

R U N R E P O R T

INTEGRATED RADIOACTIVE WASTE TREATMENT SYSTEM

CAMPAIGN 21, October 31, 1990 - January 11, 1991

Information Contributed By:

G. J. Robbins
C. F. Ross

SRC4182

LIST OF TABLES

Table 1 - Summary Table of Run Statistics

Table 2 - Comparison of Statistics from Previous Campaigns to
this Campaign

Table 3 - Detailed Tables of Run Statistics

Table 4 - Drum Testing Results

Table 5 - Drum Production Rates

Table 6 - STS Process History

Table 7 - Summary of Suspect Drums

LIST OF FIGURES

Figure 1 - Drum Cell Radiation Levels

Figure 2 - IRTS High Level Waste Tanks, 8D-1 and 8D-2

Figure 3 - STS Zeolite Usage

IRTS OPERATIONS
RUN REPORT
CAMPAIGN 21

SUMMARY

Integrated Radwaste Treatment System (IRTS) campaign 21 was initiated on October 31, 1990 and concluded on January 11, 1991 after processing 6,306 gallons of 8D-2 liquid to the Liquid Waste Treatment System (LWTS). The target dilution factor was 3.0:1 with a nominal system flow of 6 gpm. The dilution ratio is based on the original 39 weight percent (wt%) concentration of 8D-2 supernatant. Cesium removed from 8D-2 solution for campaign 21 was 74 kilocuries. During processing of supernatant to the LWTS, 26 kilocuries were removed. Forty-eight kilocuries of cesium were removed from 8D-2 to fill tank 8D-3 with decontaminated supernatant and to saturate lead column A with cesium. The supernatant which was processed to tank 8D-3 remains in the tank. This solution will be returned to tank 8D-2. Due to a temporary suspension of LWTS operations (see discussion section of this report and occurrence report WVNS-90-0026, LWTS-90-0001), this solution cannot be transferred to the LWTS.

Following campaign 20, column D was sluiced via the J-nozzle to remove the bulk of the loaded zeolite from the column. Column D was then sparged to remove the heel of spent zeolite. Two drums of fresh zeolite were then loaded into the column for a test of sparge effectiveness. This test was to be performed at the start of campaign 21 processing with a column sequence of A-B-C-D. Note that column D had been sparged between processing weeks during campaign 17. That initial sparging provided marginally acceptable performance of column D.

The cesium activity of the column D effluent was acceptable at the start of campaign 21. However, it almost immediately started to increase and continued to increase until it became necessary to remove column D from service. With column D out of service, the column sequence became A-B-C, with column C being the final, or polishing column. Column C was the final column during the previous campaign and could not perform as efficiently as a fresh column.

The volume of supernatant processed for campaign 21 was therefore reduced greatly. Cesium concentration in the system effluent was the limiting factor. Normally, lead column loading is limiting.

Following completion of the campaign, column A was saturated with cesium to provide maximum usage of the zeolite. The bulk of the cesium loaded zeolite was sluiced from column A via the J-nozzle. There was no usable hydraulic arm at the M-4 riser, so it was not possible to service the column A bottom dump plug. Therefore, a heel of cesium loaded zeolite remains in the column. This heel will be removed prior to restart of the IRTS.

Dilution of the contents of tank 8D-2 is causing some premature sludge washing to occur. This results in some constituents in the sludge, such as fissile material, to enter the supernatant solution. This was not anticipated until sludge wash operations, during which steps would be taken to limit the amounts of these constituents in the process stream. During supernatant processing, the STS does not have provision for removal of these constituents from the process stream. The increased concentrations of these constituents of the sludge layer are passed on downstream to the LWTs where they were not projected to be. Because of this undesirable phenomenon, supernatant processing has been declared complete. The total volume of supernatant removed from tank 8D-2 during supernatant processing operations was 618,000 gallons. There were 21 supernatant processing campaigns. When IRTS operations resume, the operations will commence as sludge washing.

The total zeolite usage at the end of supernatant processing is 34,928 kg dry weight. This includes the two drums of zeolite contained in column D and 4 drums of zeolite used in cold testing prior to the start of supernatant processing. The maximum zeolite usage goal is 60,000 kg dry weight. To keep within the goal limit, 25,072 kg (dry weight) of zeolite may be used to accomplish sludge washing. This equates to approximately 18 columns of zeolite.

