July 25, 1989

DC:89:0035

RUN REPORT

INTEGRATED RADIOACTIVE WASTE TREATMENT SYSTEM

CAMPAIGN NO. 10, June 10, 1989 - June 23, 1989

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July 25, 1989

SRS3001

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IRTS
CAMPAIGN NO. 10

SUMMARY:

Integrated Radwaste Treatment System (IRTS) Campaign No. 10 was concluded on June 23, 1989 after processing approximately 24,100 gallons of 8D-2 liquid and 14,000 gallons of 8D-1 liquid as flush water. Only 10,900 gallons of the 8D-2 liquid was actually transferred downstream to the LWTS; the remaining 13,200 gallons was recycled back to Tank 8D-2. The Supernatant Treatment System (STS) column sequence used was A-B-C. The target dilution ratio was 1.4:1 with a nominal system flow rate of 6 GPM. The overall campaign DF for STS was 4,470.

Liquid Waste Treatment System (LWTS) received a total of 4 batch transfers from STS totaling 37,057 gallons of process liquid.

Cement Solidification System (CSS) processed 5,772 gallons of concentrates and produced 148 drums at 39.0 gallons per drum. Average drum dose rate was 78 mR/hr. The total CSS production, at the completion of Campaign No. 10 was 4,136 drums.

DISCUSSION:

STS OPERATION

Campaign No. 10 STS Operations were performed in three stages (see also Lessons Learned section of this report).

The first stage of operations was to test column "D" for viability as a "final" or "polishing" column. It should be recalled that the zeolite in column D was sluiced out of the column at the end of Campaign No. 9 using the "J-nozzle" dip tube. Previous experience has shown that a significant zeolite heel remains behind after sluicing. The purpose of this test phase was to assess the impact

of the zeolite heel on the Cs-137 concentration in the column effluent and to determine the proper position of the column in a four column run.

The second stage of operations was to process supernatant from 8D-2 diluted at a ratio of 1.4:1 water to supernatant through three columns in sequence A-B-C. Column "C" had been the fourth (or "polishing") column, in the four column Campaign No. 9. Without a column filled with clean zeolite, for the "polishing" column, the duration of this campaign was expected to be short, and the drum dose was expected to be higher than in previous campaigns.

The third stage of operation was to fully saturate the zeolite in column "A" with Cs-137 by processing undiluted supernatant through column "A" and returning column "A" effluent directly to 8D-2.

During the first or "test" stage of the operation, 2,400 gallons of supernatant was fed to D-001, diluted with 1.4:1 by water. The process sequence was through columns A-B-C-D, with column "D" effluent routed directly to 8D-2. For this test, column "D" contained one drum of clean zeolite. During the test, column "D" effluent reached a high of 35.6 E^{+1} uCi/mL Cs-137 (by analysis). This activity concentration is greater than 100 times the allowable effluent for a polishing (fourth) column and approximately ten times greater than allowable as a third column in a four column sequence. Therefore, it was concluded that column D could serve as a second column in a four column run.

Following the test stage and confirmation of the unacceptability of column "D" to function as a "polishing column", a three column run was initiated. Processing supernatant resumed with a dilution ratio of 1.4:1 water to supernatant and the column sequence A-B-C. Although the OSR criteria of >1000 DF still applied to STS operations, a more restrictive operational goal was introduced during stage 2 of Campaign No. 10. The criteria was to terminate processing of supernatant when the Cs-137 activity of the decontaminated supernatant reached a concentration which would

produce ≥100 mR/hr CSS product drums. A total of 10,900 gallons of supernatant were processed during stage #2 of Campaign No. 10.

During stage number three of Campaign No. 10, raw (undiluted) supernatant was processed through column "A" and routed directly to 8D-2. This was done to fully saturate the zeolite in column "A" with Cs-137. Running undiluted supernatant through D-001 also provided a means to sample the 8D-2 supernatant to determine present supernatant feed concentrations. Three samples were taken and the results are as follows:

SAMPLE	Cs-137 (uCi/mL)	TOTAL SOLIDS w/o	DENSITY (g/mL)	pH
1st	1760	26.3	1.206	9.6
2nd	1920	N/A	N/A	N/A
3rd	1850	26.2	1.205	9.6

A total of 10,800 gallons of raw supernatant was pumped through column "A". Lab analysis showed column "A" to be at 100 percent breakthrough at that point.

