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Liquid Low-Level Waste Generation Projections for ORNL In 1993

S. M. DePaoli

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

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ORNL/TM-12638

Chemical Technology Division

LIQUID LOW-LEVEL WASTE GENERATION PROJECTIONS FOR ORNL IN 1993

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ACRONYMS

BSR	Bulk Shielding Reactor
CY	Calendar Year
D & D	decontamination and decommissioning
DOE	U.S. Department of Energy
ERP	Environmental Restoration Program
FFA	Federal Facilities Agreement
HFIR	High Flux Isotope Reactor
HOG	hot off-gas
ISP	Isotopes Shutdown Plan
ITE	in-tank evaporation
IX	ion exchange
LITR	Low-Intensity Test Reactor
LLLW	liquid low-level waste
LLLWC	liquid low-level waste concentrate
LLW	low-level waste
MVST	Melton Valley Storage Tank
NTF	North Tank Farm
OGR	Old Graphite Reactor
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Research Reactor
OSR	Operation Safety Report
OTE	out-of-tank evaporation
PWTP	Process Waste Treatment Plant
R & D	research and development
RA	Remedial Actions
REDC	Radiochemical Engineering Development Center
SC	solidification campaign
STF	South Tank Farm
TRU	transuranic
VOG	vessel off-gas
VRF	volume reduction factor
WAG	Waste Area Grouping

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EXECUTIVE SUMMARY

Liquid low-level waste (LLLW) is generated by various programs and projects throughout Oak Ridge National Laboratory (ORNL). These wastes are collected in underground collection tanks, bottles, and trucks; they are then neutralized with sodium hydroxide and treated for volume reduction at the ORNL evaporator facility. This report presents historical and projected data concerning the volume and characterization of LLLW, prior to and after evaporation. Storage space for projected waste generation is also discussed.

1. INTRODUCTION

The Waste Management and Remedial Actions Division 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 activities, and waste operations activities. An ongoing effort to develop and implement improved liquid processing systems has been under way with the following objectives: (1) to provide facilities to treat all present and future wastewaters generated at ORNL, (2) to meet applicable regulatory requirements, and (3) to improve effluent quality while reducing the amount of secondary waste generated. Efforts began in the mid-1980s to develop a consistent, logical approach for upgrading the low-level waste (LLW) 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 was written to support the LLLW management strategy by reflecting evaluations of current and future waste characterization/generation data, changes in interagency agreements and regulations, and advances in the R&D program to treat LLLW.

2. BACKGROUND

LLLW has been generated at ORNL since the inception of laboratory operations in the 1940s. This type of waste is collected in underground storage tanks, is often neutralized with sodium hydroxide, and is jetted or pumped to the central LLLW system where it is concentrated by evaporation. The liquid LLW concentrate (LLLWC), which is removed as bottoms from the evaporators, is transferred to tanks for storage where it

separates into sludge and supernate phases. This waste is stored in these phases until further processing steps render it suitable for disposal.

From 1964 to 1984, 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 accumulated in the LLLW evaporator service tanks (ESTs) and the Melton Valley Storage Tanks (MVSTs), which have a limited storage capacity. A diagram of the liquid waste system is shown in Figure 1.

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

The near-term management plan for treatment of LLLWC consisted of three phases: (1) reduction of wastes generated by identifying and evaluating LLLW sources and treatment systems, (2) removal of excess water from the stored waste by in-tank evaporation (ITE) in the MVSTs, and (3) solidification MVST supernatant in a concrete matrix to provide operational flexibility of the current LLLW system. The intermediate-term management plan for LLLWC was to process existing transuranic waste sludge and the associated supernatant for disposal at the Waste Isolation Pilot Plant, the deep geologic repository that the U.S. Department of Energy (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 which 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. Significant accomplishments and changes have occurred since the planning team's strategy was developed. The near-term strategy plans are progressing very effectively. However, delays

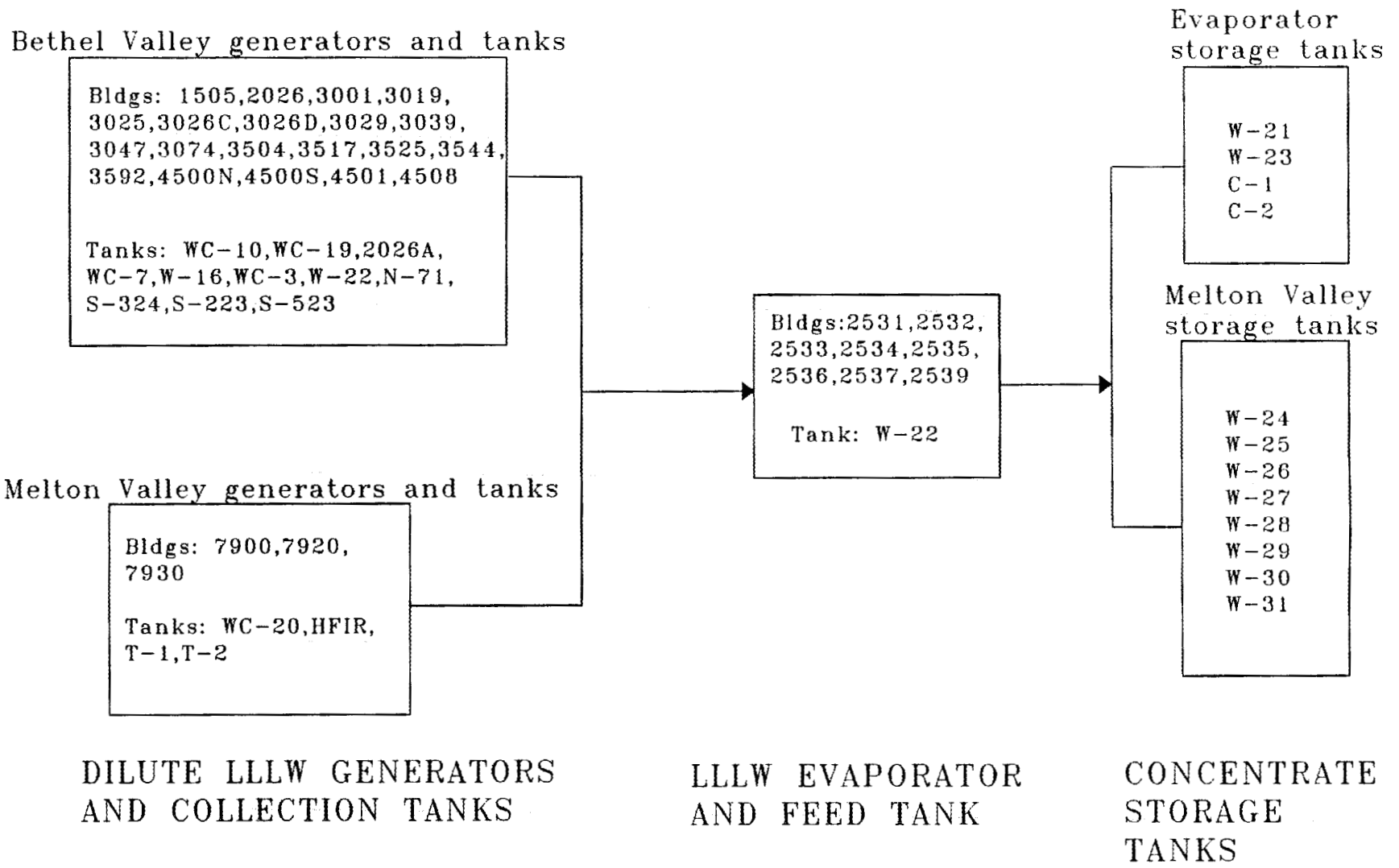


Fig. 1. Schematic of the liquid low-level waste system.

in capital projects and some increases in waste generation warranted an increase in storage space in the near term. The sources of LLLWC have been extensively identified and source treatment options are being developed for the largest generators of LLLWC. ITE has been operating successfully for just over 1 year; approximately 21,700 gal of water has been evaporated from the MVSTs during that year. Two solidification campaigns have been successfully completed. Approximately 95,000 gal of supernate was solidified in these two campaigns. A third campaign began in November 1993 to solidify 50,000 gal of LLLWC. Six new 100,000-gal tanks are scheduled to be installed toward the end of the 1990s.

