	1	< 1	< 1
Others	700	500	570	6	4	3
Total	13,100[c]	12,500[d]	17,000[e]			

[a]Estimate based on information obtained during operation.
[b]Estimate based on information obtained during shutdown.
[c]Actual concentrate generation during 1989 was 13,400 gal (including some concentrate generated early in 1990).
[d]Actual concentrate generation through October 1990 was 12,600 gal.
[e]Actual concentrate generation through September 1991 was 14,400 gal.

Table 3. Radionuclide contributors to the LLLW system[a]

Radionuclide	Generation rate (Ci/year)	Building	Percent contribution
^{60}Co	<10	HFIR	99
		3001	1
		4501	<0.1
		3047	<0.1
		Others	Trace
^{90}Sr	200	3517	99
		3030	<0.1
		Others	Trace
^{137}Cs	260	3517	78
		3525	19
		4501	<3
		3001	<0.1
		2026	<0.1
		Others	Trace
^{252}Cf	2	REDC	100
Mixed fission products[b]	42,000	REDC	99
		3525	<0.1
		Others	Trace

Other radioisotopes reported to be disposed of via the LLLW system (in trace quantities):

^{3}H

^{64}Cu, ^{67}Cu

^{99}Tc

^{106}Ru

^{110m}Ag

^{123}I, ^{125}I, ^{131}I

^{134}Cs

^{152}Eu, ^{154}Eu, ^{155}Eu

^{188}W

^{195}Pt

^{198}Au, ^{199}Au

^{232}Th

^{244}Cm, ^{246}Cm

Mixed Pu

[a]Estimated from 1991 data.

[b]These mixed fission products are predicted to be disposed of by REDC during Mark-42 processing and consist mainly of the following isotopes: ^{134}Cs and ^{137}Cs, ^{106}Ru, ^{141}Ce, ^{144}Ce, and ^{154}Eu, and ^{155}Eu.

Table 4. Major contributors of solids to the LLLW system[a]

Generator	Generation rate (kg/year)	Percent contribution
PWTP	12,500	45
REDC	12,000	43
HFIR	2,400	9
BSR/ORR	335	1
2531	300	1
Isotopes Circle	145	<1
3517	100	<1
3525	100	<1

[a]Based on 1991 data.

The systems analysis data indicate that the major generators of LLLWC (in descending order based on 1990/91 volume data) are the PWTP, the Radiochemical Engineering Development Center (REDC), the High-Flux Isotope Reactor (HFIR), the Oak Ridge Research and Bulk Shielding Reactors (ORR/BSR), and the High-Radiation-Level Examination Laboratory (HRLRL, Building 3525). The REDC is the major generator of radionuclides entering the LLLW system. The only other generators that currently produce waste containing more than 5 Ci/year are Building 3517, the HFIR, Building 3525, and Building 4501. The majority of the TRU isotopes enter the system in the REDC waste stream. The majority of the ^{90}Sr and ^{137}Cs is found in the Building 3517 waste stream, and the HFIR stream is the primary source of ^{60}Co. The primary contributors of dissolved solids to the LLLW are the PWTP and REDC. These results are of particular importance because the dissolved solids in each waste stream determine the efficiency of the LLLW evaporator in terms of the amount of resulting concentrate.

Evaluations of future waste generation rates have been undertaken assuming no waste minimization and source treatment or pretreatment to assess the long-term LLLW needs and to determine where waste minimization emphasis should be placed. Under these conditions, the radioactivity of the REDC waste stream is expected to increase significantly because of the processing of targets from the Savannah River Plant and is expected to remain high when the Advance Neutron Source Reactor becomes operational. REDC will continue to be a primary source of newly generated radionuclides, TRU isotopes, and dissolved solids. Waste generation rates from other presently operating facilities are expected to remain fairly constant, except for the Isotopes Area facilities. The Isotope Area facilities and Building 3517 have been shut down and are not expected to produce significant amounts of waste in the future other than those waste streams generated during decontamination activities. Except for REDC wastes, essentially all newly generated waste will be non-TRU. Assuming that no waste minimization and source treatment are implemented, the average LLLWC generation rate from ongoing R&D, production, and decontamination activities is expected to be 15,000–20,000 gal/year in the foreseeable future.

Remediation of inactive tanks and decontamination of surplus facilities will also generate significant volumes of LLLW in the future. Although the schedules and treatment methods for these programs have not been finalized, waste generation estimates for the next 10 years have been summarized below. The ERP[8] plans to remediate the inactive LLLW tanks containing 460,000 gal of supernatant and 45,000 gal of sludge before 2003. The supernatants in these tanks are low-level wastes, while the sludges in 11 of the ERP inactive tanks are TRU wastes. The portion of this waste to be processed in the active LLLW system will not be determined until alternative assessments are completed and records of decision have been obtained under the ERP. However, the LLLW system and capacity should be designed with the flexibility to handle these wastes. If these wastes are transferred to the LLLW system, the supernatants would be processed through the LLLW evaporator; the sludges and associated sluice water (estimated to be three times the volume of sludge) would be transferred directly to the MVSTs. This is expected to increase the LLLWC inventory by >200,000 gal. If the sluice water is decanted and processed through the LLLW evaporator, the LLLWC resulting can eventually be reduced to ~60,000 gal.