During Campaign No. 10, a total of 24,100 gallons of 8D-2 supernatant were pumped to D-001. Of this, 13,200 gallons were returned to 8D-2 and 10,900 gallons were transferred to LWTS. In addition, 24,300 gallons of dilution and flush water were also transferred to the LWTS. A total of 109,000 curies of Cesium-137 were removed from 8D-2 during Campaign No. 10.

LWTS OPERATION:

Operation of the evaporator subsystem continued to produce steady and reliable results. The only process upset during this campaign was a spill in the Chemical Viewing Aisle (CVA). This spill was caused when a sight glass in a demineralized water line ruptured. A small quantity of radioactive liquid from the process piping backed up through the final water line for pump 71-P-01 to the CVA. This event is discussed in critique minutes CM89075.

CSS OPERATION:

The sodium silicate system modification was completed incorporating a weighing system with a continuous digital readout at CSS Control Room area. The system, as installed, is designed to be independent and dedicated for monitoring of sodium silicate additions to mixer batches within an accuracy of ± 1 pound. Awaiting to be completed is the final tie-in with the CSS/Data Acquisition System (DAS) to receive the original output for documentation.

The in-cell drum lid crimper failed to crimp drum lids at least 50 percent of the time during automatic sequence. The cylinder piston seals were replaced and minor adjustments to the crimper elevation were made to correct the problem. All drum lids were checked and hand crimped as needed prior to RTS loadout.

Processing of drums was placed on hold due to a broken index cylinder shaft at M20 Smear Turntable conveyor. The cylinder was replaced by Maintenance and CSS operations resumed.

DRUM CELL OPERATION:

Work continued to determine the force produced by the drum grabber. Excessive force is theorized to be the cause of false "Drum Position" indications at the control room panel.

Drum cell radiation levels, as shown in Figure 1 are increasing due to the higher dose drums produced by this campaign. Radiation levels in the Drum Cell do not warrant extra shielding on the West face of the stack.

In the future, if radiation levels justify shielding the West face of the stack, shield drums will be placed for shielding between campaigns. It is important to note that the Drum Cell was designed to shield drums of much higher dose than seen to date. The trend of Figure 1 should decrease, as seen in the center of the graph, as low dose drums are produced in future campaigns.

DECONTAMINATION FACTOR (DF):

The graph of the batch transfer DF's along with the campaign cumulative has been omitted from this report because there were only two data points. The graph will be included in future reports when the quantity of data warrants graphical representation.

TANK LEVELS:

Campaign No. 10 continued to reduce the volumes in tanks 8D-2 and 8D-1 by processing supernatant and using 8D-1 water for flushing and sluicing operations. A graph of 8D-1 and 8D-2 levels since January 1988 is included for information, see Figure 2.

PRODUCT ACCEPTANCE:

The waste form classification data for drums produced in Campaign No. 1-7 are given in Table 6. All drums produced in Campaign No. 1-7 are class "C" waste. No additional drum classification analysis is available at this time.

LESSONS LEARNED:

STS COLUMN "D" ZEOLITE HEEL

It has been shown that normal operation of the "J-nozzle" to sluice the zeolite from the columns results in a heel of cesium-loaded zeolite remaining in the column (see Campaign No. 5 Run Report). Approximately 300 pounds of cesium-loaded zeolite remains in the column "heel". When a column containing this heel is placed last in series, the sodium in the decontaminated supernatant flowing through the column elutes some of the cesium from this heel, resulting in cesium concentrations above allowable STS effluent limits.

Prior to Campaign No. 10, the cesium loaded zeolite in column "D" was sluiced using the "J-nozzle" dip tube due to the malfunction of

the column "D" dump valve after Campaign No. 3 (see Campaign No. 4 Run Report). Therefore, all the loaded zeolite could not be removed from column "D".