In terms of intermediate and long-term plans for the LLLW system, programs are in place to perform R&D work to define flowsheets for processing LLLWC. Implementation of Land Disposal Restrictions for Resource Conservation and Recovery Act waste has required that the research concerning long-term treatment options for newly generated waste be accelerated. This research is occurring in conjunction with development of Waste Handling and Packaging Plant.

A previous report summarizes LLLW generation up to 1989.[2] This report will summarize generation of LLLW over the last few years and will discuss projected generation rates over the next 15 years. Operations to reduce LLLWC over the last few years will be discussed, as will the plans currently being developed that will be put into place in the near future to reduce LLLW generation and activity.

3. LIQUID LOW-LEVEL WASTE GENERATION

This document reports on the ongoing review of the ORNL liquid waste system to identify waste generators and analyze the current LLLW system operation. Many changes have taken place in the use and operation of the LLLW system over the last few years. Significant changes in the use of the LLLW system include (1) the shutdown of the isotope production programs, (2) the shutdown of the Oak Ridge Research Reactor (ORR) and Bulk Shielding Reactor (BSR), and (3) the restart of the High Flux Isotope Reactor (HFIR). In terms of the operation of the LLLW system, the Federal Facilities Agreement (FFA) took effect in January 1992, shutting down several active LLLW tanks. The generators that had previously used those tanks began bottling LLLW. Those tanks are now collecting only nonprogrammatic waste (filter-pit inleakage, sumps, etc.). In the next several years, many operation modifications are expected to reduce the generation of LLLW. The Process Waste Treatment Plant (PWTP) upgrades, source treatment at HFIR, possible source treatment at the Radiochemical Engineering Development Center (REDC), and rerouting of some nonprogrammatic waste streams will all have a significant impact on the LLLW system operation.

Information to support the analysis of LLLW dilute and concentrate generation has been obtained over the last 5 years through "generator surveys." Through these surveys, information has been accumulated on (1) the programs and activities which generate LLLW, (2) estimates on dilute LLLW volume, (3) radioactivity of the waste, and (4) solids contents of the waste (caustic, cleaners, etc.). This information has been used to predict dilute and concentrate generation rates for each generator, concentrate storage volume needs, and future waste profiles. The following sections summarize the information

received this calendar year, as well as the forecasted changes to this information as currently envisioned.

3.1 DILUTE LLLW GENERATION

3.1.1 Current Dilute LLLW Generation

Table 1 presents the historical dilute LLLW generation from 1990 through 1992, as well as the expected generation for 1993 (based on collection rates through October 1993 and the 1993 generator surveys). Total dilute LLLW generation has not changed significantly during the last 4 years; however, generation rates at several facilities have decreased or increased over the last few years. Among those rates that have changed are the following:

WC-10 — (Bldgs. 3029, 3030, 3031, 3038W, 3047): An estimated 176 gal/month (2200 gal/yr) will be generated in the ongoing surveillance and maintenance of these facilities. During 1992, only Bldgs. 3029 and 3047 were generating LLLW, at an estimated 250 gal/month (3000 gal/yr). However, during 1993, all the facilities listed above will be using hot drains in ongoing surveillance and maintenance activities but at a lower overall rate. Heavy decontamination of the facilities as part of the Isotopes Shutdown Plan (ISP) is on hold until funding becomes available, which will probably not occur until after 1997.

WC-19 — (Old Graphite Reactor/ORR/BSR): The ORR and BSR have stopped generating LLLW temporarily. Both facilities are regenerating the reactor pool waters by taking a bleed stream from the pool while feeding in a deionized water

Table 1. Historical and present dilute liquid low-level waste generation, 1990–1993

Tank	Building	Dilute LLLW generation (gal/year) 1990	1991	1992	1993[a]
		Generators			
WC-10	3028, 3029*, 3030-32, 3038, 3039, 3047*, 3093	1,800	4,800	3,000	2,200
WC-19	Bldgs. 3001* (OGR), 3042(ORR), 3119(BSR)	10,600	10,600	4,000	1,200
2026	Bldg. 2026*	1,400	3,400	2,700	3,600
WC-11	Bldg. 4501, 4505, 4507, 4500N	200	600	0	0
WC-12	Bldg. 4505	0	0	0	0
WC-13	Bldgs. 4500N&S, 4507, 4508	600	70	0	0
WC-14	Bldg. 4501	200	600	0	0
W-12	Bldg. 3525	17,700	12,330	0	0
WC-20	Bldg. 7920*, 7930 (REDC)	12,800	17,150	13,000	11,000
HFIR	Bldg. 7900* (HFIR)	48,100	99,400	121,400	110,000
WC-5&6	Bldgs. 3508, 3541, 3592	0	0	0	0
WC-7	Bldg. 3504*	450	2,200	530	120
WC-8	Bldg. 3503	0	0	0	0
W-16	Bldg. 3026D*	140	2,000	550	500
W-17&18	Bldg. 3026C	1,200	1,200	0	0
WC-3	Bldg. 3025*	12	250	420	200
WC-2	Bldg. 3028, 3038	0	0	0	0
W-22	PWTP Feed*	3,700	7,400	12,600	10,800
	3039 Stack*	42,300	42,000	38,900	43,200
N-71	Bldg. 3019*	1,200	1,000	360	150
S-324, 223, 523	Bldg. 3517*	4,800	0	400	0
Trucked	Bldg. 3074*	1,300	1,700	1,900	1,700
	Bldg. 3525*			1,300	1,700
Bottled	Bldg. 3026C*				12
	Bldg. 3047*				12
	Bldg. 3592*			50	96
	Bldg. 4500N*			6	12
	Bldg. 4500S*				12
	Bldg. 4501*				12
	Bldg. 4508*				12
	Bldg. 1505*				36
	SUBTOTAL	**148,502**	**206,700**	**204,116**	**186,574**
	Sumps, filter pits, other nonprogrammatic waste and inleakage				
WC-10	Various HOG pots in Isotope Area	5,300	17,700	9,200	11,900
WC-19	Bldg. 3042 HOG pot	18,600	9,200	3,000	1,000
W-1A	Inleakage	46,600	38,800	21,000	17,000
WC-11	Bldg. 4556 (filter pit), 4500N west wing sump	4,100	20,100	5,600	4,800
WC-12	Tank T-30 sump	1,100	700	700	400
WC-13	Inleakage	2,500	920	840	100
WC-14	Bldg. 4501 sumps	400	70	160	400
WC-8	Pump prime water	14,220	4,300	1,400	1,400
WC-9	HOG pot	10,570	18,600	7,760	10,000
WC-5&6	Inleakage	4,130	3,500	2,650	2,000
W-12	Inleakage	3,000	3,000	2,950	3,300
HFIR	Bldgs. 7911, 7913, 7922 (Stack, filter pit, etc.)	26,000	26,000	26,000	26,000
WC-2	Isotope HOG pot, 3039 HOG pot	240	240	300	300
WC-7	Inleakage	330	2,100	410	400
W-17&18	Inleakage	30,400	29,400	9,670	11,500
S-523, 223, 324	Bldg. 3517 filter pit, HOG pot	8,000	22,800	9,300	33,000
WC-3	Bldg. 3098 (filter pit)	100	100	100	100
W-16	Seal traps for W-16, 17, 18,Bldg.3515	200	200	200	100
	SUBTOTAL	**175,790**	**197,730**	**101,240**	**123,700**
	Other (sumps, etc.)[b]	81,100	139,150	78,000	95,000
	TOTAL	**405,392**	**543,580**	**397,628**	**405,274**

OGR = Old Graphite Reactor; ORR = Oak Ridge Research Reactor; BSR = Bulk Shielding Reactor; REDC = Radiochemical Engineering Development Center; HFIR = High Flux Isotope Reactor; PWTP = Process Waste Treatment Plant; HOG = hot off-gas

* These facilities are currently generating LLLW (as of 1993). Facilities that do not have an asterisk are not currently generating LLLW.

[a]Data for 1993 estimated based on 1993 generator surveys and information available January – October, 1993 from Waste Management.