Major decontamination efforts for the decommissioning of surplus facilities are expected to begin after the year 2000 and will produce mostly non-TRU wastes. Waste generation estimates for these activities are not available at this time.

The LLLW evaporator complex consists of two evaporators and five 50,000-gal service tanks. Originally, tanks W-12 and W-22 were used as evaporator feed tanks, and

W-23, C-1, and C-2 were used as collection tanks to temporarily collect evaporator discharges prior to transferring the LLLWC to the MVSTs for storage. Since the shutdown of the hydrofracture process, the MVSTs have been nearly filled to their operating capacity. Four of the five evaporator service tanks are now being used as LLLWC storage tanks. Tank W-22, currently the only evaporator feed tank, is filling with sludge. To regain the operational flexibility needed to operate the LLLW system efficiently and to avoid shutdown of the LLLW system when the evaporator feed tank fills with sludge, the contents of these tanks need to be transferred to MVSTs. If the contents of these five tanks (currently containing a total of 145,000 gal of LLLWC and associated sludge) are transferred to the MVSTs, the supernatant and sludges and associated sluice water (estimated to be three times the volume of sludge) would increase the inventory in the MVSTs by >500,000 gal. Over a period of time, the sluice water used to transfer the sludges between tanks can be processed through the LLLW evaporator to reduce this volume to ~150,000 gal. Of course, this will not be a possible alternative unless new tanks are built or a large percentage of the waste in the MVSTs is removed.

The results of these waste characterization and systems analysis studies are being used to identify areas for waste minimization and source treatment and to aid in the development studies required to implement these activities as well as define a facility to treat LLLWC for disposal. These are discussed throughout the remainder of this report.

4. RESEARCH AND DEVELOPMENT STUDIES

R&D studies have been initiated to support all three phases of the LLLW management strategy implementation. To reduce the existing inventory of waste in the MVSTs, studies have been implemented to support evaporation of excess water from the supernatant and to pretreat the supernatants for solidification in a concrete matrix to provide space in the MVSTs until LLLW treatment facilities are built. At present, the latter results in the production of a waste form that is less than Nuclear Regulatory Commission Class C limits but is not likely to meet the waste acceptance criteria for on-site disposal facilities. Therefore, the only alternative for disposal of the waste form at the present would be to request an exemption from DOE Order 5820.2A and ship the waste to Barnwell, South Carolina, at a cost of $18,000 per cask. Studies are under way to develop the flowsheets for treatment of LLLW, both the existing inventory and newly generated waste. Activities have also been initiated to implement waste minimization and source treatment/pretreatment to reduce the LLLWC that must be processed for disposal. The results of R&D studies in each of these areas are summarized below.

4.1 SUPERNATANT EVAPORATION

Waste characterization studies have indicated that the supernatant in the MVSTs is not saturated and that excess water could be removed to reduce the inventory in the tanks. Bench-scale tests at ORNL have shown that 50–70% of the liquid in the MVSTs could be evaporated prior to solids precipitation in the tanks.[9] Therefore, one aspect of the near-term strategy for management of the LLLWC stored in the MVSTs is to sparge the tanks with air to evaporate the excess water from the tanks and to concentrate the stored LLLWC to the point of near saturation.

The equipment[10] needed for the in-tank evaporation (ITE) process was installed at the MVSTs in 1990. Existing equipment was used as much as possible. Most of the existing equipment had been installed for use in the hydrofracture process ~10 years ago and had not been operated for over 5 years. As would be expected with old equipment that had been shut down for years, several operational problems were encountered during startup. The ITE equipment[11] was operated almost continually on four MVSTs (W-24, W-25, W-26, and W-27) from February 4 through April 22, 1991, to demonstrate the process full-scale. The air sparge rate was ramped up over half the test period to the maximum tested sparge rate of ~120 ft^3/min per tank (468 ft^3/min for four tanks).

According to air flow rate and humidity calculations, about 900 gal of water was evaporated from the MVSTs during the 3-month operational period. The data taken for air sparge rates when operating at >400 ft^3/min indicate that 6.8 gal/day per tank was actually evaporated from the MVSTs during the test period. Assuming that ITE is on-line 80% of the time and that all eight tanks are sparged, 17,000 gal/year could be evaporated at the demonstrated operating conditions for the next several years. Based on the waste generation rates estimated in Sect. 3, ITE should have the capacity to evaporate the future waste generated from normal plant operations for the next 5 years. It will not have the capacity to handle waste generated in emergency situations or waste transfers from the LLLW evaporator service tanks or inactive tanks.

During the maximum sparging period, the high-efficiency particulate air (HEPA) filters became wetted twice, and the system was shut down on April 22 because of operational problems with the air compressor. The compressor is being replaced as a scaleup priority item, and the cause of the intermittent wetting of the HEPA filters is being investigated. ITE is expected to be fully operational in 1992.