Campaign 21 produced 18,655 gallons of decontaminated supernatant solution, of which 11,593 gallons were evaporated to produce 2,075 gallons of concentrates. As noted above, the decontaminate supernatant contents of tank 8D-3 will not be transferred to the LWTs.

The Cement Solidification System (CSS) produced 53 drums at a nominal 40 gallons of waste per drum. The total drum production for supernatant processing is 10,389. Table 1 shows a summary of run statistics. As previously stated, supernatant processing is complete.

DISCUSSION

STS OPERATION

Supernatant Treatment System (STS) campaign 21 operations commenced on October 31, 1990. The process was placed in column sequence A-B-C-D. Column D had been sparged and sluiced to remove the spent zeolite heel and contained only two drums of fresh zeolite. A 30-hour test of the effectiveness of the sparge was to be performed. If this test indicated acceptably low cesium effluent from column D, the remaining ten drums of zeolite to make up a full column charge would be added. Note that sparging of column D during campaign 17 resulted in marginally acceptable performance from the column, although in third position during campaign 12, the column exhibited negative DF (effluent cesium concentration higher than that of the influent). See campaigns 17 and 18 run reports.

During the 30-hour test of column D in campaign 21, initial analysis of the cesium effluent of column D indicated approximately $6E-2$ uCi/ml and increased steadily into the E-1 range. The effluent cesium increased to approximately $4E-1$ uCi/ml within 20 hours from start of test, at which time column D was taken off line and vented. During this test, the cesium influent to column D was nearly stable at approximately $2E-2$ uCi/ml. The remainder of the campaign was operated in a column sequence of A-B-C, with column D off-line and vented. Column C was the polishing column during campaign 20 and was no longer able to perform the polishing function as well as a freshly loaded column could have. Therefore, the volume of supernatant processed during campaign 21 and the system DF's achieved were much lower than normal. An evaluation of possible reasons for ineffectiveness of the column D sparge will be performed. It should be noted that there were no obvious anomalies observed during sparging operations which could explain the sparge failure.

Following completion of campaign 21 supernatant processing, column A was sluiced using the J-nozzle. The heel of spent zeolite remains in column A due to lack of a hydraulic arm or camera mast to service the bottom plug of column A. The two drums of zeolite placed in column D for the test still remain.

LWTS OPERATION

The Liquid Waste Treatment System (LWTS) operated acceptably to concentrate the decontaminated supernatant solution transferred to it. However, LWTS operations were effected by a process phenomenon which involved material balance across the LWTS evaporator.

Routine process control sampling indicate dilution of the contents of tank 8D-2 is causing dissolution of fissile material from the sludge in the bottom of the tank. The concentration of fissile material as seen in analysis of supernatant was slowly increasing as dilution increased. This phenomenon was anticipated during sludge washing. Provisions were made to remove the fissile material from the sludge wash STS process stream in the ion-exchange columns using titanium coated zeolite in the ion-exchange columns. These provisions were not in place during supernatant processing. Therefore, this slightly increased fissile material concentration was unchanged by STS supernatant processing and was passed on to the LWTS. This fact is borne out by analyses of the evaporator feed tank 5D-15B.

While the concentration of fissile material in the evaporator feed was increasing, it was noted that the evaporator concentrates were indicating a small variance from the expected concentrations. There appears to be a small accumulation of fissile material in the LWTS evaporator. Calculations showed that even the most conservatively high estimate of the amount of fissile material accumulation in the evaporator results in fissile material concentrations significantly below the site's criticality limits.

Although no danger of criticality exists, the LWTS was placed in standby until a determination of proper actions to be taken could be developed. A task force was established to determine the actions to be performed to enable a resumption of IRTS operations.

It was determined that sludge washing had in effect started. Therefore, supernatant processing is completed with the termination of campaign 21. IRTS sludge wash operations will commence in October 1991 with the start of caustic addition for the first sludge wash.

CSS Operation

The High Shear Cement Solidification System (HSCSS) produced a total of 53 drums of low-level waste at 40 gallons of waste per drum. Due to the higher than normal STS cesium effluent concentration as noted above, there were no low dose shield drums produced during campaign 21. There were no major problems noted with respect to CSS operations during this campaign.