A "deluge" method of dumping water at high velocity from the zeolite batch tank into the empty column was used in an effort to reduce the volume of the heel. It was thought that this method would stir the heel, knocking down ridges of zeolite, making loaded zeolite available for sluicing. The "J-nozzle" dip tube would then sluice out the zeolite, eventually leaving a nearly level heel at the elevation of the dip tube inlet.

Monitoring of the "J-nozzle" header during performance of this "deluge" showed very little loaded zeolite was being discharged. Five cycles of "deluge" were performed. After the fifth cycle showed essentially no increase in the radiation detector on the "J-nozzle" header, deluge sluicing was terminated.

Column "D" was subsequently loaded with one drum of zeolite and tested to determine its proper position in a four column run by processing diluted supernatant through the system in a column sequence of A-B-C-D. Decontaminated supernatant with a Cs-137 concentration of approximately 0.1 uCi/mL was entering the top of column D. The effluent Cs-137 concentration increased to a value of 35.6 uCi/mL as a result of eluting Cs-137 off the "heel". Based on system performance during previous four column campaigns, it was concluded that column "D" would be acceptable as a second column in a four column run.

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FIGURE 1

DRUM CELL RADIATION LEVELS

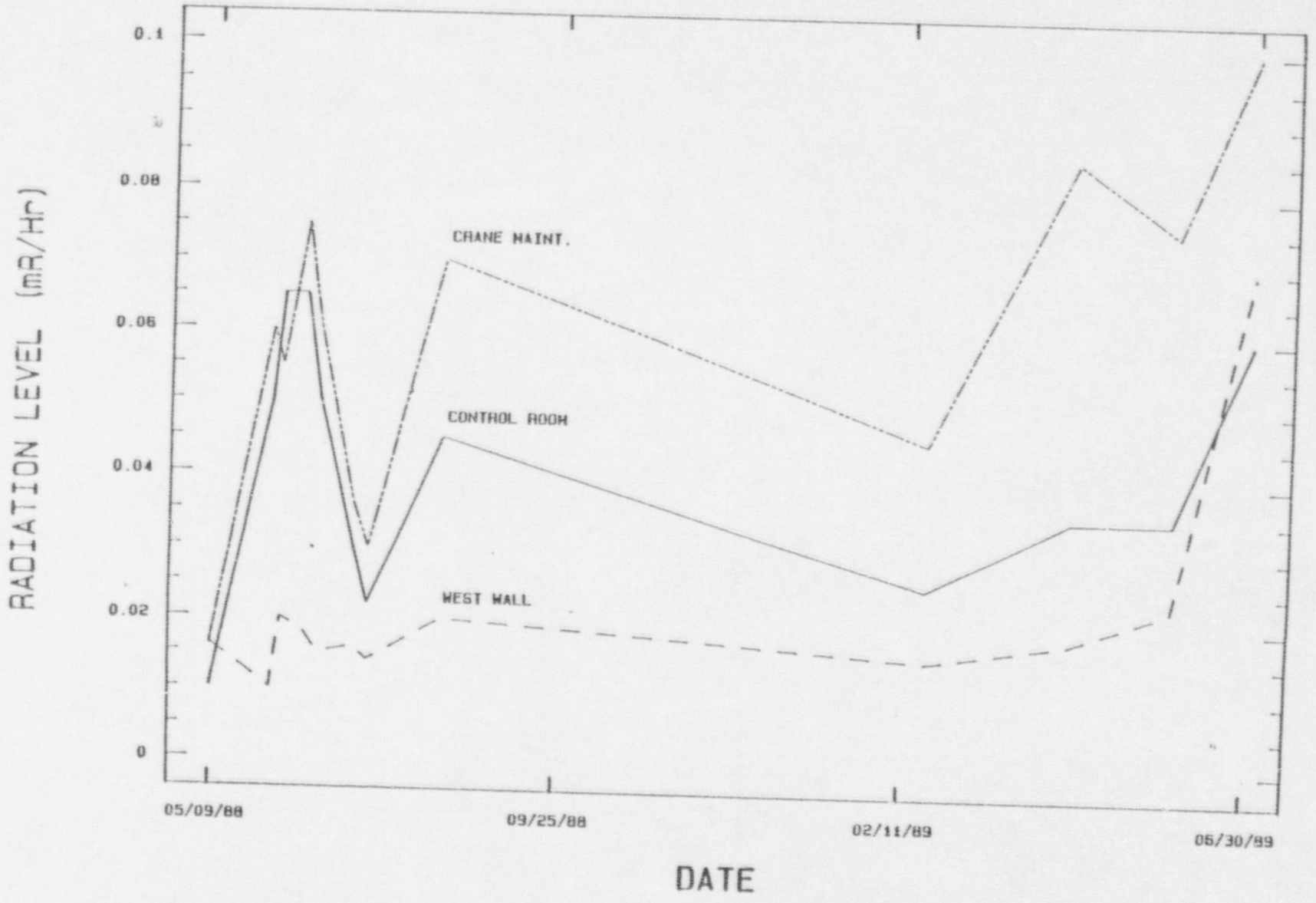

FIGURE 2

I R T S HIGH LEVEL WASTE TANKS

8D-1 & 8D-2

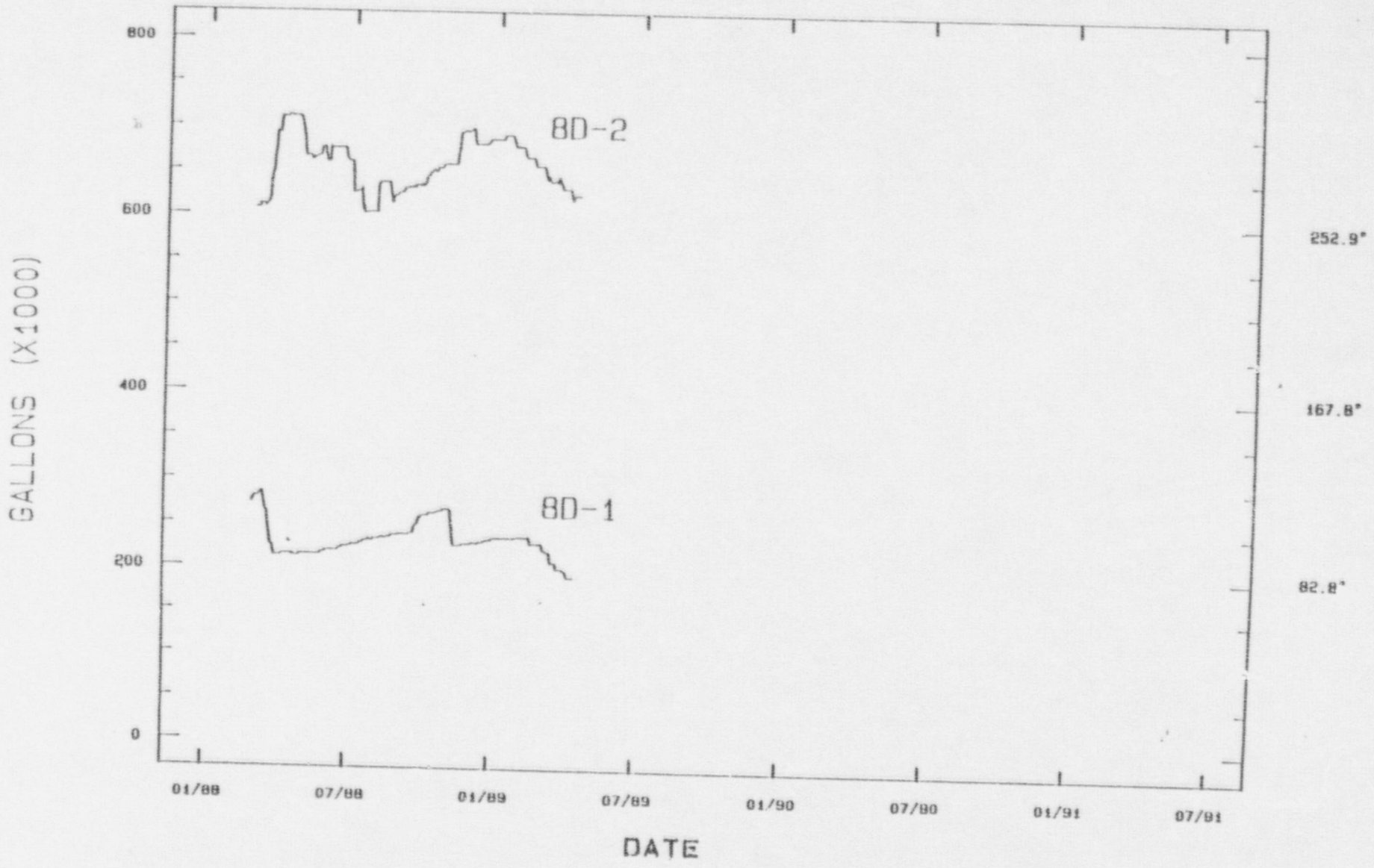

TABLE 1

IRTS CAMPAIGN NO. 10 RUN REPORT

SUMMARY TABLE OF RUN STATISTICS

1. TRANSFERS 8D-3 TO 5D-15B

A.	Campaign Nos. 1 thru 9	1,787,851 Litres	472,312 Gallons
B.	Campaign No. 10 Total	140,275 Litres	37,057 Gallons
	TOTAL TO DATE	1,928,126 Litres	509,373 Gallons

2. PROCESS VOLUMES

A.	Campaign Nos. 1 thru 9 Total Feed to Evaporator	1,772,754 Litres	468,324 Gallons
B.	Campaign No. 10 Total Feed to Evaporator	140,227 Litres	37,048 Gallons
	TOTAL TO DATE	1,912,981 Litres	505,372 Gallons
C.	Campaign Nos. 1 thru 9 Total Concentrate	597,395 Litres	157,785 Gallons
D.	Campaign No. 10 Total Concentrate	27,880 Litres	7,365(b) Gallons
	TOTAL TO DATE	625,275 Litres	165,150 Gallons

3. DRUMS PRODUCED

A.	Campaign Nos. 1 thru 9	3,988
B.	Campaign No. 10	148
	TOTAL TO DATE	4,136

4. DRUM CELL

Process drums transferred to Drum Cell 4,136(a)

5. CURIES OF CESIUM 137 REMOVED FROM 8D-2

A.	IRTS Campaign Nos. 1 thru 9	2,094,000
B.	IRTS Campaign No. 10	109,000
	TOTAL	2,203,000

6. PROCESS COMPLETION

A. Curies Percent Complete: $\frac{2,203,000}{7,098,000 - 508,000}$ = .334 or 33 percent