In order for ITE to process the expected future waste generation and to remove the present inventory in the MVSTs in order to reduce the number of additional solidification campaigns required (particularly if new treatment or storage facilities are delayed), measures will need to be implemented to enhance the evaporation rate. These options are potentially available: (1) increasing the air sparge flow rate through the MVSTs, (2) adding heat to the MVSTs, and (3) pumping the supernate to an evaporator located near the MVSTs, that is, out-of-tank evaporation (OTE). Increasing the air sparge rate appears to be the most attractive option at present. The feasibility, schedule, and implementation costs for these options will be evaluated in more detail in FY 1992.

4.2 SLUDGE PROCESSING

Studies have been performed since 1987 to define flowsheets for the liquid waste treatment portion of WHPP and for long-term treatment of wastes for on-site disposal. The sludge handling and treatment processes for the WHPP have been demonstrated at the bench scale using simulated waste. A pilot-scale facility was built in FY 1990 to demonstrate the WHPP flowsheet using simulated waste but has not been operated because of lack of funding from DOE. The pilot plant will demonstrate sludge removal techniques, liquid/solids separation steps, and solidification using a wiped-film evaporator and microwave. In addition to obtaining design data for WHPP through this pilot plant, studies are needed in which actual waste is used to demonstrate the chemical processes being proposed for decontamination of the supernatant solutions (see Sect. 4.3). It also appears that the present WHPP waste form, a dry salt cake, may not meet the WIPP waste acceptance criteria. Thermal treatment (above 600°C) may be required for the sludges, and solids may require shredding and grouting.

4.3 SUPERNATANT DECONTAMINATION

Ion-exchange[3,4] processes to remove cesium and strontium from the existing inventory of LLLWC supernatants have been demonstrated at the laboratory scale using simulated and actual supernatant. The results of these initial scoping studies indicated that hexacyanoferrate ion exchangers and sodium titanate could be used to remove cesium and strontium in existing waste that contains high concentrations of nonradioactive sodium and potassium salts that interfere with many treatment processes. These processes are being planned for use in WHPP, but development efforts needed to refine the process flowsheet have been stopped, again because of lack of funding from DOE.

Supernatants will be solidified in concrete to make additional storage space available until the WHPP becomes operational. A solidification campaign was performed in 1988 in which 50,000 gal of supernatants in tanks W-29 and W-30 were solidified,[12] and similar campaigns are planned for FY 1992 and 1993. The October 1990 analyses[13] for the future waste disposal facilities indicated that MVST supernatant solidified in concrete would likely exceed the waste acceptance criteria for disposal facilities to be located on the Oak Ridge Reservation. Evaluations indicate that decontamination factors of ≈ 15 for ^{137}Cs and ≈ 8 for ^{14}C will be required to meet on-site disposal criteria. A study was initiated to determine if cesium could easily be removed from MVST supernatants using hexacyanoferrate ion exchangers prior to near-term solidification campaigns to avoid production of waste forms that presently have no approved disposal method. It would also meet a secondary objective by obtaining additional data needed for the WHPP design. Research focused on the feasibility of adding hexacyanoferrates to the MVST for in situ decontamination.

The results of this study[14] indicated that the supernatants cannot be decontaminated in situ but that ^{137}Cs can be removed using potassium ferrocyanide (KCFC) ion-exchange material if the supernatant is removed from the tanks and processed under more controlled conditions than is possible in the storage tanks. The envisioned treatment would include adjustment of the pH to an optimum range and batch treatment with KCFC in a stirred tank to remove cesium, followed by separation of solids from the solution by filtration or other means, and ultimate disposal of the treated liquid and the KCFC solids. These processing steps are being proposed for the WHPP design.

Significant development work would be needed before treatment of supernatants could be implemented. Studies are needed to determine the optimum pH range for cesium removal and the amounts of KCFC needed for adequate removal of cesium. In addition, more work is needed to refine methods to prepare (or obtain) KCFC to determine the stability of the cesium-KCFC complex, to develop methods for separating the solids from the treated solution, and to determine some of the properties and ultimate disposal options for both the solids and the treated liquids. Scaleup studies will be needed to determine the effects on cesium decontamination of variables such as particle size, mixing time, and power input to the mixer.

4.4 TREATMENT OF NEWLY GENERATED WASTE

A study has also been initiated to develop design options for future centralized LLLW treatment systems. These systems will process future generated waste that can be pretreated and segregated at the source for optimum treatment. The composition of the newly generated waste could, therefore, be significantly different from the waste presently stored in the MVSTs. The majority of generators who significantly impact the LLLWC generation rate are being considered for source treatment or pretreatment. Treatment options include chemical precipitation, filtration, and ion-exchange treatments. The composition of the wastewater and the secondary solid waste generated will have a bearing on the treatment method selection.

Source treatment studies are currently under way for the PWTP, HFIR, REDC, ORR/BSR, Building 4501 and HRLEL. Source treatment is planned for the PWTP, HFIR, the ORR, and the BSR to eliminate production of LLLWC at these facilities. Pretreatment is being considered for HRLEL, Building 4501, and REDC. Pretreatment at these facilities has the potential to reduce the volume of waste generated and to reduce the radioactivity in the resulting waste streams and will remove TRU waste from the central LLLW system. After implementation of these projects (~2003), REDC will likely be the largest contributor to the LLLW system, but the LLLWC generation rate should be significantly lower than the current rate (see Table 5). The ERP remedial action activities are also expected to make a major contribution to the LLLWC in the future.