[b]Includes Bldgs. 2531, 2533, 2534, 7830, inactive tanks, etc.

stream for replacement water, rather than the customary regeneration which produces LLLW. A 1992 General Plant Project is being implemented to make this a permanent arrangement. However, LLLW will possibly be generated before the permanent arrangement is implemented if some problems are encountered in reaching a steady state. A reduction of approximately 1000 gal/year dilute LLLW has been accomplished through these upgrades (6000-7000 gal/year if the reactors were operating). LLLW collection at WC-19 is down significantly from 1992. Regeneration of the demineralizer columns in Bldg. 3001, the Old Graphite Reactor (OGR), is ongoing. Regeneration of the columns at OGR results in approximately 1200 gal/yr of dilute LLLW.

S-324, 223, 523 — (Bldg. 3517): The large increase in volume for 1993 is due entirely to rainfall variation. While 1992 was a very dry year, early 1993 experienced extremely heavy rainfall. The filter pits were jetted many times early in 1993. No decontamination activities have been performed during 1993 at Bldg. 3517.

WC-20 — (REDC): Although a small change in volume is expected for 1993 (<1000 gal/year over the previous year), the waste stream composition has changed significantly. The REDC off-gas scrubber (VOG) solution was changed from 4-5 *M* potassium hydroxide to 2.2 *M* sodium hydroxide, thus greatly reducing the potassium salts entering the LLLW system. Removal of potassium is desirable because potassium competes with cesium removal in most treatment processes. This change has also reduced the amount of dissolved solids in the LLLW. Because the volume-reduction capability of the LLLW evaporators is a function of the dissolved solids, this resulted in a lower production of concentrate for this facility. An estimated 50-

65% reduction in concentrate generation at REDC has been realized by eliminating the potassium and reducing the dissolved solids content in the VOG system.

REDC personnel are working on other waste minimization projects, some to reduce the activity as well as the volumes, but reduction estimates cannot be made at the present time.

HFIR: HFIR generation has remained approximately the same for CY1993 as compared with generation estimates for 1992; however, problems associated with the resin in the demineralizer columns have increased the number of regenerations performed over the past few years. A generation of 120,000 gal was reported for last year (1992) and approximately 120,000 gal of dilute LLLW is expected to be generated during 1993, although through October 1993 that yearly average is 110,000 gal.

W-12 — (Bldg. 3525): All waste generated at Bldg. 3525 is now collected in tank F-501 and trucked from there to the LLLW system. The estimate for 1993 is 1700 gal/yr (higher than the 1992 generation). This increase is due to more decontamination of cells and an increase in the work level at the facility.

WC-3 — (Bldg. 3025): The 1993 generator estimate from Bldg. 3025 is 1700 gal/yr. This is a conservative estimate, and to date the generation is only approximately 200 gal/yr. The projected increase is due to a projected increase in research activities involving metal polishing; however, the change in generation rates has yet to be

realized. Bldg. 3098, the Filter Facility for the BSR and the Low-Intensity Test Reactor (LITR) also discharges an estimated 100 gal/yr to this tank.

Bottled waste — (Chemistry Division, Chemical Technology Division, Health and Safety Research Division, Environmental Sciences Division, Metals and Ceramics Division): A total of 204 gal/yr of dilute LLLW is estimated to be bottled by the listed divisions for CY 1993.

Inactive tanks — (7562, 3001-B, 3013, H-209): Several inactive tanks will possibly be emptied to the LLLW system in 1993. Approximately 5500 gal of dilute LLLW would be generated. Through June 1993, only contents of tank 7562 were sent to the LLLW system (5000 gal by tanker truck). The contents of a few of these tanks may be sent to the PWTP.

Trucked waste — (Bldgs. 3074, 7830): The Manipulator Repair Facility (Bldg. 3074) is estimating a generation rate of 382 gal/month which is identical to the 1992 estimate. Approximately 1000 gal/month is trucked from the MVST sumps at Bldg. 7830.

Other generation — (Bldg. 2531): An estimated 2000 gal/month of dilute LLLW is collected and sent to W-22 from the Evaporator Complex Facility filter pits and sumps. (This volume is included in the "Other" grouping under the "Sumps, filter pits, other nonprogrammatic waste and inleakage" subheading in Table 1.)

The major *dilute* LLLW generators for 1993 are as follows: HFIR (30%), the 3039 stack (9%), REDC (2%), and the PWTP (2%); all others account for 4% of the dilute LLLW. Nonprogrammatic waste and inleakage account for the other 53% of dilute LLLW generation during 1993.

3.1.2 Future Dilute LLLW Generation

Several changes are expected in dilute LLLW generation over the next 15 years. Forecasted dilute LLLW generation rates are listed in Table 2. Included are generation rates of LLLW for decontamination and decommissioning (D&D) activities by the Surplus Facilities Program, as well as Remedial Actions (RA) activities which mainly consider the cleanup and remediation of Waste Area Grouping (WAG) sites. In both cases, the LLLW to be generated is a result of decontamination activities. The transfer of inactive tank supernates will be a major source of dilute LLLW during 1997 and 1998 when the South Tank Farm is expected to be remediated. The following paragraphs summarize changes in LLLW generation expected by the current generators.

Tank WC-10 is serving only to maintain and eventually to decontaminate the Isotope Facilities. The shutdown of these facilities is dependent on budgeting concerns for the ISP. Currently, the funding for shutdown is not expected to become available until 1998; thereafter, shutdown is expected to take approximately 4 years to complete. The availability of WC-10 for this whole period is unknown; however, for purposes of projections, it is assumed that the tank will be available.

Tank WC-19 is currently receiving waste only from the regeneration of ion exchange columns at the ORR. This is expected to occur for 3–4 more years, until the required

Table 2. Forecasted dilute liquid low-level waste generation, 1994-2010

Tank (Facility)	Dilute LLLW generation (gal/year)																
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Generators																	
WC-10 (Isotope Area)	2,200	2,200	2,200	2,200	12,000	12,000	12,000	12,000	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
WC-19 (Reactors)	1,200	1,200	1,200	1,200	0	0	0	0	0	0	0	0	0	0	0	0	0
2026 (Bldg. 2026)	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700
WC-20 (REDC)	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
HFIR	120,000	120,000	120,000	120,000	0	0	0	0	0	0	0	0	0	0	0	0	0
WC-7 (Bldg. 3504)	120	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
W-16 (Bldg. 3026D)	900	900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WC-3 (Bldg. 3025)	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700
W-22 (PWTP feed)	10,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(3039 Stack)	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200	43,200
N-71 (Bldg. 3019)	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
S-523 (Bldg. 3517)	400	400	400	400	4,000	4,000	4,000	4,000	0	0	0	0	0	0	0	0	0
Trucked (Bldg. 3074)	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700
(Bldg. 3525)	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800
Bottled (various)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
SUBTOTAL	**202,220**	**191,310**	**190,410**	**190,410**	**82,610**	**82,610**	**82,610**	**82,610**	**68,810**	**68,810**	**68,810**	**68,810**	**68,810**	**68,810**	**68,810**	**68,810**	**68,810**
Others																	
Nonprogrammatic waste[a]	215,000	215,000	215,000	215,000	215,000	185,000	185,000	185,000	185,000	185,000	185,000	185,000	185,000	185,000	185,000	185,000	185,000
Inactive Tanks[b]	109,300	0	0	276,000	100,300	0	0	0	0	0	0	0	0	0	0	0	0
D&D Activities	2,350	0	11,244	41,584	56,326	81,457	62,278	127,204	72,432	72,638	64,925	140,456	140,456	140,456	75,531	75,531	77,158
RA Activities	110,402	129,888	131,260	169,510	105,585	108,817	110,592	110,594	41,606	46,992	59,877	47,186	34,243	34,243	33,918	33,573	23,664
SUBTOTAL	**437,052**	**344,888**	**357,504**	**702,094**	**477,211**	**375,274**	**357,870**	**422,798**	**299,038**	**304,630**	**309,802**	**372,642**	**359,699**	**359,699**	**294,449**	**294,104**	**285,822**
TOTAL	**639,272**	**536,198**	**547,914**	**892,504**	**559,821**	**457,884**	**440,480**	**505,408**	**367,848**	**373,440**	**378,612**	**441,452**	**428,509**	**428,509**	**363,259**	**362,914**	**354,632**

REDC = Radiochemical Engineering Development Center; HFIR = High Flux Isotope Reactor; PWTP = Process Waste Treatment Plant; D&D = decontamination and decommissioning; RA=Remedial Actions.