B. Drums Percent Complete:

$\frac{4,136}{13,000}$ = .318 or 32 percent

(a) Includes 5 drums removed from pile for core boring (#72847, 72791, 72949, 71004, 72813) which are now located in Lag storage.

(b) Includes heels leftover in the following tanks at the end of Campaign No. 10.

5D-15A1 = 686 gallons
5D-15A2 = 898 gallons
70-D-1 = 9 gallons

TABLE 2

IRTS CAMPAIGN NO. 10 RUN REPORT

COMPARISON OF CAMPAIGN NO. 8 & 9 TO CAMPAIGN NO. 10 STATISTICS

	CAMPAIGN NO. 8	CAMPAIGN NO. 9	CAMPAIGN NO. 10
S T S			
Volume of 8D-2 Supernatant Processed (Gal.)	34,020	35,101	10,900(b)
Total Volume Processed (Includes flush and dilution Water) (Gal.)	123,699	114,533(a)	37,057
Column Breakthrough (%)			
- Lead Column	86	95	55
- 2nd Column	20	24	6
Average System DF	37,500	57,170	4,470
Average Cs-137 in Effluent (uCi/mL)	.0456	.0217	.1493
L W T S			
Concentrates(d)			
- Volume (Gal.)	24,144	26,715	7,375(c)
- Average Cs-137 (uCi/mL)	.154	.095	.63
C S S			
Drums Produced(d)	696	685	148
Average Cs-137/Drum (Ci)	0.0095	.0225	.092
Average Drum Contact Dose Rate (mR/hr)	22	16	78

(a) An additional 590 gallons from Campaign No. 8 were processed in LWTS.

(b) In addition, 2,400 gallons was processed during testing of column D and 10,800 gallons during saturation of column A which were all recycled back to Tank 8D-2.

