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OAK RIDGE NATIONAL LABORATORY

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U.S. ATOMIC ENERGY COMMISSION

ORNL-TM-313

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UNIT OPERATIONS SECTION

MONTHLY PROGRESS REPORT

JUNE 1962

NOTICE

ORNL-TM-313

UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT

June 1962

CHEMICAL TECHNOLOGY DIVISION

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OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
Operated By
UNION CARBIDE CORPORATION
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ABSTRACT

This periodical reports the development work of the Unit Operations Section of the Chemical Technology Division on an interim basis. This issue includes data and results on the subjects given below. The development of foam separation as a unit operation considered distributor design and gas rate. The development of a shear and leach process for power reactor fuel processing used carburized Yankee prototype fuel assemblies which were sheared to determine the effect of fuel element condition on the nature of the chopped pieces. A Squarkeen No. 3 moving blade lasted for 5,894 cuts while a Kleencut blade failed at 320 cuts under normal program use. A plastics and coating material testing program for the Transuranium facility is under way. The Volatility development program is studying the recycle of the salt charge for zirconium fuel element dissolution and has completed the fourth recycle test. The radioactive waste processing program has completed the test R-65 which studied the movement of mercury out of the calciner during the processing of TBP-25 waste.

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SUMMARY

1.0 CHEMICAL ENGINEERING RESEARCH

Foam Separation

Determinations of HTU_x values for stripping of Sr-89 from a dodecylbenzenesulfonate solution were continued. The values of 2.2 to 10 cm for HTU_x using a weir type liquid feed distributor were higher than corresponding values using "spider" type distributors of seven capillary tubes. The differences at higher flow rates were small; values of 2.2-2.6 cm were obtained for the weir distributor at 130-160 gal/sq ft hr. Decreased HTU_x values for increased gas rates and relatively little variation with column length were confirmed.

2.0 POWER REACTOR FUEL PROCESSING

Shear and Leach

Particle distribution measurements were made on a carburized, 0.8% max C, ORNL Mark I fuel prototype assembly and a Yankee prototype fuel assembly. The carburized assembly sheared into batches of 1/2, 1, and 1-1/2 in. lengths produced 26, 44, and 20% more particles, respectively, in the fraction $< 9520\ \mu$ than for a noncarburized assembly. Similarly, particles in the smallest fraction measured ($< 44\ \mu$) were 16, 20, and 22% less, respectively, than for a noncarburized assembly. The total stainless steel in the fractions $< 9520\ \mu$ for cuts of 1/2, 1, and 1-1/2 in. was 18.5, 5.3, and 3.3% of the original weight, respectively, and compares to noncarburized measurements of 2.7, 2.0 and 1.1%, respectively.

A Yankee type fuel assembly of 25 porcelain filled tubes, 5/16 in. o.d. with 1/4 in. o.d. spacer ferrules, was sheared into 1/4, 1/2, 5/8, 3/4, and 1 in. lengths and the particles $< 9520\ \mu$ were 81, 30, 18, 15, and 11% by weight, respectively, for the total batch. Shearing of this assembly which is smaller than the ORNL Mark I assembly resulted in tube compaction on cuts above 1/4 in. in length and ~38% by weight lesser amount of particles in the fractions $< 4760\ \mu$ as compared to an ORNL Mark I assembly.

The center step of the Squarkeen No. 3 (American Shear and Knife Co.) moving blade was chipped on the cutting edge during the 5894th cut of a porcelain filled ORNL Mark I fuel assembly. Failure occurred while shearing through the solid steel end plugs. A replacement blade of Kleenkut represented by the Heppenstall Company as an equal to Squarkeen failed at 320 cuts.

3.0 TRANSURANICS

Material Evaluation

A total of 24 different protective coatings and 2 plastic materials were irradiated by a Co^{60} source at 1×10^6 r/hr and 40-45°C. Failures occurred as follows:

3 of 7 epoxies failed in water between 3×10^8 and 1×10^9 R
1 of 7 epoxies on metal failed in air at 1×10^9 R
1 of 7 epoxies on concrete failed in air at 3×10^8 R
11 of 13 vinyls failed between 2×10^8 R and 5×10^8 R
9 of 13 vinyls failed in air between 5×10^8 R and 1×10^9 R
2 of 2 polyesters failed in both air and water at 5×10^8 R
3 of 3 phenolics failed in water at 1×10^9 R
0 of 3 phenolics failed in air at 1×10^9 R
0 of 1 zinc base based in air at 1×10^9 R

An epoxy joint sealer by the Sika Chemical Corp. exhibits questionable failure at 5×10^8 R in air. The material expanded ~50% but has not deteriorated.

A silicone rubber adhesive and moulding compound "Silastic RTV No. 731 and 501" by Dow Corning failed at 5×10^8 R in air.

4.0 VOLATILITY

A series of dissolutions of Zr-2 with HF in molten NaF-LiF-ZrF_4 salt will provide information on the problems of recycling the salt charge. Four tests have been made to date with the mol % of ZrF_4 ~35% in the initial charge, and with addition of NaF-LiF to the product salt to bring the composition back to 35 mol % ZrF_4 for the following test. Sampling of product salt indicates a corrosion product buildup of < 2 times the initial value.

5.0 WASTE PROCESSING

Forty-two per cent of the mercury fed to the calciner pot ended up in the evaporator at the completion of test R-65. The off-gas line between the calciner and the calciner condenser was electrically heated and operated at a temperature between 180-470°C. The calciner flanged top and the calciner condenser inlet also were heated to a temperature of ~180°C. Twenty-eight per cent of the mercury was found to be plated out in the off-gas system. Of the 28%, ~20% was located above the baffle section of the calciner vessel and 8% in the 1 in. off-gas line between the calciner top and the calciner condenser.

The evaporator condensate vapor sampler was operated satisfactorily, however, its rate was boilup dependent and insufficient sample was obtained during the latter part of the test.

1.0 CHEMICAL ENGINEERING RESEARCH

1.1 Foam Separation - P. A. Haas, D. A. McWhirter

Engineering studies of the problems associated with design and operation of columns for countercurrent exchange between a liquid and the surface of a foam were continued in 6 in. i.d. columns. Experimental runs were made to determine the heights of transfer units as a function of column length, flow rates, foam bubble sizes, and liquid distributor designs.