Table 5. Forecasted reduction in LLLWC generation rates as a result of waste minimization and resource treatment

Source	Present generation rate (gal/year)[a]	Future generation rate (gal/year)[b]
REDC	5,600	~4,200
PWTP	6,000	0
HFIR	1,200	0
Bldg. 3525	750	<750
ORR/BSR	500	0
Other	500	<650
Total	**14,700**	**<5,600**

[a]Based on programmatic generator estimates in 1990.
[b]Projects will be implemented between 1994 and 2003.

Future waste streams, other than those generated at the REDC and by the ERP, are likely to exhibit low contamination levels and fairly consistent composition. They will likely be composed of collection-sump rainwater, groundwater leakage into underground tanks, off-gas scrubber solutions, laboratory wastes, and effluents from source treatment activities. It is anticipated that these wastes, when combined, will closely resemble the composition of contaminated groundwater. They should be segregated from other LLLW, such as REDC and ERP waste, which will contain higher levels of dissolved solids and radionuclides.

Activities are currently under way to develop treatment processes for dilute LLLW. A surrogate waste stream is being produced for development studies using process wastewater (which is a mixture of rainwater, groundwater, and laboratory wastewater) traced with wastewater from an inactive underground storage tank (Tank W-1A) that contains low levels of a wide variety of radioactive contaminants. The testing will focus on precipitation and ion-exchange methods for decontamination of these wastes such that the radioactive contaminants are reduced to the solid form for disposal and the effluent stream could be sent to process wastewater treatment systems.

Treatment studies for the more concentrated wastes, such as those generated from REDC (after pretreatment) and ERP, will be continued after the results of pretreatment studies are obtained.

5. REGULATORY AND OPERATIONAL CONSTRAINTS

Several new regulatory and operational constraints require modifications in the LLLW management strategy. The most significant of these are the pending Federal Facilities Agreement (FFA), RCRA regulations, waste acceptance criteria for solid waste disposal facilities, and funding constraints.

5.1 FEDERAL FACILITIES AGREEMENT

The FFA for the Oak Ridge Reservation establishes new requirements for tank systems at ORNL. It will require major upgrades to the active LLLW system and will require the removal from service of many active LLLW tanks and remediation of all inactive LLLW tanks. This agreement states that all LLLW tanks and associated piping must be doubly contained and must meet leak detection requirements or be scheduled for upgrade/replacement with components that meet these requirements. Singly contained systems must also pass leak tests and integrity assessments in order to remain in operation until replaced. Doubly contained systems that do not meet all of the new requirements must be upgraded to meet these requirements. All singly contained systems that are known to leak (either inleakage or outleakage) must be either repaired or permanently removed from service immediately.

The status of the ORNL LLLW tanks with respect to the FFA is summarized below. Thirty-nine LLLW tanks are inactive and are "owned" by the ERP. The remaining 59 tanks are "owned" by OWMRA or the LLLW generating research divisions at ORNL. Fourteen tanks [the LLLW evaporator service tanks, the MVSTs, and tank T-13 at the New Hydrofracture Facility (NHF)] are expected to meet FFA leak detection and secondary containment standards without upgrades. None of the tank systems used for collection and transfer of generator waste is expected to fully meet FFA leak detection and secondary containment requirements. Eighteen tanks will be removed from service prior to the effective date of the FFA because they are no longer being used or they are known or are suspected to be leaking. These tanks will be transferred to the ERP for remediation. Three tanks will be used for near-term decontamination activities (1991–1994) and then will be removed from service and transferred to the ERP. The remaining 24 collection and transfer tank systems must either be upgraded or replaced in order to remain in long-term service.

The upgrade/replacement plans for the active LLLW system include

1. local collection and roadway transport of waste to the central LLLW system,

2. upgrade or replacement of systems (partial upgrades are also required in some cases to keep the systems in interim service),

3. source treatment,

4. reduction of activity and volume at the source with roadway transport of the effluent to the central LLLW system, and

5. process relocation to gain access to upgraded LLLW systems.

Areas selected for source treatment were determined on the basis of waste stream analyses discussed in the previous two sections. Bottling and process relocation will be implemented where feasible. All other facilities (most of which have hot cell activities) are being considered for tank system upgrades or replacements. FFA upgrades and replacements are being implemented by a number of expense and capital projects.[15,16]