[a]Nonprogrammatic waste refers to inleakage, collection in hot off-gas pots, stacks, etc. throughout the active LLLW system.

[b]The remediation of the inactive LLLW tanks is expected to generate these volumes of dilute LLLW by transfer of supernate only to the active LLLW system.

decontamination work in that facility is completed. The time frame for this work is dependent on budget concerns and would change if funding were not forthcoming.

The PWTP dilute "feed" stream will be eliminated. Currently, a portion of the regeneration solution at the PWTP is sent to the LLLW system for evaporation (the "PWTP feed" stream) because of the limited capacity of the PWTP evaporator. An upgrade at the PWTP will enable the whole stream to be evaporated on-site, thus eliminating the "PWTP feed" stream to the LLLW system around CY 1995. The "PWTP concentrate" stream will increase somewhat, but an overall waste reduction for the PWTP will be realized (see Sect. 3.3.2).

Tank WC-7 will be shut down in 1994, and Bldg. 3504 will bottle the LLLW. Waste generation at Bldg. 3504 will probably decrease somewhat when this occurs.

LLLW at HFIR will be eliminated when the resin currently used in the demineralizer ion exchange columns is disposed of as a solid waste rather than being regenerated. The time frame for this upgrade is about 1997.

Waste generation at Bldg. 3026D is projected to cease in CY 1995. Liquid waste generated during the past few years at Bldg. 3026D has been the result of cleanup and decontamination activities. The final cleanup and decontamination of the facility is dependent on budget concerns and availability and is therefore subject to change depending on the procurement of these funds. The availability of tank W-16 during this whole period is unknown; however, for projection purposes, it is assumed the tank will be available.

REDC is researching various techniques for the removal of TRU elements from its waste stream, although the volume is not expected to decrease much in the next several

years. Significant strides in volume reduction have occurred in the previous few years at REDC (see Sect. 3.1.1, "WC-20—REDC").

Forecasts for generation of LLLW by the D&D projects and RA activities at ORNL have been incorporated in the projections in this report for planning purposes. The majority of this waste will not be generated until after 2000. In addition, the LLLW generated through these programs will be decontamination liquids and will likely have large volume reduction factors (VRFs).

For the rest of the facilities, generation rates have been kept constant for the 1994–2010 time frame for projection purposes. These estimates are certain to change as time progresses.

3.2 CHARACTERISTICS OF LLLW

3.2.1 Current LLLW Characteristics

Generators are asked to report also on the radioactive contents of the liquid waste in the LLLW surveys. Table 3 summarizes the current findings on radioactive species being disposed of through the LLLW system as reported in the surveys. The curie quantities given in Table 3 are estimates, because actual sample analyses are not made. REDC contributes the majority of the radioactivity in the currently generated LLLW and will continue to contribute significantly to the total activity of the waste.

Other contaminants (such as cleaners, acids, caustics, and salts used and disposed of by the facility) determine the amount of LLLWC generated. In addition, caustic is added to many of the tanks when they are jetted or pumped to the central LLLW system for evaporation. This also adds to the concentrate produced. Most facilities use nitric acid, sodium hydroxide, and cleaners such as Ajax and Mr. Clean when regenerating columns

Table 3. Estimated isotopes and amounts in liquid low-level waste generated during CY1993

Isotope(s)[a]	Estimated quantity (Ci/year)	Facility
^{3}H	4	High Flux Isotope Reactor (HFIR) (>99%); Bldgs. 3026C, 4500S, 1505; Waste Area Grouping (WAG) 5
^{14}C	0.14	Bldg. 4500S (>99%); Bldgs. 4500N, 3504
^{54}Mn	0.33	HFIR (91%); Bldg. 3025 (9%); Bldgs. 4508, 3026D, 4500S
^{60}Co	10.82	HFIR (88%); Bldg. 3029 (11%); Bldgs. 3047, 4500S, 4508, 3025, 3026D, 1505, 3001, 3504; WAG 5
^{90}Sr	1	Bldg. 3029 (>99%); Bldgs. 3541, 3019, 4500S, 1505, 3504; WAG 5 (see MFP also)
^{131}I	0.4	HFIR (>99%); Bldg. 3047
^{137}Cs	1.13	Bldg. 3029 (88%); Bldg. 3001 (7%); Bldgs. 4501, 3019, 4500N, 4500S, 3074, 1505; WAG 5 (see MFP also)
$^{152,153,154}Eu$	0.16	Bldg. 3001 (>99%); Bldgs 3047, 3031 (see MFP also)
^{192}Ir	13	Bldg. 3525 (77%); Bldg. 3029 (23%); Bldgs. 3026C, 3047
^{241}Am	2.16	Bldg. 7920 (>99%); Bldgs. 4500S, 3504, 5505
MFP (mixed fission products)[b]	10,050	Bldg. 7920 (>99%); Bldg. 3525

[a]Other isotopes reported in trace quantities include: ^{55}Fe, ^{59}Fe, ^{85}Sr, ^{99}Tc, ^{103}Pd, ^{125}I, ^{134}Cs, ^{153}Gd, ^{188}Re, ^{188}W, ^{191}Os, ^{232}Th, ^{233}U, ^{235}U, ^{238}U.
[b]Mixed fission products include ^{137}Cs, ^{134}Cs, ^{90}Sr, and $^{152,154,155}Eu$.

and decontaminating hot cells. The amount of these products used by the facility determines the VRF which will be realized when processed through the LLLW evaporator. This VRF is used in calculating the volume of LLLWC generated by the facility. Table 4 lists the major contaminants in the LLLW generated during CY 1993 as estimated in the LLLW surveys.

3.2.2 Future LLLW Characteristics

Information on the changes in the radioactivity of LLLW streams during the next 15 years is not easily estimated. The following occurrences are expected to have an impact on the radioactivity of the LLLW, the extent of which is given, if known:

(1) HFIR conversion of LLLW to solid LLW will remove the majority of ^{3}H, ^{54}Mn, ^{60}Co, and ^{131}I from the waste. Current planning projects that this will occur in 1998 and beyond.

(2) The ISP will generate a significant amount of radioactivity from a broad spectrum of isotopes, including most of those listed in Table 3 (especially ^{90}Sr and ^{137}Cs, which would figure prominently in the cleanup of Building 3517).

(3) REDC source treatment, if implemented, would reduce the activity of its waste stream, especially the TRU content.

Changes in the quantities of nonradioactive contaminants in the LLLW are summarized below.

(1) HFIR conversion of LLLW to solid LLW will result in a large decrease in NaOH and HNO_3 quantities.

(2) PWTP conversion of LLLW to solid LLW will result in a large decrease in NaOH and HNO_3 quantities.