Countercurrent Run Results. Calculations were completed for countercurrent runs using a weir type liquid feed distributor with column lengths and flow rates as the variables. This distributor had ten 1/8 in. wide slots as weirs cut into 1/2 in. o.d. tubing; eight of the slots were equally spaced around a 4-1/4 in. dia ring of tubing and two on a cross bar. The liquid feed entered the distributor at the cross bar center. Calculations were made and results tabulated (Table 1.1) using the procedures and nomenclature previously reported (May, February 1962 Unit Operations Monthly Reports).

Countercurrent runs were made with flow rates of up to 2300 cc/min or 190 gal/hr sq ft of liquid and 10,000 cc/min of gas. The average foam bubble sizes were as large as 1.65 mm compared to 0.54-0.75 mm for previous runs with the spinnerette gas spargers. This size increase was not anticipated when the 4,000 cc/min gas rate was used for runs 25A-25D. Therefore the $(\Gamma/c)(V/L)$ ratios for these runs were a low 0.59-0.84 instead of the desired 1.1 to 1.3. This means that the operating and equilibrium lines for these runs pinched at the top. The top operating line end point is relatively inaccurately known and appears to lie across the equilibrium line for 25A thus indicating an infinite number of transfer units and a zero HTU_x value. The results for 25B and 25C are very sensitive to the values of Γ/c and a because of the low $(\Gamma/c)(V/L)$ ratio and are therefore less certain than the other results.

Surfactant material balances were discontinued after run 26. The variations in exit surfactant concentrations are of small importance and can be adequately estimated from the known feed concentrations and the measured condensed foam rate and concentrations. The checks of the Sr distribution coefficients from results with zero countercurrent length were much closer to the 6.2×10^{-3} cm used for calculations than the last several checks at lower gas flow rates.

Examination of results for the weir distributor (Tables 1.1 and 1.2) show decreasing HTU_x values as the liquid flow rate is increased. This decrease would be expected from observations of unequal liquid flows through the weirs. Observed weir to weir variations around the ring as percentages of the average flow per weir were 53 to 155% of average for 880 cc/min total flow, 67 to 142% of average for 1900 cc/min total flow and 90 to 131% of average for 3900 cc/min total flow. Much of the variation at low flows appeared due to preferential wetting. While degreasing and air oxidation to give a uniform surface scale did not eliminate this

Table 1.1. Foam Column Material Balances and HTU Calculations - Runs 25, 26, and 27

Surfactant Complexing Agent: Dodecylbenzenesulfonate, concentrations given are ppm of Trepolate F-95, about 90% sodium salt.

Constant Feed Concentrations: 2×10^{-6} M $Sr(OH)_2$, 10^{-3} M NaOH in demineralized water and 275 ppm Trepolate F-95 for liquid feed. Prepurified N_2 gas scrubbed with 1 M NaOH at 5-9 psig, $y_B = 0$ cpm/sq cm, $x_B^* = 0$ cpm/cc.

Liquid Feed Distributor: Distributor "E" consisting of ten 1/8-in. wide slots cut into a 4-1/4-in. dia ring of 1/2-in. dia tubing.

Quanity	Symbol	Units	Run Numbers: 25A	25B	25C	25D	26A	26B	26C	26D
Gas spargers used	-	-	←Spinnerette with 50 μ dia holes→				←EC sintered glass→			
Countercurrent length	z	cm	28	29	13	0	19	27	12	0
Liquid rate in	$L + E_p$	cc/min	2000	1100	2000	2000	2400	1430	2400	2400
Gas rate	V/a	cc/min	4000	2200	4000	4000	2880	1720	2880	2880
Condensed foam rate	E_p	cc/min	21	11	28	23	110	30	90	100
Net liquid rate	L	cc/min	1980	1090	1970	1975	2290	1400	2310	2300
Liquid surfactant conc. out	-	ppm	252	246	253	253	263	266	264	269
Condensed foam surfactant rate	-	mg/min	24.8	15.8	21.9	19.4	50.5	24.8	46.1	48.3
Surfactant material balance	-	%	96	92	96	95	99	101	99	101
Average bubble diameter	d	mm	1.00	0.90	1.00	1.30	0.41	0.33	0.39	0.41
Average foam surface area	a	sq cm/cc	60	67	60	46	146	182	154	146
Gross β in liquid feed	x_2	cpm/cc	2680	2680	2680	2680	3700	3700	3700	3700
Gross β in liquid out	x_B (also x_1^*)	cpm/cc	440	650	590	1800	390	460	640	1820
Gross β in condensed foam	y_2V	10^3 cpm/min	4650	2200	3750	2100	7400	4600	7200	4700
Gross β material balance	-	%	103	101	92	105	95	97	98	100
Sr distribution coefficient	Γ/c	10^{-3} cm	6.2	6.2	6.2	6.3[a]	6.2	6.2	6.2	6.15[a]
Phase flow ratio	$(\Gamma/c)(V/L)$	dimensionless	0.75	0.84	0.76	0.59[a]	1.14	1.38	1.19	1.12[a]
Liquid conc. in equil. with y_2	x_2^*	cpm/cc	3130[b]	2400	2500	1800[a]	2840	2390	2620	1830[a]
Liquid conc. entering liquid pot	x_1	cpm/cc	770	1200	1040	2860[a]	835	1095	1400	3860[a]
Liquid concentration change	$x_2 - x_1$	cpm/cc	1910	1480	1645	-	2865	2605	2300	-
Average driving force	$(x-x^*)_{ln\ mean}$	cpm/cc	-[b]	397	294	-	630	930	910	-
Number of transfer units	N_x	-	-[b]	3.74	5.9	-	4.6	2.7	2.5	-
Height of transfer unit	HTU_x	cm	-[b]	7.7	2.2	-	4.3	10	4.7	-
Height of transfer unit	HTU_x	in.	-[b]	3.0	0.9	-	1.7	3.9	1.9	-

[a] The liquid pot was assumed to be one theoretical stage for zero countercurrent length and the values of Γ/c calculated from the exit concentrate.