A strategy has been developed for implementing upgrades required by the FFA. It assumes that the storage tanks associated with the LLLW treatment system (evaporator complex, MVSTs, and NHF) meet FFA leak detection and secondary containment requirements and that no contingency measures or upgrades are needed. Upgrades to these may be needed as hazard ratings are reviewed and changes or significant deficiencies are noted in the tank system. Some real-time assessments of the integrity of the tanks' system will be required before the year 2000. It assumes that upgrades will be required for all collection tanks upstream of the LLLW treatment facilities. Permanent LLLW system replacements will be provided for most hot cell facilities that have long-term programmatic funding. Bottling and trucking stations will be installed for the 4500 area and portions of the 3000 area. Source treatment/pretreatment/process waste segregation systems will be installed for the ORR, BSR, HFIR, and REDC. It is assumed that tank systems can be used for near-term and one-time decontamination (1991–1995), that is, Isotopes Facility Shutdown, without performing upgrades and that a few tanks that appear to be subject to exemption from some FFA requirements on environmental, safety, and health (ES&H) grounds can be used without performing upgrades until they are replaced. It is also assumed that the regulatory authorities will accept ORNL's nominations for tank systems eligible for ES&H exemptions. Long-term LLLW services will be discontinued for the Isotopes Production Area and most of the 3000 area complex. It may not be possible to provide hard-piped LLLW service for decontamination and decommissioning of surplus facilities.

The FFA will have the following major impacts on the LLLW strategy. Development efforts for source treatment/pretreatment have been accelerated to reduce LLLW generation and to avoid program shutdown as LLLW collection systems are taken out of service. The FFA will accelerate the schedule for transfer of waste stored in inactive LLLW tanks to tanks meeting the new double-containment standards, that is, the MVSTs. Costs of implementing FFA-related projects are expected to be very high, thus impacting funding available for these and other waste management activities.

5.2 LAND DISPOSAL RESTRICTIONS

Section 3004(j) of the 1984 Hazardous and Solid Waste Amendments to RCRA (40 CFR Part 268) prohibit storage of land-disposal-restricted (LDR) hazardous waste except "solely for the purpose of accumulation of such quantities of hazardous waste as necessary to facilitate proper recovery, treatment, or disposal." A treatment system for newly generated waste and any waste transferred from inactive tanks containing RCRA-regulated materials must be operational in 1994 to gain compliance, or a Federal Facilities Compliance Agreement (FFCA) will have to be developed. Even if an FFCA is granted, the timing will require accelerating development and implementation of the long-term treatment system originally planned as the third phase of the LLLW waste management strategy.

5.3 SOLID LOW-LEVEL WASTE DISPOSAL OPTIONS

Another major area of uncertainty involves the storage and disposal of solid radioactive waste. Much work has been done to define the disposal requirements for wastes containing different levels of radioactivity, but meaningful estimates of radionuclide concentration limits cannot be made for disposal sites on the Oak Ridge Reservation until completion of the environmental impact statement (EIS) for the Reservation and the performance assessments (PA) required by DOE Order 5820.2A for each individual disposal site. Although the results of the EIS and PA will not be available in the near term, preliminary[13] results indicate that the waste acceptance criteria will be lower than previously expected for certain radionuclides.

This is likely to reduce the amount of solid low-level waste (SLLW) that can be disposed of on the Oak Ridge Reservation and to increase the amount of waste that will require long-term storage prior to off-site disposal. Neither a site nor the waste acceptance criteria for a disposal facility for high-activity non-TRU waste has been identified yet by DOE. The space in long-term storage facilities is likely to be limited, particularly in the near-term, until new facilities can be identified and/or built.

Similar situations exist for off-site disposal facilities such as WIPP for TRU waste. In addition to ongoing uncertainty with respect to the applicability of RCRA requirements to waste disposal, the state of New Mexico is developing additional requirements that will be imposed at WIPP.

The uncertainties and limitations associated with solid waste storage/disposal options indicate a need to decrease the volume of SLLW derived from LLLW treatment. They also indicate a need to design treatment facilities that can produce waste forms suitable for interim storage until the waste acceptance criteria for off-site disposal facilities are identified. There is some reluctance to build facilities to convert LLLW into SLLW until the waste acceptance criteria for disposal facilities are finalized. The impact on new LLLW treatment facilities is described in the next section.

5.4 FUNDING CONSTRAINTS

Intense competition for limited funding resources is expected as DOE facilities across the country upgrade or replace waste management capability. In addition, the funding limit for general plant projects (GPPs), small projects that can implement upgrades in 3 to 4 years, has not been increased above $1.2M for many years. Inflation and additional quality assurance, safety, environmental assessments, conservatism of design requirements, and contractor overhead have significantly limited the activities that can be completed on GPPs. No projects are forecast to be done after FY 1993 because of the low dollar value. Most upgrade projects may have to be accomplished through line item projects (LIPs), which take 8–10 years to implement. These constraints are likely to delay implementation of the ORNL waste management strategy. Special examples and effects are discussed below.

The WHPP was originally proposed as an FY 1991 LIP to process remote-handled TRU waste for disposal at WIPP. However, WHPP has been delayed to FY 1995 or later. Delays in the WHPP project up to this point in time dictate that (1) additional storage tanks be built and (2) plans for development of the long-term treatment flowsheet to treat newly generated waste be accelerated to meet regulatory requirements.