DRUM CELL OPERATION

Operation of the Drum Cell (DC) continued in support of CSS operations with no major problems noted.

TANK LEVELS

This campaign completes supernatant processing. Formerly, the target level of tank 8D-2 at completion of supernatant processing was a 32 inch level (approximately 84,000 gallons). However, due to above mentioned considerations, supernatant processing has been terminated following campaign 21. At the completion of supernatant processing the volume in tank 8D-2 was 293,000 gallons and the volume in tank 8D-1 was 214,000 gallons. See figure 2 for a graph of the volumes in the high level waste tanks 8D-1 and 8D-2.

PRODUCT ACCEPTANCE

The waste form classification analyses for drums produced is as follows:

- * Campaigns 1-13, Class C Low Level Waste; verification complete.
- * Campaign 14, awaiting QA update.
- * Campaign 15, awaiting QA update.
- * Campaign 16, awaiting QA update.
- * Campaign 17, awaiting QA update.
- * Campaign 18, awaiting QA update.
- * Campaign 19, awaiting QA update.
- * Campaign 20, awaiting QA update.
- * Campaign 21, awaiting QA update.

TABLE 1
IRTS CAMPAIGN NO. 21 RUN REPORT
SUMMARY TABLE OF RUN STATISTICS

1. TRANSFERS 8D-2 TO 8D-15B		
A.Campaign Nos. 1 thru 20	6,181,894 L	1,633,261 gal.
B.Campaign No. 21	<u>40,489 L</u>	<u>10,696 gal.</u>
TOTAL TO DATE	6,222,383 L	1,643,957 gal.
2. LWR PROCESS VOLUMES		
2.1 Total Feed to Evaporator		
A.Campaign Nos. 1 thru 20	6,224,023 L	1,644,218 gal.
B.Campaign No. 21	<u>43,884 L</u>	<u>11,593 gal.</u>
TOTAL TO DATE	6,267,907 L	1,655,811 gal.
2.2 Total Concentrate		
A.Campaign Nos. 1 thru 20	1,452,563 L	387,775 gal.
B.Campaign No. 21	<u>7,854 L</u>	<u>2,075 gal.</u>
TOTAL TO DATE	1,460,417 L	389,850 gal.
3. DRUMS PRODUCED*		
A.Campaign Nos. 1 thru 20	10,336	
B.Campaign No. 21	<u>53</u>	
TOTAL TO DATE	10,389	
4. CURIES OF CESIUM 137 REMOVED FROM 8D-2		
A.IRTS Campaign Nos. 1 thru 20	5,135.0 KCi	
B.IRTS Campaign No. 21	<u>74.0 KCi</u>	
TOTAL	5,209.0 KCi	
5. PROCESS COMPLETION		
A.Curies Percent Complete:	0.793	
B.Drums Percent Complete:	0.7992	

* Includes 5 drums removed from pile and core bored (#72847, 72791, 72949, 71004, 72813,) which are now located in Lag Storage and does not include 1 drum which was left in the CSS process room.

TABLE 2
IRTS CAMPAIGN NO. 21 RUN REPORT
COMPARISON OF STATISTICS FROM PREVIOUS CAMPAIGNS TO THIS CAMPAIGN

	<u>CAMPAIGN NO. 19</u>	<u>CAMPAIGN NO. 20</u>	<u>CAMPAIGN NO. 21</u>
<u>S T S</u>			
Volume of 8D-2 Supernatant ^(a) Processed (Gal.)	49,186	50,705	6,306
Total Volume Processed (Includes flush and dilution Water) (Gal.)	123,048	140,985	18,653
Column Breakthrough (%)			
Lead Column	97	99.5	n/a
2nd Column	1.2	5.6	n/a
Average System DF	94,977	62,909	n/a
Average Cs-137 in Effluent (uCi/mL)	.017	.026	.132

<u>L W T S</u>			
Concentrates Volume (Gal.) ^(b)	27,218	26,440	2,075
Average Cs-137 (uCi/mL)	.072	.206	.522

<u>C S S</u>			
Drums Produced	675	661	53
Average Cs-137/Drum (Ci)	.01	.025	.079
Average Drum Contact Dose Rate (mR/hr)	12	25	70

(a) See Table 6 for volume of supernatant recycled.