[b] The operating line for run 25A appeared to cross the equilibrium line (see discussion) and thus prevents calculation of a HTU_x value.

Table 1.1. Continued

Quanity	Symbol	Units	Run Numbers: 27A	27B	27C	27D	27E	28A	28B	28C	28D
Gas spargers used	-	-	←Spinnerette with 50 μ dia holes→					←Spinnerette with 50 μ dia holes→			
Countercurrent length	z	cm	27	27	12	13.5	0	50	27	13	0
Liquid rate in	$L + E_p$	cc/min	1460	1000	1000	1460	1460	1700	1700	1700	1700
Gas rate	V/a	cc/min	4000	4000	4000	4000	4000	10000	8000	8000	8000
Condensed foam rate	E_p	cc/min	30	30	30	30	30	160	92	86	90
Net liquid rate	L^p	cc/min	1430	970	970	1430	1430	1540	1610	1615	1610
Liquid surfactant conc. out	-	ppm	-	-	-	-	-	-	-	-	-
Condensed foam surfactant rate	-	mg/min	~24	22.4	~24	20.0	25.1	70	47	53	49
Surfactant material balance	-	%	-	-	-	-	-	-	-	-	-
Average bubble diameter	d	mm	1.06	1.10	1.00	1.10	1.20	1.65	1.55	1.55	1.55
Average foam surface area	a	sq cm/cc	57	55	60	55	50	36	39	39	39
Gross β in liquid feed	x_2	cpm/cc	3350	3350	3350	3350	3350	2800	2800	2800	2800
Gross β in liquid out	x_B(also x_1^*)	cpm/cc	490	195	390	625	1950	55	115	280	1270
Gross β condensed foam	y_2V	10^3 cpm/min	4300	3080	2880	3140	2500	4950	4640	4300	2630
Gross β material balance	-	%	102	98	97	83	108	106	101	100	98
Sr distribution coefficient	Γ/c	10^{-3} cm	6.2	6.2	6.2	6.2	6.4[a]	6.2	6.2	6.2	6.7[a]
Phase flow ratio	(Γ/c)(V/L)	dimensionless	0.99	1.41	1.53	0.96	0.90[a]	1.45	1.19	1.19	1.29[a]
Liquid conc. in equil. with y_2	x_2^*	cpm/cc	3040	2250	1940	2280	1950[a]	2220	2420	2240	1270
Liquid conc. entering liquid pot	x_1	cpm/cc	975	470	985	1225	3700[a]	135	252	610	2900
Liquid concentration change	$x_2 - x_1$	cpm/cc	2375	2880	2365	2125	-	2665	2548	2190	-
Average driving force	$(x-x^*)_{ln\ mean}$	cpm/cc	395	590	945	810	-	252	238	435	-
Number of transfer units	N_x	-	6.0	4.9	2.50	2.62	-	10.6	10.7	5.0	-
Height of transfer unit	HTU_x	cm	4.5	5.5	4.8	5.1	-	4.7	2.52	2.60	-
Height of transfer unit	HTU_x	in.	1.8	2.2	1.9	2.0	-	1.9	1.0	1.0	-

[a]The liquid pot was assumed to be one theoretical stage for zero countercurrent length and the values of Γ/c calculated from the exit concentrate.

Table 1.2. Comparison of Foam Column HTU_x Results

Location of Detailed Results:
Runs 15, 16, and 17, February 1962 Unit Operations Monthly
Runs 21, 22, 23, and 24, April 1962 Unit Operations Monthly
Gas Sparger: Spinerette with 1760 50 μ dia holes or as noted.

Variable Compared	Net Liquid Rate, L cc/min	Gas Rate cc/min	Counter-current length,cm	Liquid Distrib. Used	HTU_x cm	Run No.
Liquid Distributors	1100	2000	26.5	C	0.65	22B
	1100	2000	26.5	D	2.3	23B
	1090	2200	29	E	7.7	25B
	1430	2620	26.5	C	1.5	22A
	1435	2620	26.5	D	3.8	23A
	1430	4000	27	E	4.5	27A
Liquid Flow Rate	1100	2000	26.5	C	0.65	22B
	1230	2000	27	C	2.5	17B
	1430	2620	26.5	C	1.5	22A
	970	4000	27	E	5.5	27B
	1430	4000	27	E	4.5	27A
	1610	8000	27	E	2.5	28B
Gas Flow Rate	1090	2200	29	E	7.7	25B
	970	4000	27	E	5.5	27B
	1610	8000	27	E	2.5	28B
Countercurrent Length	1615	8000	13	E	2.6	28C
	1610	8000	27	E	2.5	28B
	1430	4000	13.5	E	5.1	27D
	1430	4000	27	E	4.5	27A
	970	4000	12	E	4.8	27C
	970	4000	27	E	5.5	27B
Gas Sparger-Spinnerette	1090	2200	29	E	7.7	25B
-EC Glass	1400	1720	27	E	10	26B
-Spinnerette	1430	4000	27	E	4.5	27A
-Spinnerette	1970	4000	13	E	2.2	25C
-EC Glass	2290	2880	19	E	4.3	26A
-Spinnerette	1610	8000	27	E	2.5	28B
-Spinnerette	1100	2000	26.5	D	2.3	23B
-EC Glass	1385	2000	26.5	D	2.7	24A
-Spinnerette	1435	2620	26.5	D	3.8	23A

preferential wetting, it is probably of less importance in the column where the distributor is completely surrounded by and wetted by the foam.

The liquid distributor and flow rate effects cannot be separated. The "C" spider of 0.095 in. i.d. capillary tubes has given the lowest HTU_x values (Table 1.3). However, its optimum range (May Unit Operations Monthly Report) corresponds to the optimum range of liquid and gas flows for the 6 in. dia column and the spinnerette gas sparger used. The A and B distributors are too small while the D and E distributors require such high gas flows that the bubbles are larger, and much less uniform, and the foam is less stable.