Table 4. Contaminants disposed of via the liquid low-level waste system in 1993

Other contaminants	Facility	Quantity (g/year)	Quantity (lb/year)
409 Cleaner	Bldg. 3525	3600	7.9
(NH4)2CO3	Bldg. 3592	240	0.5
Trichem cleaner	Bldg. 2026	90,909	200.0
SrCl/CsCl	Bldg. 4500N, E-28	1	< 1.0
Oxalic acid	Bldg. 3047	65,455	144.0
NH4OH	Bldg. 4501	416	0.9
NaOH	Bldg. 7920	108,500	238.7
	Bldg. 7900	5,850,000	12,870.0
	Bldg. 4501	9,652	21.2
	Bldg. 4500N, E-28	4	< 1.0
	Bldg. 3592	240	0.5
	Bldg. 3544	4,300,000	9,460.0
	Bldg. 3525	7570	16.7
	Bldg. 3039	88,400	194.5
	Bldg. 3001	9,700	21.3
	added to tanks	462,166	1,016.8
NaNO3	Bldg. 7920	520,500	1,145.1
	Bldg. 4500N, E-28	286	0.6
NaNO2	Bldg. 4501	2,350	5.2
NaHCO3	Bldg. 4500N, E-28	323	0.7
	Bldg. 3592	3,000	6.6
NaDithionite	Bldg. 3592	50	0.1
NaCl	Bldg. 7920	108,500	238.7
	Bldg. 4500N, E-28	436	1.0
NaCitrate	Bldg. 3592	134	0.3
NaAlO2	Bldg. 7920	110,000	242.0
Na2SO4	Bldg. 3592	720	1.6
Na2CO3	Bldg. 7920	108,500	238.7
	Bldg. 4500N, E-28	89	0.2
	Bldg. 3592	1,200	2.6
Mr. Clean	Bldg. 3525	4,542	10.0
	Bldg. 3074	41,635	91.6
	Bldg. 3029	8,327	18.3
	Bldg. 3026D	4,164	9.2
	Bldg. 3025	912	2.0
LiCl	Bldg. 7920	68,000	149.6
KNO3	Bldg. 4500N, E-28	11	< 1.0
KMnO4	Bldg. 3592	960	2.1
	Bldg. 3047	54,545	120.0
KCl	Bldg. 4500N, E-28	8	< 1.0
HNO3	Bldg. 7900	2,930,000	6,446.0
	Bldg. 5505	3407	7.5
	Bldg. 4500S	100	0.2
	Bldg. 3592	1,645	3.6
	Bldg. 3544	5,790,000	12,738.0
	Bldg. 3525	9,538	21.0
	Bldg. 3047	22,680	49.9
	Bldg. 3029	4770	10.5
	Bldg. 3025	2520	5.5
	Bldg. 3019	4,700	10.3
	Bldg. 3001	8,600	18.9
	Bldg. 2026	457,834	1,007.2
H2SO4	Bldg. 4508	371	0.8
	Bldg. 3025	2,138	4.7
Fantastic	Bldg. 3026C	1,249	2.7
Citric acid	Bldg. 3592	50	0.1
	Bldg. 3047	21,818	48.0
Ajax	Bldg. 3047	87,200	191.8
	Bldg. 3026C	1,249	2.7
Adogen-HCl	Bldg. 7920	8,000	17.6
Abrasives	Bldg. 3025	3,750	8.3
HDEHP	Bldg. 7920	89,000	195.8
HCl	Bldg. 7920	100,000	220.0
	Bldg. 3525	4,835	10.6
Acetic acid	Bldg. 4508	2271	5.0
Perchloric acid	Bldg. 4508	58	0.1
Total:		**21,593,828**	**47,498.4**

(3) The ISP, when implemented, will result in an increase of HNO_3, oxalic acid, and cleaners used in decontaminating hot cells and glove boxes (Mr. Clean, Ajax, etc.).

3.3 LLLWC GENERATION

3.3.1 Current LLLWC Generation

Three of the four largest dilute generators are the major sources of LLLW concentrate: the PWTP, HFIR, and REDC. Approximately 65% of the concentrate produced during 1992 was attributed to operations at the PWTP. HFIR operations generated an estimated 16%, and REDC generated 12% of the LLLWC during 1992. These estimates were based on generator survey information. Table 5 summarizes the concentrate generated during 1992 and the expected generation during 1993.

The actual rate of concentrate generation appears to be rather high during the first six months of 1993 (15,500 gal in 6 months); however, during 1991 and 1992, more than 65% of the concentrate produced for the year was generated in the first six months, so one might expect the generation rate to slow during the second half of this year. Generator estimates, as well as Waste Management records, show that HFIR generation has been up significantly during this 6-month period also. In addition, the frequency of regeneration at HFIR is up, resulting in a projected increase in concentrate generation by HFIR. Most of the increase in total LLLWC generation is likely attributable to this fact.

Approximately 26,000 gal of concentrate is expected to be generated during 1993 based solely on the extrapolation of the amount of LLLWC that has been generated through July of this year. This LLLWC volume is 30% higher than the amount predicted by the generator surveys for this year. Based on generator estimates, the PWTP is

Table 5. Liquid low-level waste concentrate (LLLWC) generation during 1992 and 1993

Generator	1992		1993 (expected)	
	(gal/year)	(percent)	(gal/year)	(percent)
Process Waste Treatment Plant	11,500	67	14,400	56
High Flux Isotope Reactor	2,500	15	8,200	32
Radiochemical Engineering Development Center	1,900	11	2,100	8
Oak Ridge Research Reactor/Bulk Shielding Reactor	200	1	0	0
Bldg. 3517	< 100	< 1	0	0
Bldg. 3525	< 100	< 1	< 250	< 1
Isotopes Area	< 100	< 1	< 250	< 1
Others	800	5	< 250	3
Total:	**17,200**		**26,000**[a]	

[a]Generator survey estimates were scaled up 30% to account for greater-than-average generation of LLLWC during CY 1993.

expected to account for 56%, HFIR for 32%, REDC for 8%, and all others for <6% of the LLLWC generation.

3.3.2 Future LLLWC Generation

Table 6 lists the predicted LLLWC generation rates for 1994–2010. These generation rates are calculated based on the increase or decrease in dilute LLLW generation rates expected and, if known, changes in the concentrations of other contaminants, acids, bases, salts, and cleaners added to the LLLW by the various generators. However, in most cases, the current VRFs (calculated for the various facilities based on current LLLW characteristics) are used along with the estimated future dilute LLLW generations to give future LLLWC volumes. These LLLWC volumes are used to determine the storage space needed over the next 15 years. The following is a summary of changes which will affect the volume of LLLWC generated over the given time frame:

(1) The PWTP upgrade, due to be completed in 1995, will result in an overall reduction of LLLWC for this facility of approximately 2700 gal/year. A holding tank will be installed to enable the treatment of the entire PWTP LLLW stream by the PWTP evaporator. Currently, a portion of the PWTP stream is evaporated at the LLLW Evaporator Facility, which is less efficient than the PWTP evaporator. Beginning in 2003, the new PWTP will be in operation. The new ion exchange (IX) columns will use nonregenerable IX material which will be disposed of as a solid waste, thus eliminating LLLWC generation at the PWTP entirely. This upgrade is expected to decrease the overall production of solid LLW at the PWTP by about 40 m^3 (1400 ft^3) because of the change in the type of resin used.

Table 6. Forecasted liquid low level waste concentrate (LLLW) generation, 1994 - 2010

Generator	Concentrate LLLW generation (gal/year)																
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Process Waste Treatment Plant	11,100	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400	0	0	0	0	0	0	0	0
High Flux Isotope Reactor	5,500	5,500	5,500	5,500	0	0	0	0	0	0	0	0	0	0	0	0	0
Radiochemical Engineering Development Center	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700
Bldg. 3517	< 100	< 100	< 100	< 100	600	600	600	600	0	0	0	0	0	0	0	0	0
Bldg. 3525	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100
Isotopes Area	< 100	< 100	< 100	< 100	300	300	300	300	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100
Others	600	600	500	600	600	450	450	450	600	600	600	600	600	600	600	600	600
Subtotal, generators:	**19,100**	**16,400**	**16,400**	**16,500**	**11,700**	**11,550**	**11,550**	**11,550**	**10,900**	**2,500**	**2,500**	**2,500**	**2,500**	**2,500**	**2,500**	**2,500**	**2,500**
Subtotal, + 30% contingency:	**24,900**	**21,400**	**21,300**	**21,400**	**15,200**	**15,000**	**15,000**	**15,000**	**14,200**	**3,300**	**3,300**	**3,300**	**3,300**	**3,300**	**3,300**	**3,300**	**3,300**
Inactive Tanks:																	
liquid	3,900	0	0	15,700	9,800	0	0	0	0	0	0	0	0	0	0	0	0
sludge + sluice water conc.[a]	0	15,700[b]	0	0	0	10,600	6,800	11,100	8,300	9,800	900	3,500	2,000	0	0	0	0
Decontamination and Decommissioning	100	0	200	800	1,100	1,600	1,300	2,600	1,500	1,500	1,300	2,800	2,800	2,800	1,500	1,500	1,600
Remedial Actions	2,200	2,600	2,600	3,400	2,100	2,200	2,200	2,200	900	900	1,200	1,000	700	700	700	700	500
Total:	**31,100**	**39,700**	**24,300**	**41,300**	**28,200**	**29,400**	**25,300**	**30,900**	**24,900**	**15,500**	**6,700**	**10,600**	**8,800**	**6,800**	**5,500**	**5,500**	**5,400**

[a] The volume generated is sludge volume plus the remaining sluice water concentrate (after settling and evaporation). This is one scenario; it is possible that the
tank sludges will be solidified in place and no sludge or sluice water concentrate will be generated.