(c) Includes heels leftover in the following tanks at the end of Campaign No. 10.
5D-15A1 = 686 gallons
5D-15A2 = 898 gallons
70-D-1 = 9 gallons

(d) The volume of concentrate produced is reported from the Tank Transfer Data Sheets. Concentrate storage tanks are not emptied each campaign. The volume remaining in the tank (referred to as "heel"), accounts for inconsistencies between the volume of concentrates produced and the number of drums produced at 39 gallons per drum.

TABLE 3

I R T S CAMPAIGN NO. 10 RUN REPORT

DETAILED TABLE OF RUN STATISTICS

COLUMN SEQUENCE: A-B

		1	2	3	4
1.	Transfer 8D-3 to 5D-15B				
	A. Date	6/12/89	6/13/89	6/14/89	6/15/89
	B. STS Flow Rate (gpm)	N/A	6.0	6.0	N/A
	C. D-001 Sample No.	8902158	8902191	8902211	N/A
	i. Cs-137 (uCi/mL)	880	899	857	N/A
	ii. TDS (wt %)	14.25	14.54	14.68	N/A
	iii. Density (gr/mL)	1.101	1.103	1.105	N/A
	D. Cesium-137 Activity (Column Effluents) (uCi/mL)				
	i. Lead Column A	190	312	470	N/A
	ii. 2nd Column B	4.50	12.67	26.50	35.10
	E. Column Breakthrough (%)				
	i. Lead Column A	21.6	34.6	54.8	N/A
	ii. 2nd Column B	2.4	4.1	5.6	N/A
	F. 8D-3 Sample No.	8902159	8902136	8902205	8902226
	i. Cs-137 (uCi/mL)	0.1000	0.1720	0.2350	0.0904
	ii. TDS (wt %)	7.99	14.01	13.48	6.5
	iii. Density (gr/mL)	1.047	1.099	1.095	1.034
	G. STS System DF				
	i. Transfer DF	N/A	5,019	3,317	N/A
	ii. Cumulative DF	N/A	5,019	4,470	N/A
	H. 5D-15B Sample No.	8902175	8902200	8902218	8902241
	i. Cs-137 (uCi/mL)	0.1310	0.1790	0.2220	0.0947
	ii. TDS (wt %)	10.33	13.98	13.95	7.04
	iii. Density (gr/mL)	1.072	1.099	1.099	1,038
	I. Volume Received (litres) in 5D-15B	30,823	34,383	31,029	44,040
	J. Cumulative Volume for Campaign (litres)	30,823	65,206	96,235	140,275

TABLE 4

I R T S CAMPAIGN NO. 10 RUN REPORT

DRUM TESTING RESULTS

CONCENTRATES BATCH	31	32
LWTS TANK	5D-15A2 #16	5D-15A1 #28
LAB ANALYSIS NO.	8902222	8902261
TOTAL SOLIDS %	39.98	38.23
Cs-137 CONCENTRATION (uCi/mL)	6.19 E-1	6.35 E-1
POUNDS CEMENT +$CaNO_3$	20,475	12,825
NUMBER OF DRUMS	91	57
TOTAL GALLONS	3,549	2,223
CURIES PER DRUM (AVERAGE)	.091	.0935
RADIATION DOSE (mR/hr) PER DRUM	70	90
PRESOLIDIFICATION RESULTS	>700 PSI	>700 PSI
IN-CELL TEST RESULTS DRUM NO./PSI	75614 >700	75718 >700

Total Cement	33,300 LBS.
Total Number of Drums	148
Total Volume Solidified	5,772 Gallons
Total Curies Solidified	13.6 Ci

TABLE 5

I R T S CAMPAIGN NO. 10 RUN REPORT

DRUM PRODUCTION RATES

	DATE	DAILY AVERAGE	CUMULATIVE TOTAL
Campaign #1	6/1 to 6/17	33	401
Campaign #2	6/27 to 7/8	45	783
Campaign #3	7/18 to 8/5	35	1347
Campaign #4	8/22 to 9/26	30	1681
Campaign #6	12/5 to 12/13	45	2009
Campaign #7	1/23 to 2/23	50	2607
Campaign #8	3/6 to 4/13	60	3303
Campaign #9	4/24 to 5/26	80	3988
Campaign #10	6/19	57	
	6/20	34	
	6/21	8	
	6/22	49	4136

TABLE 6

IRTS CAMPAIGN NO. 10 RUN REPORT

WASTE FORM CLASSIFICATION INFORMATION

CRITERIA FOR CLASS "C": THE SUM OF LONG LIVED RADIONUCLIDE FRACTION AND THE SUM OF THE SHORT LIVED RADIONUCLIDE FRACTION MUST BOTH BE LESS THAN 1. SEE TEXT.