The effects of other variables with the "E" weir distributor were the same as previously observed. Increased gas flows appeared to decrease the HTU_x values. The effects of the countercurrent length variations were small with two small decreases and one small increase in HTU_x values as the length was increased from 13 to 27 cm. The EC sintered glass gas sparger gave larger HTU_x values than the spinnerette gas sparger.

Table 1.3. Range of HTU_x Values

Liquid Distributors				Results for Spinn.		Results for EC Glass	
Designation	Type	Size	Optimum flow range, cc/min	No. of Tests	Range of HTU_x, cm	No. of Tests	Range of HTU_x, cm
A	"spider"	0.048 in. i.d.	100-300	0	-	3[a]	9-12[a]
B	"spider"	0.061 in. o.d.	150-500	9	2.9-8.4	0	-
C	"spider"	0.095 in. o.d.	400-1200	11	0.5-2.5	2	3.3, 7.1
D	"spider"[b]	0.188 in. o.d.[b]	1500-4500	3	2.3-8.3	4	2.7-6.6
E	weir	1/8 in. slots	1500-6000	10	2.2-7.7	3	4.3-10

[a] These results are for porosity "D" stainless steel spargers.

[b] This "spider" had 0.125 in. dia orifices at each tube inlet.

2.0 POWER REACTOR FUEL PROCESSING

C. D. Watson

2.1 Shear and Leach - B. C. Finney, G. A. West

A shear and leach program to determine the economic and technological feasibility of leaching the core material (UO_2 or UO_2-ThO_2) from relatively short sections (1 in. long) of fuel elements produced by shearing is continuing. The apparent advantage of this method is the recovery of fissile and fertile material from spent power reactor fuel elements without dissolution of the inert jacketing and end adaptors. These unfueled portions are stored directly in a minimum volume as a solid waste. A "cold" shear and leach complex consisting of a shear, conveyor-feeder, and leacher is being evaluated prior to hot runs.

Shakedown runs of the complete mechanical complex showed that the shearing and leaching of prototype oxide fuel could be started.

Particle size measurements were made to determine the amount and size of the soluble and insoluble particles dislodged during shearing of spent fuels. Such measurements will be valuable in predicting the fate of particulate matter in the rotary drum leacher particularly their influence on leaching rate and their transfer as solid waste.

The leacher and auxiliary catch pots including liquid process lines were checked out using hot water to simulate acid. After making a few minor modifications to eliminate vapor locking, the system operated satisfactorily. The leacher can be heated to ~105°C in 10 min by introducing steam at ~10 psig into the leacher through the acid and wash water lines, screen cleaning nozzles, and into the feed end.

A wash down system to decontaminate the shear was checked out. The nozzles wet the interior of the shear well; however, pieces of prototype fuel (porcelain filled) sheared 1 in. long on top of the movable blade were not dislodged. The capacity of the 43 nozzles is approximately 17 gal/min at 65 psig water pressure.

The Squarkeen No. 3 moving blade was chipped on the center step at 5892 cuts of the porcelain filled ORNL Mark I prototype fuel assemblies (Figure 2.1). Three porcelain filled ORNL Mark I fuel assemblies were sheared into 1/2 in. sections in continuing blade wear studies. While making the second cut on each assembly (cutting steel end plugs and ferrules, Figure 2.2) the shear was stalled approximately 1/4 the way through the assembly. The shear was operated at a hydraulic oil pressure setting of ~1000 psig which is equivalent to ~150 tons. Four attempts were required to shear through the first two assemblies and five attempts were required on the third assembly. On the fifth attempt, a wedge shaped piece 1-5/8 in. x 5/8 in. x 1/4 in. was chipped from the center step of the Squarkeen No. 3 blade (Figure 2.3). The cutting edge and corners of the center step and two adjacent steps of the moving blade were badly rounded and apparently the difficulty encountered was the result of blade

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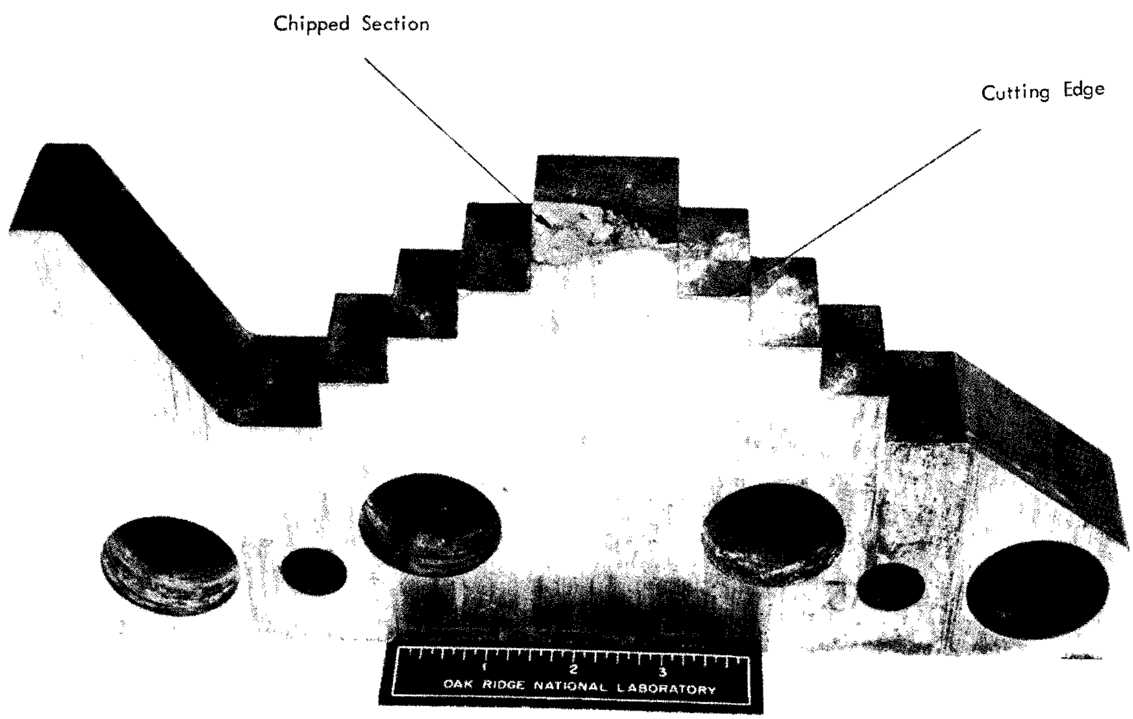

Fig. 2.1. Squarkeen No. 3 moving blade showing chipped section of center step which occurred at 5892 cuts of the porcelain-filled ORNL Mark I prototype fuel assemblies.