[b] Active tank W-22 sludge is sluiced into the Melton Valley Storage Tanks.

(2) HFIR will dispose of loaded IX resin as solid waste in the near future. This will eliminate LLLWC from this facility in 1997; the rate of solid LLW generated is expected to be approximately 10 m^3 (35 ft^3).[3]

(3) Building 3517, after the ISP has been effectively carried out, will not generate LLLWC.

The remaining generators have been estimated to continue production of dilute and concentrated LLLW at the current rates.

LLLWC generation is expected to vary greatly in the next 15 years, depending on the time frame for and extent of the remediation of the inactive tanks (liquids and sludges), Surplus Facility Program D&D activities, and RA activities. Estimates for the volumes of LLLWC to be generated by these programs are given in Table 6.

Another activity which will generate significant amounts of LLLWC is sludge removal from ESTs and inactive tanks. The current scenario includes the sluicing of sludges in the following ESTs: W-22 during 1995; and C-1, C-2, W-21, and W-23 during 1999 (removal by sluicing). The sluicing of tank W-22 is expected to generate approximately 14,500 gal of LLLWC. Normally, sluicing of a tank will increase the volume of LLLWC to be stored by the amount of sludge plus sluice water concentrate; however, the sluicing of C-1, C-2, W-21, and W-23 will increase the volume of stored LLLWC only by the amount of sluice water concentrate because the sludge volumes are already included as part of the total cumulative LLLWC volumes. The amount of water needed for sluicing a given amount of sludge was estimated as 3 times the volume of the sludge.[4] The sluice water can then be evaporated after the sludge has settled, thus leaving a lower volume of "sluice water concentrate." The sludges and sluice water volumes of the inactive tanks are included in the forecasted dilute and concentrated LLLW, beginning in 1999 through 2006.

3.4 STORAGE OF LLLWC

Table 7 lists the LLLWC generations for 1990–2010 and the cumulative storage volumes during that time for various scenarios. Several options are being implemented to provide additional storage space in the MVSTs; a solidification campaign (SC) during the fall of 1993 is planned which will free almost 50,000 gallons of space, and ITE is evaporating an estimated 18,000 gal/year of water from the MVSTs. (From June 1992 to June 1993, 21,700 gal of water were evaporated from the MVSTs by ITE.) The effects on the cumulative volume of LLLWC with ITE, out-of-tank evaporation (OTE, a proposed activity in which the waste in the MVSTs is removed, evaporated further by an evaporator, and then returned to the tanks), and SCs implemented are given in Table 7. These volumes are shown graphically in Fig. 2 and 3.

Based on the current scenario, assumptions of which are summarized in Fig. 2, an additional SC (past the 1993 campaign) or OTE will be necessary to maintain the LLLWC cumulative volume below the "operationally constrained region" (under 470,000 gal) through 1998. If no inactive tanks or ESTs are emptied before 1998, the cumulative LLLWC volume at the end of the year (1998) would be about 450,000 gal according to current estimates.

Three new 100,000-gal storage tanks will be available in 1998 (Phase I) and three more after 1999 (Phase II), according to the current strategy plans. Figure 3 shows the storage space increase in the Operation Safety Report (OSR) limit with the addition of these tanks. The first phase adds three 100,000-gal tanks in 1998, and the OSR is raised to 720,000 gal (a total space of 900,000 gal less one empty 100,000-gal tank, and 90% capacity per the OSR). The second phase adds 3 more 100,000-gal tanks, and the OSR is raised to 810,000 gal. The limit is adjusted by removing C-1 and C-2 from service, emptying W-21 (because the

Table 7. Profile of liquid low-level waste concentrate (LLLWC) storage needs and uses through 2010

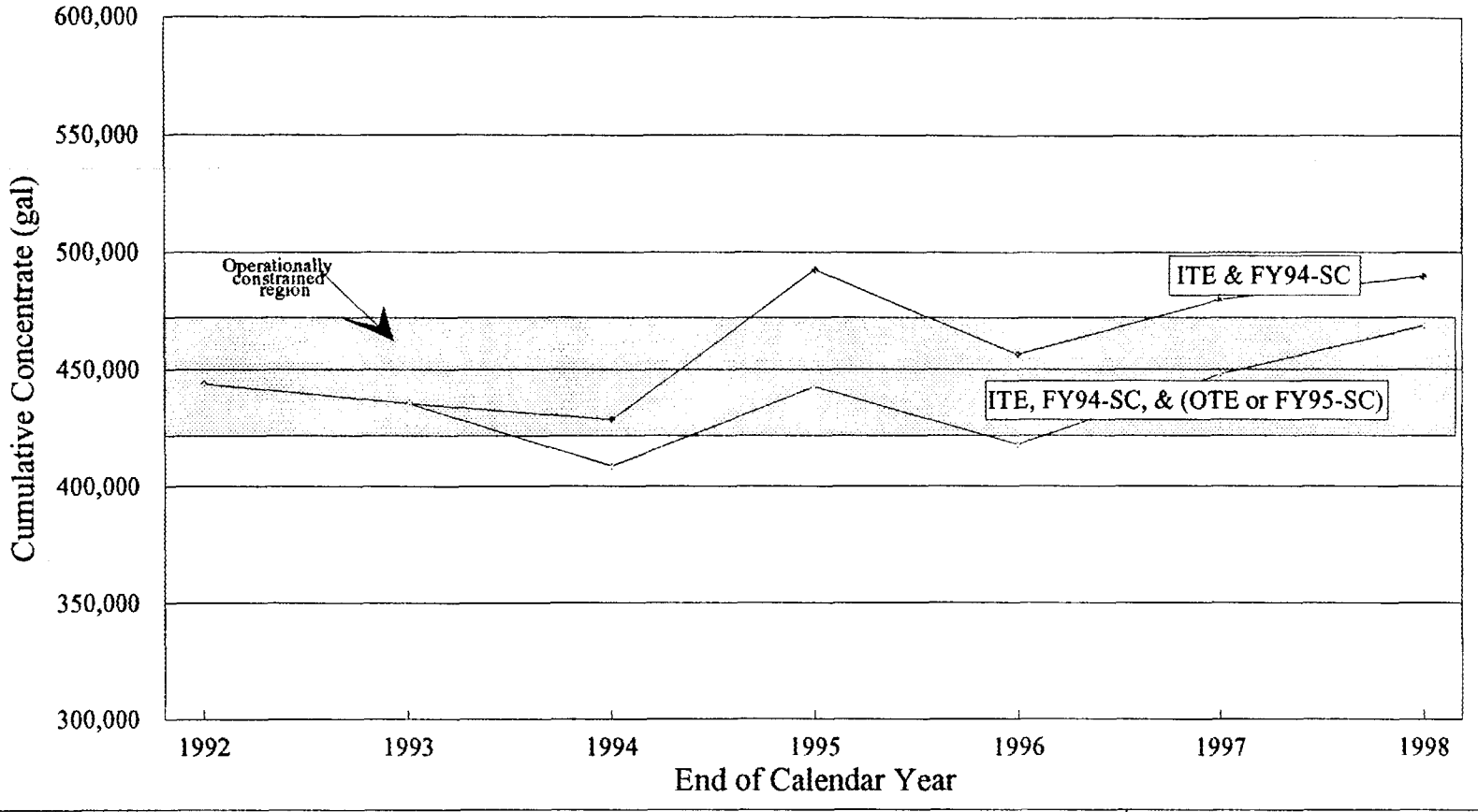
End of year	Concentrate (gal/year)	Sluice water evap. (gal/year)	Volume solidified (gal/year)	OTE volume evap. (gal/year)	ITE volume evaporated		Cumulative stored volume of LLLWC (gal)			
					without OTE (gal/year)	with OTE (gal/year)		with ITE	with ITE & SC	with ITE, SC & OTE[a]
1990[b]	16,140	0	0	0	0	0	474,650	474,650	474,650	474,650
1991[b]	22,052	0	27,960	0	0	0	460,500	460,500	460,500	460,500
1992[b]	17,263	0	18,940	0	15,501	15,501	443,930	443,930	443,930	443,930
1993[c]	39,600	0	20,000	0	18,000	18,000	483,530	465,530	415,530	415,530
1994	31,100	0	30,000	20,000	18,000	18,000	514,630	478,630	428,630	408,630
1995	39,700	42,400	0	30,000	18,000	18,000	554,330	500,330	450,330	400,330
1996	24,300	0	0	0	18,000	6,363	578,630	506,630	456,630	418,267
1997	41,300	0	0	0	18,000	10,017	619,930	529,930	479,930	449,549
1998	28,200	0	0	0	9,216	9,216	648,130	548,914	498,914	468,533
1999	29,400	154,400	0	0	4,457	4,457	677,530	573,856	523,856	493,475
2000	25,300	18,400	0	0	18,000	18,000	702,830	581,156	531,156	500,775
2001	30,900	30,000	0	0	4,609	4,609	733,730	607,448	557,448	527,067
2002	24,900	22,600	0	0	4,464	4,464	758,630	627,884	577,884	547,503
2003	15,500	26,500	0	0	1,127	1,127	774,130	642,257	592,257	561,876
2004	6,700	2,400	0	0	1,159	1,159	780,830	647,798	597,798	567,418
2005	10,600	9,400	0	0	961	961	791,430	657,438	607,438	577,057
2006	8,800	5,300	0	0	1,019	1,019	800,230	665,219	615,219	584,838
2007	6,800	0	0	0	985	985	807,030	671,034	621,034	590,653
2008	5,500	0	0	0	941	941	812,530	675,593	625,593	595,212
2009	5,500	0	0	0	941	941	818,030	680,151	630,151	599,771
2010	5,400	0	0	0	941	941	823,430	684,610	634,610	604,229