(b) Tank heels:

	<u>CAMPAIGN 19</u>	<u>CAMPAIGN 20</u>	<u>CAMPAIGN 21</u>
5D-15A1	20 Gallons	22 Gallons	20 Gallons
5D-15A2	2 Gallons	2 Gallons	2 Gallons
70-D-1	68 Gallons	60 Gallons	88 Gallons
TOTAL	90 Gallons	84 Gallons	110 Gallons

TABLE 3
I R T S CAMPAIGN NO. 21 RUN REPORT
DETAILED TABLE OF RUN STATISTICS

COLUMN SEQUENCE: A-B-C

1) TRANSFER 8D-3 to 5D-15B	1	2
A. DATE 1990	11/1	Flush
B. STS FLOW RATE (gpm)	6.0	Flush
C. D-001 SAMPLE NO.	9003142	Flush
i. Cs137 (uCi/mL)	409	Flush
ii. TDS (wt%)	9.94	Flush
iii. Density (gr/mL)	1.069	Flush
D. CESIUM-137 ACTIVITY (COLUMN EFFLUENTS)		
i. Lead Column A (uCi/mL)	5.94	Flush
ii. 2nd Column B (uCi/mL)	0.32	Flush
E. COLUMN BREAKTHROUGH (%)		
i. Lead Column A	1.5	Flush
ii. 2nd Column B	5.4	Flush
F. 8D-3 SAMPLE NO.	9003150	Flush
i. Cs-137 (uCi/mL)	0.1320	Flush
ii. TDS (wt %)	5.72	Flush
iii. Density (gr/mL)	1.034	Flush
G. STS SYSTEM DF		
i. Transfer DF	1,725	Flush
ii. Cumulative DF	1,725	Flush
H. 5D-15B SAMPLE NO.	9003180	Flush
i. Cs-137 (uCi/mL)	1.27 E-1	Flush
ii. TDS (wt %)	9.34	Flush
iii. Density (gr/mL)	1.064	Flush
I. Volume Received (Litres) in 5D-15B	40,489	Flush
J. Cumulative Volume	40,489	Flush

TABLE 4
I R T S CAMPAIGN NO. 21 RUN REPORT
DRUM TESTING RESULTS

CONCENTRATES BATCH	84
LWTS TANK	5D-15A2
LAB ANALYSIS NO.	9003221
TOTAL SOLIDS %	39.86
Cs-137 CONCENTRATION (uCi/mL)	5.22E-01
POUNDS CEMENT +CaNo ₃	24,168
NUMBER OF DRUMS	53
TOTAL GALLONS	2,120
CURIES PER DRUM (Average)	0.079
RADIATION DOSE (mR/hr) Per Drum	70
PRESOLIDIFICATION RESULTS	>700 PSI
IN-CELL TEST RESULTS	81,793
DRUM NO./PSI	>700 PSI
Total Cement	24,168 LBS.
Total Number of Drums	53
Total Volume Solidified	2,120 Gallons
Total Curies Solidified	4.19 Ci

TABLE 5
I R T S CAMPAIGN NO. 21 RUN REPORT
DRUM PRODUCTION RATES

	<u>DATE</u>	<u>DAILY AVERAGE</u>	<u>WEEKLY TOTAL</u>	<u>CUMULATIVE TOTAL</u>
Campaign #1	06/01 to 06/17	33		401
Campaign #2	06/27 to 07/08	45		783
Campaign #3	07/18 to 08/05	35		1,347
Campaign #4	08/22 to 09/26	30		1,681
Campaign #6	12/05 to 12/13	45		2,009
Campaign #7	01/23 to 02/23	50		2,607
Campaign #8	03/06 to 04/13	60		3,303
Campaign #9	04/24 to 05/26	58		3,988
Campaign #10	06/19 to 06/22	37		4,136
Campaign #11	07/26 to 08/24	58		4,778
Campaign #12	09/05 to 10/13	50		5,421
Campaign #13	10/23 to 11/10	62		5,921
Campaign #14	11/20 to 12/15	67		6,532
Campaign #15	01/22 to 02/14	59		7,124
Campaign #16	03/12 to 04/16	42		7,808
Campaign #17	05/08 to 06/15	60		8,451
Campaign #18	06/28 to 07/25	45		9,000
Campaign #19	08/09 to 09/13	38		9,575
Campaign #20	09/24 to 11/01	45		10,336
Campaign #21	11/13	26		
	11/14	27	53	10,389