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PHOTO 57628

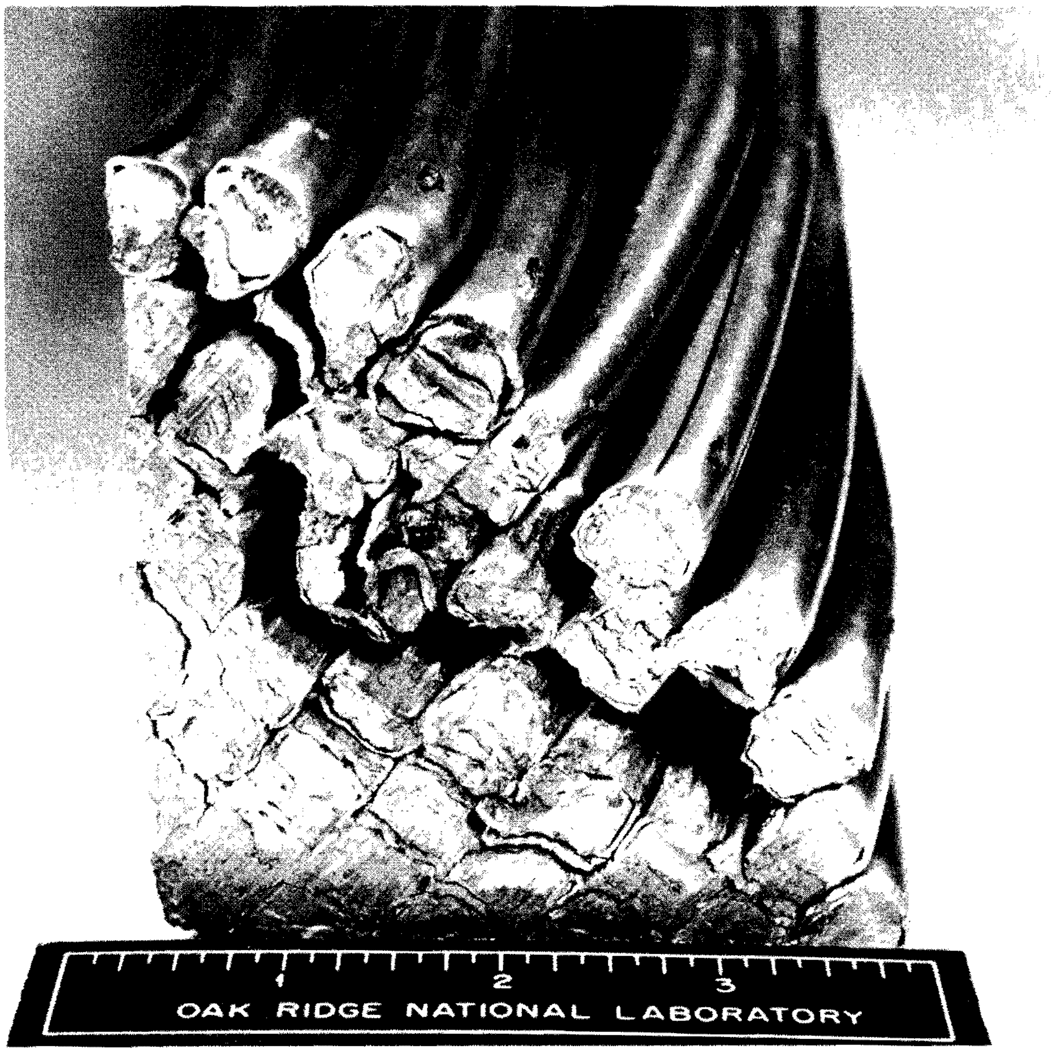

Fig. 2.2. Shape of ORNL Mark I fuel assembly after having sheared through the solid steel end plugs and row of ferrules.

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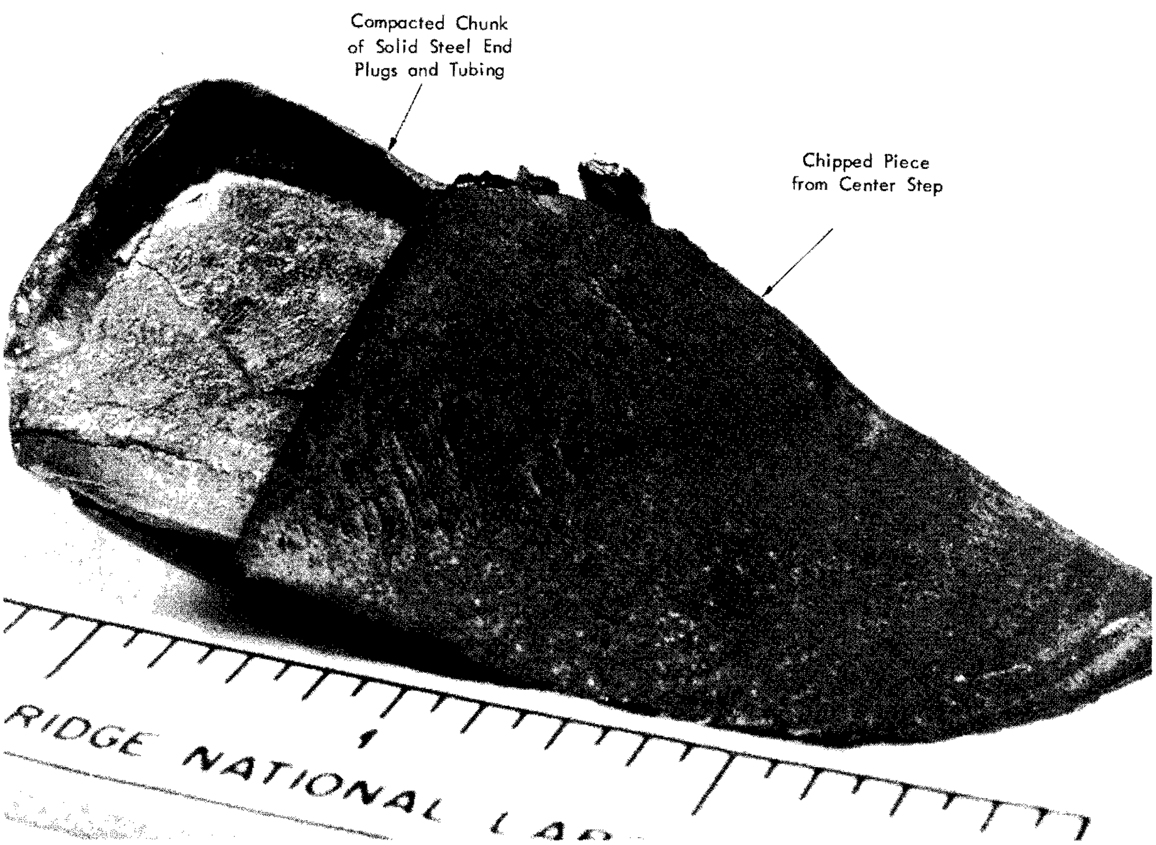