OTE = out-of-tank evaporation; ITE = in-tank evaporation; SC = solidification campaign.

[a]An additional SC would have the same effect as OTE on stored volumes of LLLWC in this analysis.

[b]Historical data is reported prior to 1993.

[c]Includes a 15,300 gal addition to the concentrate generation to account for change in level instrumentation; 1993 through 2010 is projected data.



ASSUMPTIONS:

BASELINE CASE:

1. Present generators produce waste at the rates estimated in the 1993 generator survey plus 30% contingency.
2. No new waste streams will be accepted until new MVSTs are available.
3. Supernates from the OHF, the NTF, and TH-4 are processed through the LLLW system in 1994. Supernates from the STF are processed in 1997-1998.
4. Tank W-22 is sluiced in 1995 to the MVSTs.

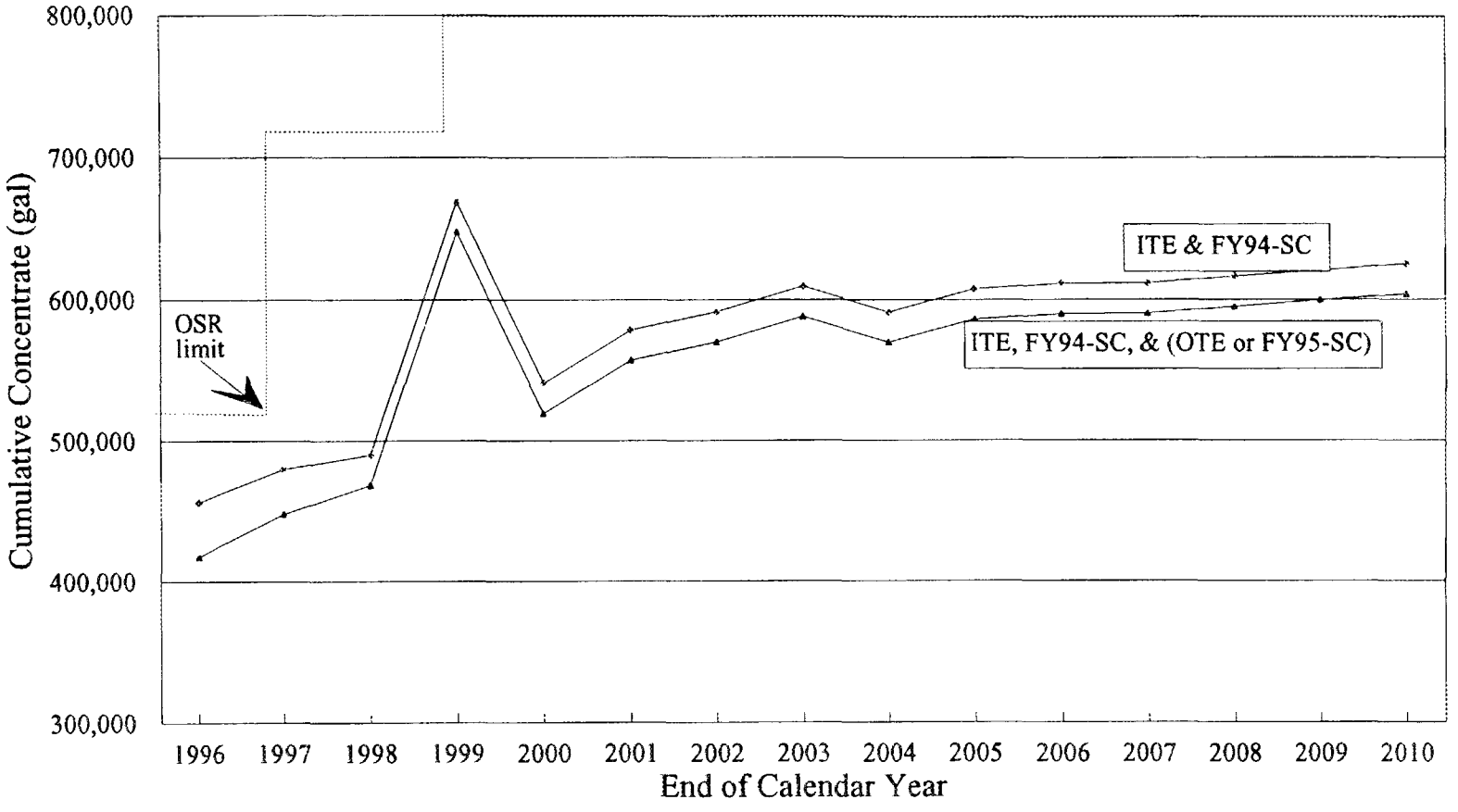
ITE, OTE, and SC:

1. ITE evaporates 3,000 gal/tank per year until concentrate is saturated with sodium nitrate.
2. OTE evaporates 50,000 gal of LLLWC during 1994-1995.
3. An estimated 50,000 gal of LLLWC is solidified in the FY1994 campaign.

Acronyms:

ITE = In-tank evaporation;
SC = Solicification campaign;
OTE = Out-of-tank evaporation;
MVST = Melton Valley Storage Tanks;
STF = South Tank Farm;
NTF = North Tank Farm;
ERP = Environmental Restoration Program
OHF = Old Hydrofracture Facility.

Fig. 2. Liquid low-level waste concentrate (LLLWC) generation, 1992 - 1998.



ASSUMPTIONS:

BASELINE CASE:

1. Present generators produce waste at the rates estimated in the 1993 generator survey plus 30% contingency.
2. No new waste streams will be accepted until new MVSTs are available.
3. Supernates from the OHF, the NTF, and TH-4 are processed through the LLLW system in 1994. Supernates from the STF are processed in 1997-1998.
4. Tank W-22 is sluiced in 1995 to the MVSTs.

ITE, OTE, and SC:

1. ITE evaporates 3,000 gal/tank per year until concentrate is saturated with sodium nitrate.
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OHF = Old Hydrofracture Facility.

Fig. 3. Liquid low-level waste concentrate (LLLWC) generation, 1996 - 2010.

tank will be used only as an LLLW feed tank), and emptying W-23 to allow for segregation of waste. This reduces the total capacity by 200,000 gal; a reduction in capacity of only 100,000-gal would be seen if C-1 and C-2 were kept in service. Current plans are to keep tanks C-1 and C-2 in service; however, in the past, the removal of these tanks from service has been discussed. Should the tanks remain in service, the OSR limit would be 900,000 gal.