TABLE 6
IRTS CAMPAIGN NO. 21 RUN REPORT
STS PROCESS HISTORY

CAMPAIGN	DATE	NOMINAL DILUTION RATIO	COLUMN SEQUENCE	COLUMN(S) DUMPED	Cs-137 CONCENTRATION IN 8D-2 ($\mu\text{Ci}/\text{mL}$)	SUPERNATANT PROCESSED				TOTAL Cs-137 REMOVED (KCi)	Cs-137 INVENTORY REMAINING IN 8D-2(a)(b) (KCi)
						AND TRANSFERRED TO LWTS (Gallons)	Cs-137 REMOVED (KCi)	AND RECYCLED TO 8D-2 (Gallons)	Cs-137 REMOVED (KCi)		
1	5/88	no dilute	B-C-D-A	B	2860	24,185	262	0	0	262	6,836
2	6/88	no dilute	C-D-A-B	C	2600	15,800	155	0	0	155	6,681
3	7/88	no dilute	D-A-B-C	D	2600	26,356	259	0	0	259	6,422
4	8/88	no dilute	A-B-C	A	2600	17,000	167	4,000	39	206	6,215
5	9+10/88	no dilute	N/A	B&C	2400	0	0	30,200	274	274	5,942
6	12/88	no dilute	A-B-C-D	A	1980	17,800	133	0	0	133	5,809
7	1+2/89	2:1	B-C-D-A	B	1980	35,342	265	0	0	265	5,544
8	2+3/89	2:1	C-D-A-B	C	1980	34,040	255	0	0	255	5,289
9	4+5/89	2:1	D-A-B-C	D	1980	35,101	263	0	0	263	5,026
10	6/89	2:1	A-B-C	A	1885	10,900	78	13,200	31	109	4,917
11	8/89	2:1	B-C-A	B	1885	35,096	250	0	0	250	4,667
12	10/89	2:1	C-D-A-B	C	1885	33,363	238	0	02	238	4,429
13	10+11/89	2:1	D-A-B-C	D&A	1855	28,333	199	14,767	42	241	4,188
14	12/89	2:1	B-C-A	B&C	1810	33,873	232	19,180	131	363	3,825
15	1+2/90	2:1	D-A-C	D&A	1810	33,300	228	34,434	202	430	3,395
16	3+4/90	3.6:1	C-A-B	C	1790	46,578	316	0	0	316	3,079
17	6/90	3.6:1	A-B-C-D	A	1790	45,236	315	1,458	7	315	2,764
18	8/3/90	3.0:1	B-C-D-A	B	1790	39,804	270	0	0	270	2,494
19	9/13/90	3.0:1	C-D-A-B	C	1090	49,184	203	0	0	203	2,291
20	11/02/90	3.0:1	D-A-B-C	D,C	1090	50,705	209	32,855	119	328	1,963
21	11/31/90	3.0:1	A-B-C	A	1090	6,306	26	18,195	48	74	1,889
						618,302	4,323	168,289	893	5,209	

(a) Total curies of Cesium-137 reported in Safety Analysis Report (SAR) report decayed to 7-21-88 = 7,098 KCi minus curies of Cesium-137 processed

(b) Includes approximately .489 KCi Cesium-137 left in 32-inch heel in Tank 8D-2 at the end of supernatant processing estimated as follows:

Volume of 32 inch heel = 80,464 gallons

Volume of solids in heel = 7,548 gallons

(Ref.: DOE/NE-44139-14, Page A2)

Volume of supernatant in heel = 72,916 gallons

Curies of CS-137 in heel = 489 KCi

$[(7.29 \text{ E}+04 \text{ gal})(3.785 \text{ E}+03 \text{ mL/gal})(1.79 \text{ E}+03 \text{ } \mu\text{Ci/mL})]$

$10^6 \text{ } \mu\text{Ci/Ci}$

TABLE 7

SRC4002

July 9, 1991

DC:91:0074

TABLE 7
IRTS CAMPAIGN NO. 21 RUN REPORT
SUMMARY OF SUSPECT DRUMS

(CONTINUATION)