Fig. 2.3. Chipped piece from center step of the Squarkeen No. 3 moving blade showing the compacted chunk of solid steel end plugs and tubing in which step of blade was nestled at the time of breakage.

dullness (Figure 2.4). The porcelain sections were sheared without difficulty but there was an increase in the amount of wiping of the stainless steel tubing.

The Squarkeen No. 3 blade was replaced with a Kleenkut blade (Heppenstall Company) of similar hardness (54-56 Rockwell C). After having made only 320 cuts of the porcelain filled fuel assemblies the cutting edge of the center and two adjacent steps was badly rounded indicating very unsatisfactory service.

The shearing of the porcelain filled fuel assemblies was completed and the shear was dismantled for inspection and thorough cleaning in preparation for shearing UO_2 filled aluminum, stainless steel, and Zr-2 tubing and UO_2-ThO_2 and ThO_2 filled stainless steel tubing. Approximately 6200 cuts of the porcelain filled fuel assemblies had been made and in general the condition of the shear was very good; however, there was a considerable increase in the amount of scoring (Figures 2.5 and 2.6) of the gibs and liners since the last inspection (elapsed time represented by approximately 4800 cuts of the porcelain filled fuel assemblies). The increase in scoring did not appear to be detrimental to the operation of the shear.

Particle size determinations were made using shaker sieve screens from 9520 to 44 μ openings on porcelain filled, stainless steel clad sheared sections of a (1) carburized, 0.8% maximum C, ORNL Mark I fuel assembly, and (2) Yankee type fuel assembly.

The ORNL Mark I carburized assembly sheared into 1/2, 1, and 1-1/2 in. lengths in ~4 kg batches generated particles < 9520 μ of 45, 20, and 9% by weight, respectively, which amounts to 26, 44, and 20% more particles than for a noncarburized assembly. Similarly, particles in the smallest fraction measured (< 44 μ) totaled 3.7, 1.2, and 0.7% by weight, respectively, and was 16, 20, and 22% less than for a noncarburized assembly (Figure 2.7). Analysis of the material in the various fractions show that the total stainless steel < 9520 μ for cuts of 1/2, 1, and 1-1/2 in. lengths was 18.5, 5.3, and 3.3% by weight, respectively, of the original metal weight and compares to 2.7, 2.0, and 1.1% by weight, respectively, for a noncarburized assembly. The total porcelain dislodged in the fractions < 9520 μ from 1/2, 1, and 1-1/2 in. cut length of the carburized element was 88, 44, and 16% by weight, respectively, of the original porcelain present and is 23, 48, and 25%, respectively, more than a noncarburized sheared element (Figure 2.8).

A Yankee type fuel assembly of 36 porcelain filled stainless steel tubes, 0.340 in. o.d. with 1/4 in. o.d. x 1/2 in. long spacer ferrules was sheared into 1/4, 1/2, 5/8, 3/4, and 1 in. lengths to determine the particle fractions produced and the effect of shearing with the stepped shear blade designed for the 53% larger cross section ORNL Mark I fuel. The particles produced in the fractions < 9520 μ from the 1/4, 1/2, 5/8, 3/4, and 1 in. cut lengths were 81, 30, 18, 15, and 11% by weight, respectively, of the total batch; the stainless steel < 9520 μ was 61, 30, 10, 10.5, and 7.8% by weight, respectively, of the total metal

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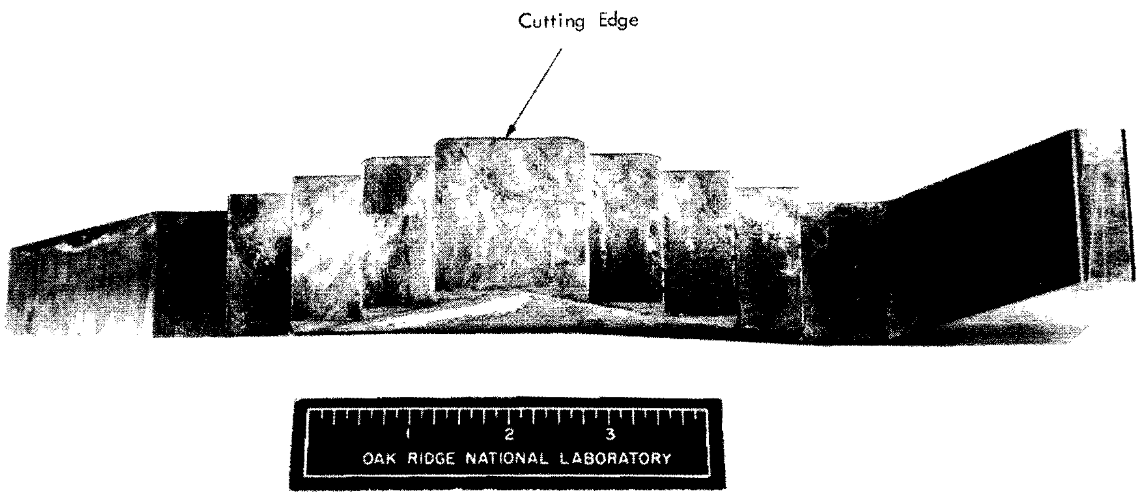

Fig. 2.4. Squarkeen No. 3 moving blade showing rounded corners and cutting edge of the center and two adjacent steps (chipped portion was put in place while photographing the blade).