CAMPAIGN NUMBER	LAB ANALYSIS	NUMBER OF DRUMS	AVERAGE LONG-LIVED	AVERAGE SHORT-LIVED
1	8801605	115	3.37 E-01	7.32 E-05
1	8801607	95	4.54 E-01	5.94 E-05
1	8801831	191	4.11 E-01	4.62 E-05
2	8801932	100	3.30 E-01	2.43 E-05
2	8801963	160	3.69 E-01	4.92 E-05
2	8802011	122	3.91 E-01	2.32 E-05
3	8802094	193	3.55 E-01	3.44 E-05
3	8802108	93	4.39 E-01	4.39 E-05
3	8802159	211	3.83 E-01	5.04 E-05
3	8802220	67	3.53 E-01	6.29 E-05
4	8802345	99	4.07 E-01	1.21 E-04
4	8802373	199	3.92 E-01	1.17 E-04
4	8802611	36	4.07 E-01	1.14 E-04
6	8803744	167	4.38 E-01	4.28 E-05
6	8803754	97	4.24 E-01	5.76 E-05
6	8803854	37	3.97 E-01	5.32 E-05
7	8900176	188	3.48 E-01	1.89 E-05
7	8900330	196	4.32 E-01	1.34 E-05
7	8900384	87	3.88 E-01	9.09 E-06
7	8900531	125	3.88 E-01	2.14 E-05

TABLE 7

IRTS CAMPAIGN NO. 10 RUN REPORT

CESIUM-137 PROCESSED

CAMPAIGN	DATE	Cs-137 CONCENTRATION IN 8D-2 uCi/mL	VOL. PROCESSED (GALLONS)	Cs-137 REMOVED (KCi)	Cs-137 INVENTORY(a)(d) REMAINING IN 8D-2 (MCI)
1	5/88	2,860	18,726	203	6.895
2	6/88	2,600	15,800	155	6.740
3	7/88	2,600	26,356	259	6.481
4	8/88	2,600	21,000	207	6.274
5A 5B	9/88 10/88	2,400	30,200(b)	274(b)	6.000(b)
6	12/88	2,150	17,800	145	5.855
7(c)	1-2/89	2,150	35,342	288	5.567
8(c)	2-3/89	2,150	34,040	277	5.290
9(c)	4-5/89	2,150	35,101	286	5.004
10(c)	6/89	1,840	24,100(e)	109	4.895

(a) Total curies of Cesium-137 reported in Safety Analysis Report (SAR) report decayed to 7-21-88 = 7.098 MCi minus curies of Cesium-137 processed.

(b) Totals for Campaign Nos. 5A & 5B. Two columns were dumped.

(c) Diluted runs at a nominal 2:1 dilution.

(d) Includes approximately 0.508 MCi 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

Vol. of solids in heel = 7,548 gallons

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

Vol. of supernatant in heel = 72,916 gallons

Curies of Cs-137 in heel = 0.508 MCi

$$\frac{[(7.29\ E{+}04\ gal)(3.785\ E{+}03\ mL/gal)(2.84\ E{+}03\ uCi/mL)]}{10^6\ UCi/Ci}$$

(e) Includes 13,200 gallons which were recycled back to Tank 8D-2.

DOCKET NO. M-32.
CONTROL NO. 25820
DATE OF DOC. July 28, 1989
DATE RCVD. August 4, 1989
FCUF ____ PDR ✓
FCAF ✓ LPDR ✓
I&E REF. ✓
SAFGS ARDS ____
FCTC ____ OTHER ✓
DATE 8/4/89 INITIAL JAC