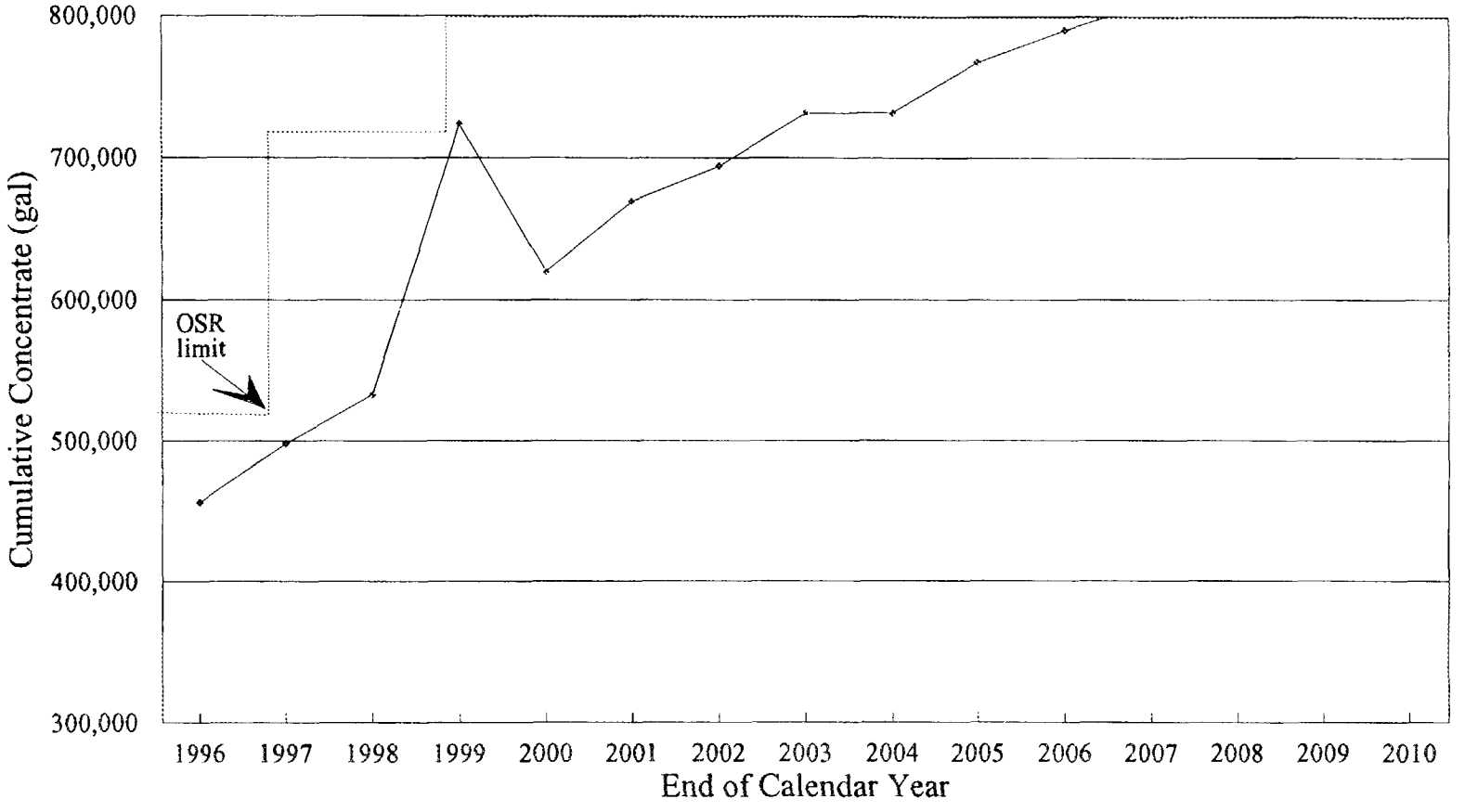
Fig. 4 depicts the concentrate storage situation for 1996 through 2010 under the following scenario:

(a) the only solidification campaign is the one scheduled during FY94;
(b) ITE is discontinued when the new tanks are completed (1997);
(c) the HFIR continues to produce LLLW through this time period (1997–2010);
(d) the PWTP upgrade is terminated, and LLLWC continues to be generated through 2010 at this facility.

This scenario, shown in Fig. 4, is the most conservative view of the LLLWC storage situation over the next 15 years, while Fig. 3 graphically illustrates the storage situation assuming ITE continues, the HFIR begins source treatment in 1998, and the PWTP concentrate production ends in 2002. Because of budget uncertainties, either scenario is plausible. Fig. 4 demonstrates the need for a second phase of new tanks, thereby increasing the storage space to an acceptable level.

4. SUMMARY AND CONCLUSIONS

Total dilute LLLW generation rates for ORNL have been relatively steady when compared to the previous few years. Most generators have not significantly changed their 1993 waste generation rates over the last year. REDC has reduced the solids content of its LLLW and therefore its resulting concentrate volume. Groundwater and rainwater continue to make up a large portion (~50%) of the dilute LLLW generation. HFIR and the PWTP are both



ASSUMPTIONS:	Acronyms:
BASELINE CASE:	ITE = In-tank evaporation;
1. Present generators produce waste at the rates estimated in the 1993 generator survey plus 30% contingency.	MVST = Melton Valley Storage Tanks;
2. No new waste streams will be accepted until new MVSTs are available.	STF = South Tank Farm;
3. Supernates from the OHF, the NTF, and TH-4 are processed through the LLLW system in 1994.	NTF = North Tank Farm;
Supernates from the STF are processed in 1997-1998.	ERP = Environmental Restoration Program
4. Tank W-22 is sluiced in 1995 to the MVSTs.	OHF = Old Hydrofracture Facility.
ITE, SC:	SC=solidification campaign;
1. ITE evaporates 3,000 gal/tank per year until concentrate is saturated with sodium nitrate and until 1997.	PWTP=Process Waste Treatment Plant;
2. One solidification campaign is carried out in FY94.	HFIR=High Flux Isotope Reactor.

Fig. 4. Liquid low-level waste concentrate (LLLWC) generation, 1996 - 2010 without (a) source treatment at HFIR and (b) the PWTP upgrade.

preparing to generate only solid LLW in the next decade. Remediation activities from various programs are expected to begin generating significant amounts of dilute LLLW over the same time frame.

CY 1993 generation rates of LLLWC have increased approximately 30% over predicted rates based on generator input. Approximately 26,000 gal of LLLWC is expected to be produced by the end of 1993. During 1992, 17,200 gal of LLLWC was produced. The majority of the increase is attributed to operational difficulties at HFIR which have resulted in additional waste generation at that facility. Further explanation for the increase in LLLWC generation during 1993 has not been ascertained. The PWTP continues to be the largest generator of LLLWC (56%); HFIR generates 32% of the concentrate, and REDC accounts for 8% of the concentrate. The PWTP will, most likely, be decoupled from the LLLW system within 10 years, as will HFIR (about 1997). During the next 10–20 years, the Surplus Facilities and RA programs will generate a larger percentage of the concentrate through cleanup activities, such as emptying the inactive tanks.

Assuming the given LLLWC generation rates in Table 6, the continuance of ITE, and the completion of the 1993 SC, the available tank space will remain under the 470,000-gal limit that Waste Operations personnel have deemed operationally manageable only until early 1997. An additional SC or OTE will be necessary to maintain the free space at 50,000 gal below the OSR limit of 520,000 gal after 1997. If the current schedule for the new tanks is maintained, additional storage volume for LLLWC should be available by 1998. Although it is conceivable that operation of the LLLW system could continue through this time period (1993–1998) without an additional SC (or OTE), recommendations are to plan an additional SC (or OTE) to accommodate a delay in the installation of new tanks or generation of concentrate above those rates estimated over the next several years.

Uncertainties in budgets rule the need for the second phase of new concentrate storage tanks. If the HFIR source treatment and the PWTP upgrades are not acquired, a second phase of new storage tanks will be necessary, as seen from Fig. 4.

This report recommends continuation of projects to develop and implement source treatment at REDC, HFIR, PWTP, and ORR/BSR. These source treatment projects envelop the major generators of LLLWC (approximately 95% of the LLLWC generation). Reducing the dilute LLLW generation by the major dilute generator — nonprogrammatic waste and infiltration of groundwater — continues to be a topic considered by the FFA team. Appointed team members are responsible for identifying nonprogrammatic areas to be rerouted to the PWTP. Repairs to tanks and reduction of input to the LLLW system in any other appropriate manner continue to be tasks followed by the FFA team.

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