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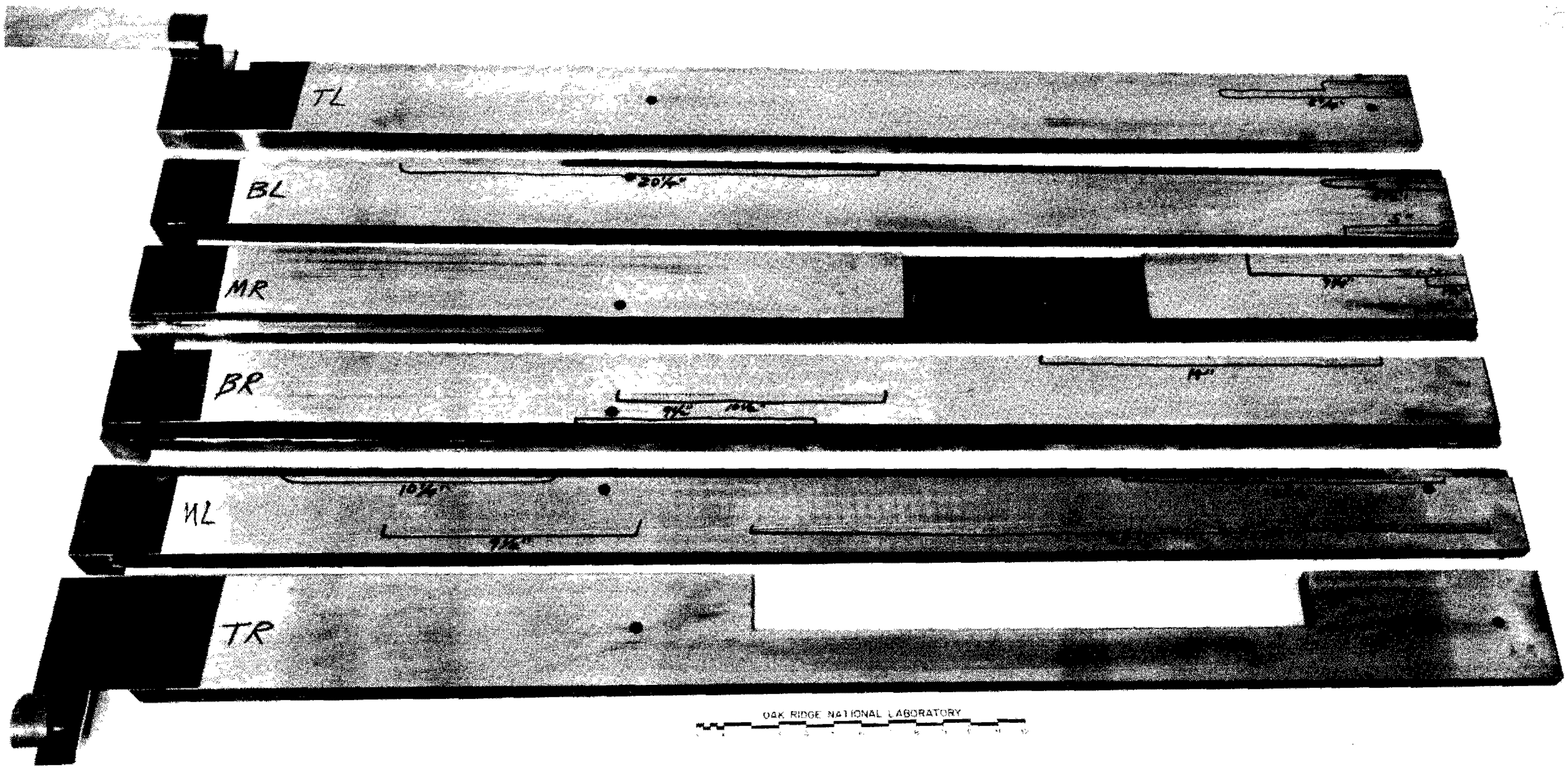

Fig. 2.5. Scored areas on shear gibs after having made approximately 1400 cuts on the porcelain-filled ORNL Mark I prototype fuel assemblies.