The project to upgrade the PWTP has also been affected by funding limitations and the solid waste disposal PA. The FY 1992 LIP to build centralized solid waste disposal facilities for the Oak Ridge Reservation was to replace the PWTP with a new facility with increased treatment operations and feed capacity to allow processing for the landfill leachate. This treatment facility was also being designed to treat new waste streams generated by implementation of FFA-related projects, to treat the decontaminated LLLWC supernatant, and to eliminate production of LLLW at the PWTP. Limited resources and preliminary PA results for disposal facilities resulted in the decision to drop the PWTP upgrade from the waste disposal line item, which has been delayed to an FY 1994+ project. An FY 1995 LIP is now being proposed by ORNL for the PWTP upgrade, but the 3-year delay will significantly increase the amount of LLLWC that will have to be stored in the MVSTs and eventually processed for off-site disposal because the PWTP produces 40% of the LLLWC.

The inability to implement capital projects quickly using expense and GPP funding is likely to delay efforts for source treatment, waste minimization, process relocation, and treatment of MVST supernatant to provide storage capacity. This will probably delay compliance with FFA requirements, implementation of LLLW treatment capability, and minimization of ES&H risks.

6. STRATEGY CHANGES

The WHPP and the PWTP upgrade are the cornerstone of the LLLW waste management strategy. They are required to meet regulatory requirements and to avoid shutdown of the LLLW system because of lack of storage space. The WHPP line item has been delayed from an FY 1991 line item to an FY 1995 or later project. The PWTP line item has been delayed from an FY 1992 line item to an FY 1995 project. Studies indicate that existing sludges in the MVSTs cannot be treated without a facility comparable to the WHPP and that a facility such as the WHPP is necessary to complete the long-term LLLW treatment strategy. The WHPP is also needed to treat TRU waste sludges from inactive LLLW storage tanks and to treat some wastes generated by decontamination and decommissioning of surplus facilities. Most newly generated R&D wastes can be treated with less complex processes if they are properly segregated and/or pretreated. Much of the newly generated waste might be diverted to the new PWTP (possibly with pretreatment) for treatment and discharge to the environment.

ORNL has three options for dealing with LLLW long-term: (1) proceed with WHPP as an FY 1995 line item designed with the flexibility to produce any waste form required to meet waste acceptance criteria for the WIPP and on-site disposal facilities, (2) build a treatment facility as soon as possible to treat newly generated waste and construct the WHPP to treat legacy waste in the MVSTs after the WIPP waste acceptance criteria are finalized, and (3) build the portion of the WHPP that could be utilized to treat newly generated waste for on-site disposal as soon as possible and complete construction of WHPP after the WIPP PA is complete. The first case is considered to be the safest and most economical by ORNL. In all three cases, the new PWTP will be required to treat supernatant and/or dilute LLLW for discharge to the environment.

Facilities to treat LLLWC need to be operational by 1994 to meet the LDR treatment requirements for newly generated wastes, or an FFCA needs to be negotiated to allow storage of LLLW until the treatment systems are in place. The option that will be pursued is being negotiated with DOE.

Regardless of the option chosen, supernatants in the MVSTs must be treated to provide storage space for the LLLWC generated until new treatment facilities can be installed. Supernatants are presently being treated by solidification in concrete and by ITE at ambient temperature. Both will be required to avoid shutdown of the LLLW system before the year 2000, when the MVSTs are expected to be filled to capacity with sludges and saturated supernatants. Since new treatment facilities are not likely to be operational in this time frame, an FY 1994 line item for an MVST expansion has been proposed to install an additional 450,000 gal of LLLW storage capacity plus a free reserve capacity equal to the capacity of the largest tank installed that is needed for safety purposes. These new tanks will have the capacity to store waste transferred from the inactive LLLW tanks and the evaporator service tanks, return the operational safety margin to previous levels, and accommodate 5 years of LLLWC generation. This would also allow increased operational flexibility to allow for waste segregation, which will result in more efficient treatment for waste volume reduction and improved waste forms for disposal and will not produce the current type of problematic waste that is giving us problems.

Evaluations of future waste generation indicate that a combination of (1) ITE, (2) two or three solidification campaigns (or enhanced evaporation), (3) not transferring the inactive LLLW tank sludges to the MVSTs, and (4) no acceptance of significant new waste streams could provide the storage capacity needed until new storage tanks come on-line in 1997 and new treatment facilities become operational (estimated for 2003 to 2006). However, it should be noted that this will severely limit the capabilities of the LLLW system to handle emergency situations and any effects produced by delays in capital projects for new tanks and/or treatment facilities. New R&D programs will be limited as to the types and amounts of wastes which they can generate and may require preprocessing before discharge to treatment facilities. In addition, potential regulatory limitations might be imposed on the ERP. Therefore, as a contingency measure, enhanced ITE should be investigated for the wastes in both the active and inactive LLLW tanks.

Implementation of source treatment/pretreatment processes will be accelerated for newly generated waste streams: (1) source treatment will be implemented for streams that have low concentrations of radioactivity and (2) pretreatment systems will be developed for streams that contain components that cause problems with centralized treatment. The remaining waste streams should be processed in the centralized treatment system through a facility designed to produce the optimum waste forms for storage/disposal. Dilute "nongenerator" waste (i.e., groundwater inleakage and waste collected from filter pits, sumps, floor drains, condensate from the hot off-gas system, etc.) will be evaluated to determine if these sources can be either eliminated or diverted to the process waste system after the PWTP upgrades are completed.