DATE PRODUCED	CAMPAIGN NUMBER	DRUM SERIAL NUMBER	CRITIQUE NUMBER	NON- CONFORMANCE REPORT	DESCRIPTION OF SUSPECT CONDITION
	19				
7/05/88	2	71542	CM90042	N/A	Low water-to-cement ratio.
7/24/88	3	72539	CM90042	N/A	
8/23/88	4	72331	CM90042	N/A	
10/10/89	12	76392	CM90042	N/A	
11/20/89	14	77401	CM90042	N/A	
11/20/89	14	77213	CM90042	N/A	
12/15/89	14	77829	CM90042	N/A	
12/14/89	14	77523	CM90042	N/A	

FIGURE 1

DRUM CELL RADIATION LEVELS

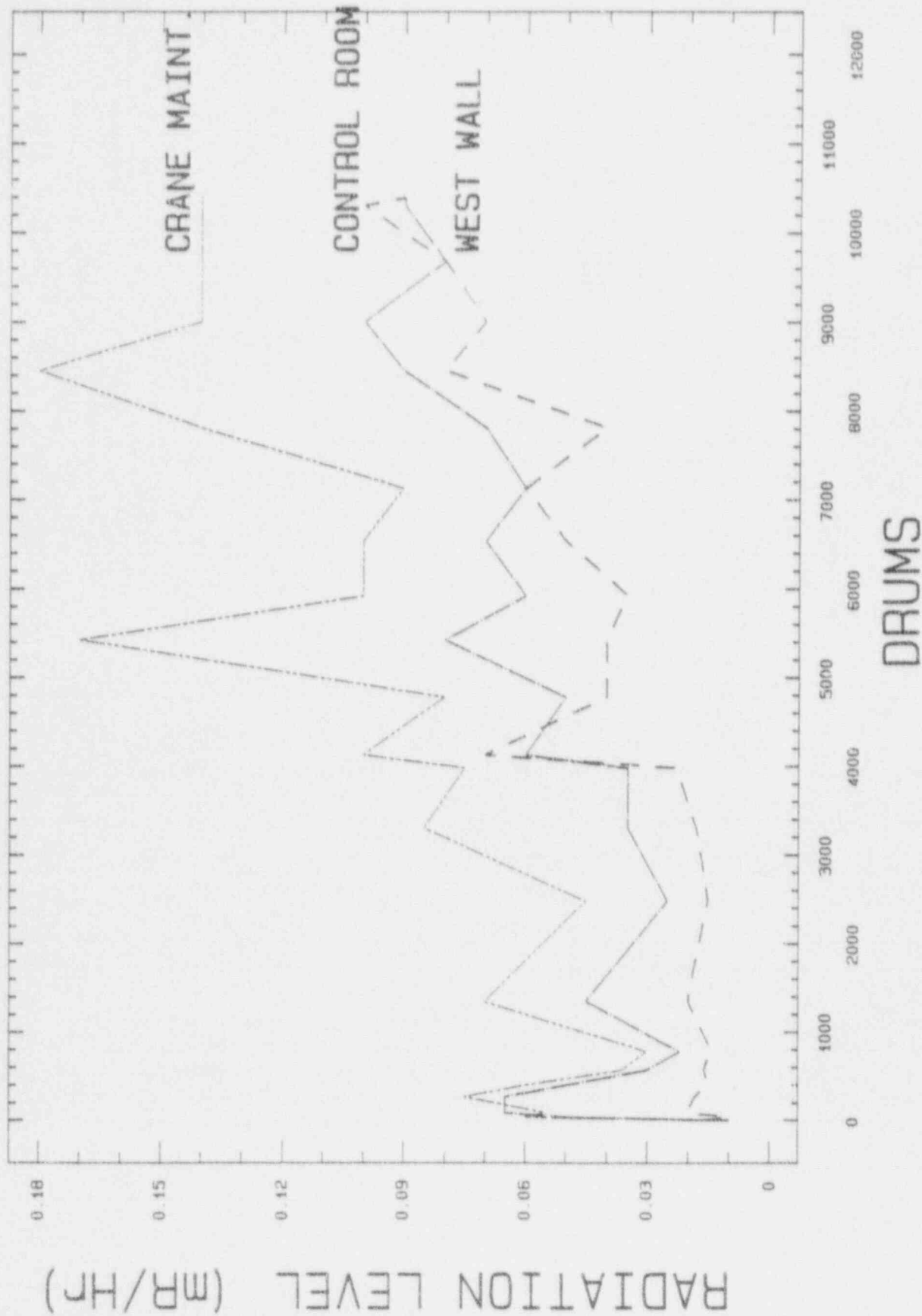


FIGURE 2

IRTS HIGH LEVEL WASTE TANKS

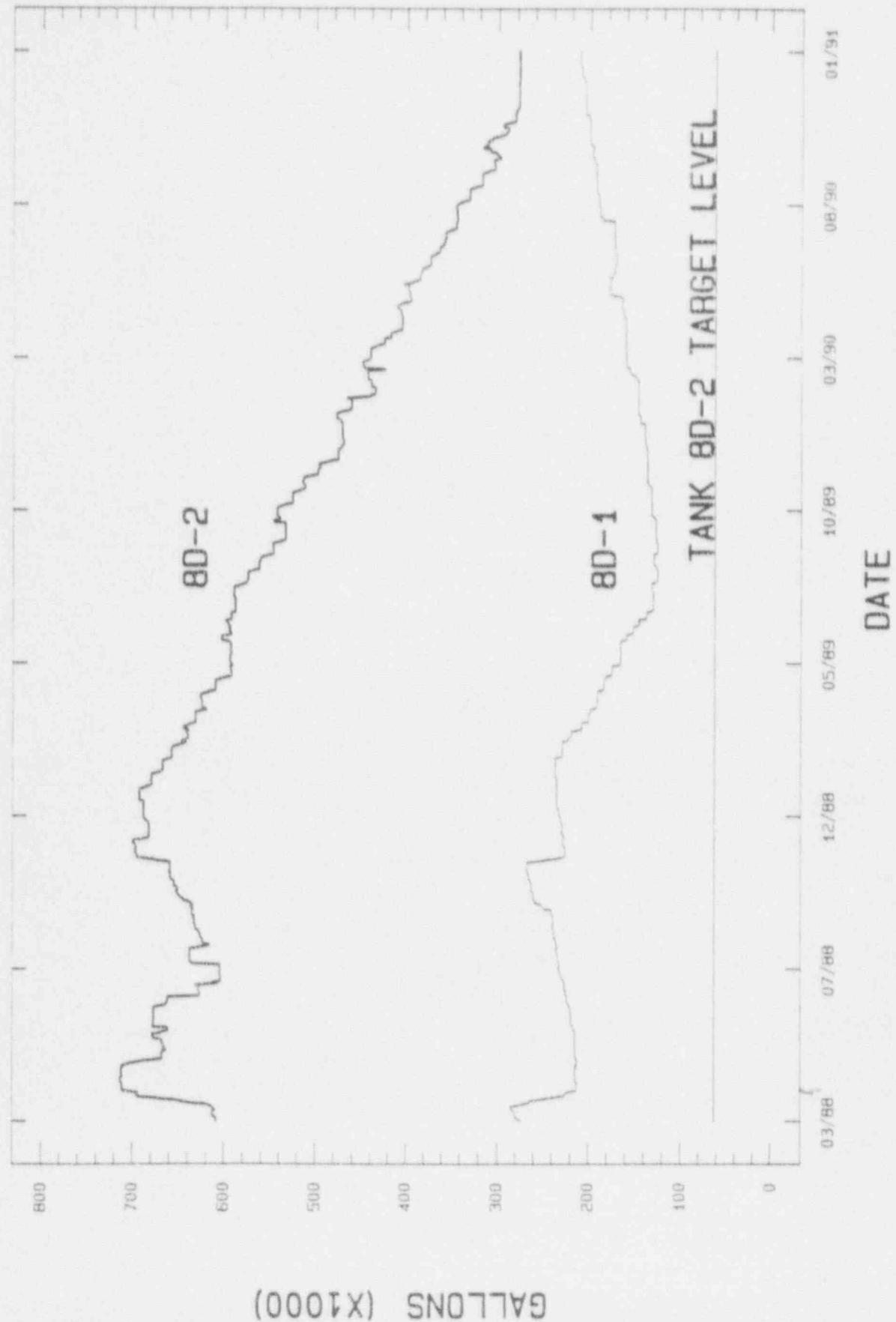


FIGURE 3

Zeolite Usage for Supernatant Processing