7. STATUS OF STRATEGY IMPLEMENTATION

The LLLW waste management plan is being implemented in near- and long-term phases. The near-term activities include (1) implementing expense-funded projects to begin meeting FFA requirements and reducing waste generation rates, (2) removal of excess water from the MVSTs by evaporation, and (3) as a last resort, solidification of MVST supernatant in a concrete matrix to reduce the inventory in the MVSTs until LLLW treatment facilities can be built. The long-term activities include implementation of capital projects to (1) meet the FFA requirements, (2) implement source treatment/pretreatment projects to reduce LLLWC generation, and (3) implement capital projects to provide centralized treatment facilities to process existing and newly generated waste for storage/disposal. Near-term activities are well under way, and development and planning efforts are under way for long-term projects.

Improvements in waste management operations and reductions at the source reduced the LLLWC generation rate from about 32,000 gal/year in 1986 to about 16,000 gal/year in 1990. An ITE demonstration indicated that the process is capable of reducing the MVST volume by 1400 gal/year per tank. To implement ITE, the air compressor is being replaced, and the reasons for intermittent wetting of the HEPA filters are being identified. ITE is expected to be operational in FY 1992. Based on experimental results, ITE would be capable of evaporating the majority of the newly generated waste produced from normal operations before 1997, when additional storage space becomes available—equivalent to one additional 50,000-gal solidification campaign. ITE alone will not be sufficient to keep the LLLWC inventory below the maximum capacity of the MVSTs until 1997. Therefore, up to four 50,000-gal MVST supernatant solidification campaigns (including the one conducted in 1989) are being planned. Methods to enhance the supernatant evaporation rate are also being considered to minimize the number of additional solidification campaigns. The evaporation rates are expected to be a maximum of 2,800 gal/tank per year based on experimental results.

Supernatant pretreatment prior to solidification has been considered to reduce the activity in the waste to produce a waste form acceptable for on-site disposal. Studies have been performed to determine if decontamination could be performed in situ (inside the MVSTs) or if treatment would have to be performed in a processing facility under more controlled conditions. These studies[13] indicate that in situ pretreatment is not feasible. Pretreatment in a processing facility appears possible, but significant development work will be required. Pretreatment efforts will be continued for inclusion in WHPP.

The upgrades for the LLLW system, including those required by the FFA, are being implemented by numerous capital projects (see Tables 6 and 7) and expense-funded projects. Expense funding is being used to implement bottling and trucking, relocate facilities, and provide source treatment for generators that are likely to lose direct access to the LLLW system in the near future as a result of the FFA implementation. GPPs are being implemented to (1) treat waste at the source, (2) eliminate waste streams, (3) divert dilute waste streams to the process waste treatment system, (4) install bottling and trucking stations, and (5) implement small system upgrade projects. LIPs are being implemented to replace or upgrade the LLLW collection systems to completely implement the new standards required in the FFA.

ORNL has three LIPs planned to upgrade the collection and transport system for facilities that will continue to have long-term LLLW service: the Bethel Valley Collection and Transfer (CAT) System Upgrade (FY 1988 with a budget of $35M), the Melton Valley CAT System Upgrade (FY 1992 with a budget of $41M), and the Bethel Valley FFA Upgrade (FY 1994 with a budget of $45M). These projects will replace the LLLW CAT systems for the REDC, HFIR, and Buildings 3092, 3517, 3525, 3025, and 2026 and will build a tanker truck/bottle unloading station at the LLLW evaporator facility.

Two treatment facilities are presently planned for the treatment of LLLW. The WHPP is proposed to treat existing LLLWC and future generated waste for disposal. This facility has been delayed from an FY 1991 line item to an FY 1995+ project. All development studies and detailed design projects are on hold because of lack of funding. An FY 1995 LIP is planned to replace the PWTP with a new facility that will have increased capacity and enhanced treatment capabilities to allow it to process dilute LLLW (possibly after pretreatment) for disposal. The development efforts and capital project planning activities for this project are under way.

Table 6. General plant projects identified for upgrade of the ORNL LLLW system[a]

Year	Title	Scope	Facility affected
1992	BSR LLW Upgrade	Provides source treatment to convert LLLW to solid and process waste.	BSR
1992	3544 IE/E Room Upgrade	Doubly contains Tank L-11.	3544
1992	HFIR LLW System Upgrade	Provides source treatment to convert LLLW from laboratory facilities to solid and process waste.	HFIR
1992	3000 Area LLW Upgrade	Provides bottling stations for low-volume generators.	3504
1992	4500 Area LLW Upgrade	Provides bottling stations for low-volume generators.	4500 Complex
1992	Building 3047 Trucking Station	Provides trucking station for Building 3047 generators.	3047
1992	FFA Compliance Work, Bldg. 3019A	Doubly contains noninspectable piping for 3019.	3019
1993	Bldg. 3525 LLLW FFA Upgrade	Installs doubly contained piping to bypass leaking LLLW tank at 3525.	3525
1993	FFA Compliance Work, Bldg. 3025	Provides bottling stations for 3025.	3025
1993	LLLW Treatment Alternative	Provides source treatment to convert LLLW from reactors to solid and process waste.	HFIR
1993	Piping Additions for FFA	Pipes 4500 area floor sumps to process waste.	4500 Complex
1993	Filter Pit Upgrade	Enclose filter pit at REDC.	REDC
1993	3108 Filter Pit Enclosure	Enclose filter pit 3108 which services Building 3019.	3019
1994	Three GPPs to be defined	Eliminate nonprogrammatic waste generation or upgrade appropriate collection/transport system for secondary containment.	
1995	Three GPPs to be defined	Eliminate nonprogrammatic waste generation or upgrade appropriate collection/transport system for secondary containment.	
1996	Three GPPs to be defined.	Eliminate nonprogrammatic waste generation or upgrade appropriate collection/transport system for secondary containment.	

[a]Based on requirements-level funding.

Table 7. Line item projects identified for upgrade of the ORNL LLLW system[a]

Year	Title	Scope	Facility affected
1988	Bethel Valley CAT System Upgrade	Replaces 2026 tank system and the hot off-gas scrubber LLLW piping. Provides upgraded tanker truck and bottle unloading stations.	2026 Hot Off-Gas Scrubber
1992	Melton Valley CAT System Upgrade	Replaces or upgrades tank systems for REDC and HFIR.	REDC HFIR
1994	MVST Capacity Increase	Provides storage capacity for concentrated LLLW.	All
1994	Bethel Valley FFA Upgrades	Replaces tank systems for 3517, 3025, 3525, and WC-9. Doubly contains LLLW piping for 2533.	3025 3517 3525 Hot Off-Gas Pot 2533 Transfer Lines
1995	Pretreatment System for Decontamination of ORNL Wastewaters	Provides source treatment to convert LLLW to solid waste.	3544
1995	Waste Handling and Packaging Plant	Provides treatment capabilities for concentrated LLLW.	All

[a]Based on requirements-level funding.

8. SUMMARY

Plans for LLLW management have been to either upgrade or replace the LLLW collection and transfer system (for the most part by replacement of underground tanks/lines) to meet new FFA standards and to build the WHPP and new PWTP to treat existing and future LLLWC for disposal. This approach is considered to be the safest and most flexible way of handling LLLW. It also efficiently utilizes funding by increasing the treatment capabilities and life expectancy of the WHPP (which must be built to treat legacy TRU waste) for a small incremental cost. Delays in these projects and FFA and RCRA-LDR requirements have resulted in the need to build new LLLWC storage tanks. They have also resulted in the need to accelerate implementation of source treatment/pretreatment options.

New centralized treatment facilities must be built which will treat existing and/or newly generated LLLW for WIPP and/or on-site disposal/storage. However, the numbers and types of facilities to be built depends on approval of LIPs by DOE. ORNL recommends that the WHPP facility be built as an FY 1995 line item to process both legacy and newly generated LLLWC. However, if the WHPP (as proposed) is not funded until after the WIPP waste acceptance criteria are developed, other, more costly alternatives must be implemented to begin treatment of newly generated waste as soon as possible. Until plans for WIPP are finalized, development efforts will focus on reducing the inventory in the MVSTs and treatment of newly generated waste.

Even with the delays in capital projects, considerable progress has been made this year in implementing the LLLW strategy. Work commenced this year on (1) developing a strategic plan for meeting the FFA,[15] (2) preparing FFA deliverables documents,[16] (3) implementing contingency plans, (4) developing a plan for leak testing, (5) preparing secondary containment design demonstrations, and (6) conducting structural integrity assessments for the active tank systems. Bottling and trucking are being implemented for generators who are expected to lose access to LLLW tanks when the FFA becomes effective. Some generators losing access to LLLW tanks are being relocated to facilities that are being upgraded to have continued long-term LLLW access. Projects are also under way to locate and attempt repairs for potentially leaking system components.

Solidification campaigns and ITE projects to reduce the inventory in the MVSTs are under way. Methods to accelerate the evaporation rate are also being investigated.

R&D efforts have been initiated to develop pretreatment or treatment systems that can be implemented at the source of generation. Treatment facilities are being developed for the PWTP, the REDC, the HFIR, and the ORR/BSR to eliminate nonradioactive dissolved solids, cobalt, and TRU waste from the centralized LLLW system. If successful, these projects have the potential to reduce the LLLW generation at ORNL by 60% and to segregate TRU and highly contaminated waste streams from the bulk of the waste produced. This will result in minimizing the volume of solid waste generated as a result of LLLW processing. All processes that generate LLLW are also being reviewed to determine if waste reduction activities can be implemented. Design of systems to treat the resulting waste for discharge to the new PWTP and to produce solid waste for on-site storage/disposal are being developed.

The near-term solid waste generation rates for ORNL will increase significantly above previous estimates when these projects are implemented. It is likely that presently operational and proposed solid waste storage/disposal facilities will have trouble accommodating these waste streams. The impacts of increasing solid waste generation are being examined and incorporated into the solid waste management strategy.

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