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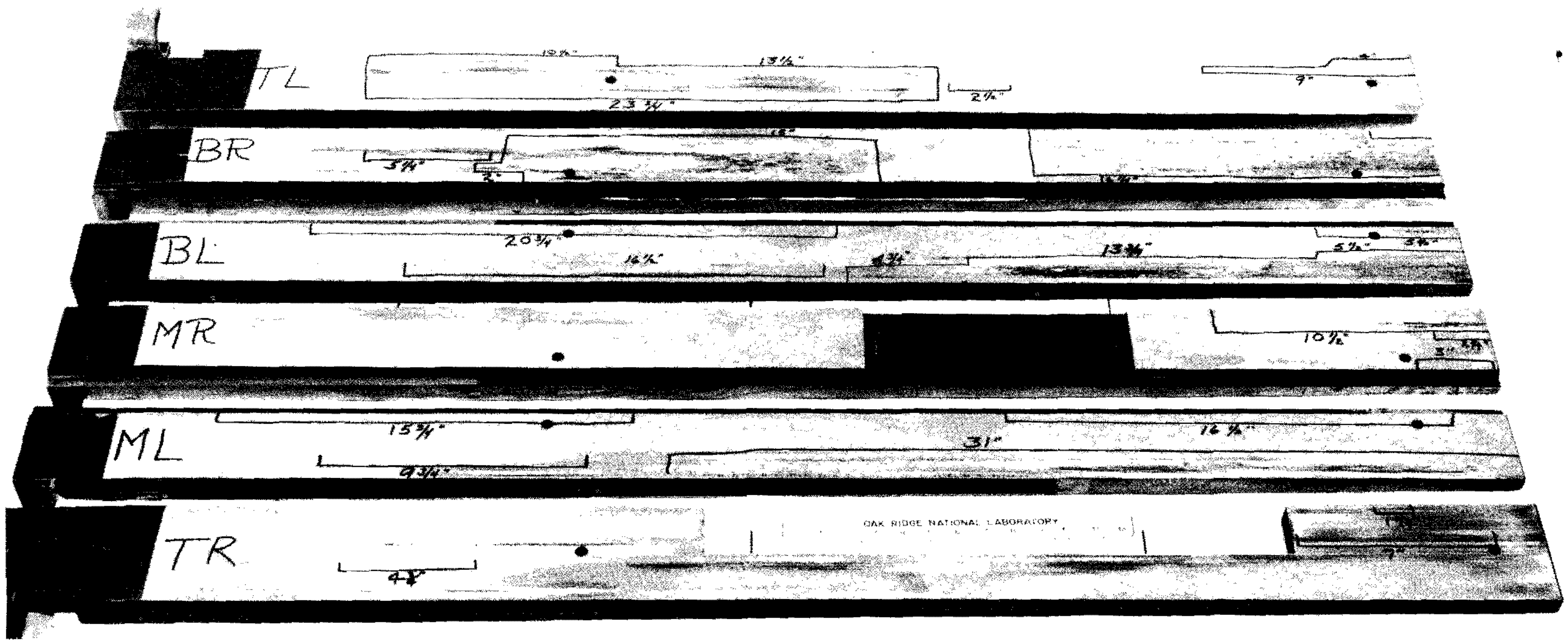

Fig. 2.6. Scored areas on the shear gibs after having made approximately 6200 cuts on the porcelain-filled ORNL Mark I prototype fuel assemblies.

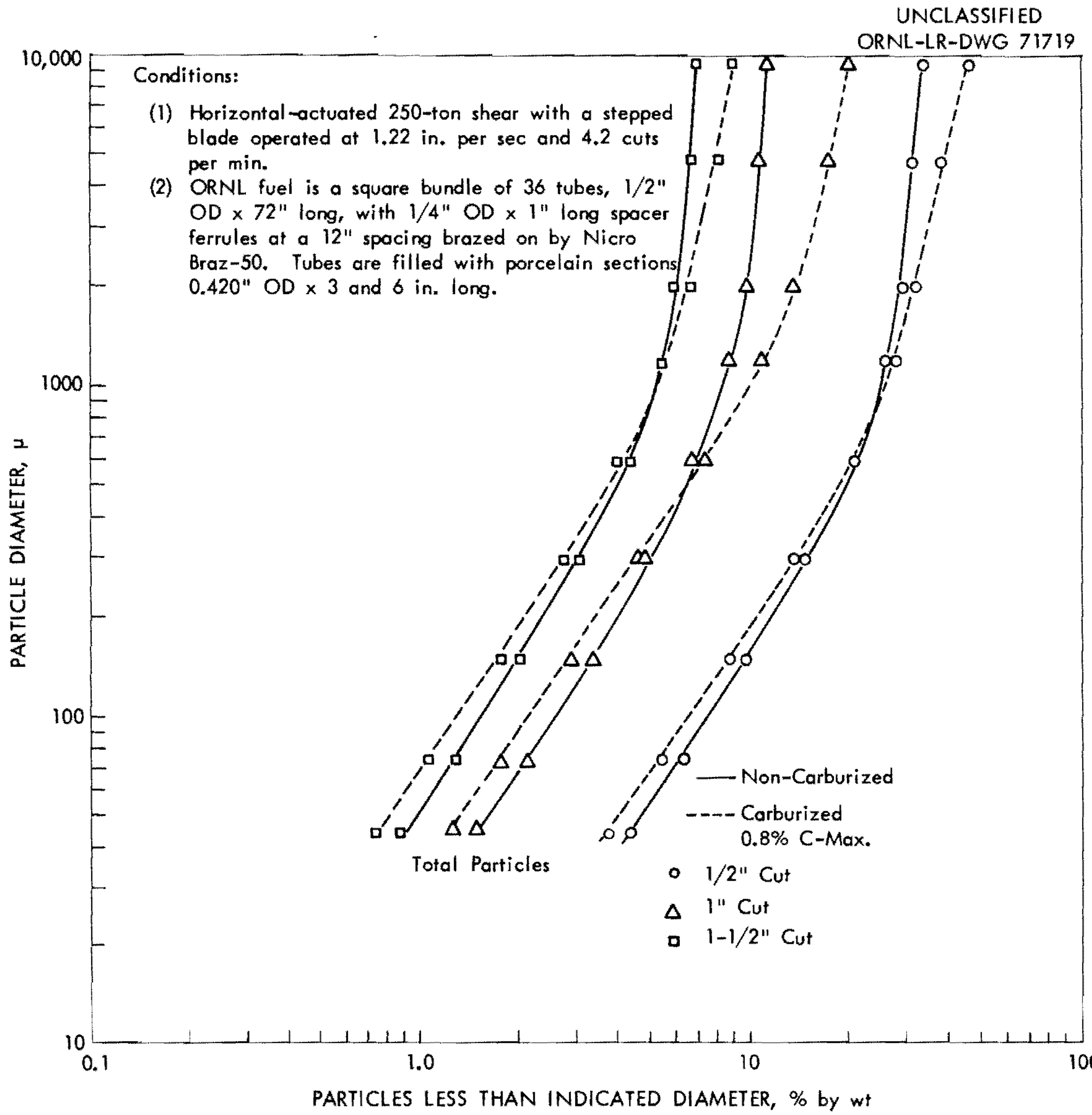

Fig. 2.7. Total particles dislodged from shearing of ORNL Mark I fuel into various lengths.

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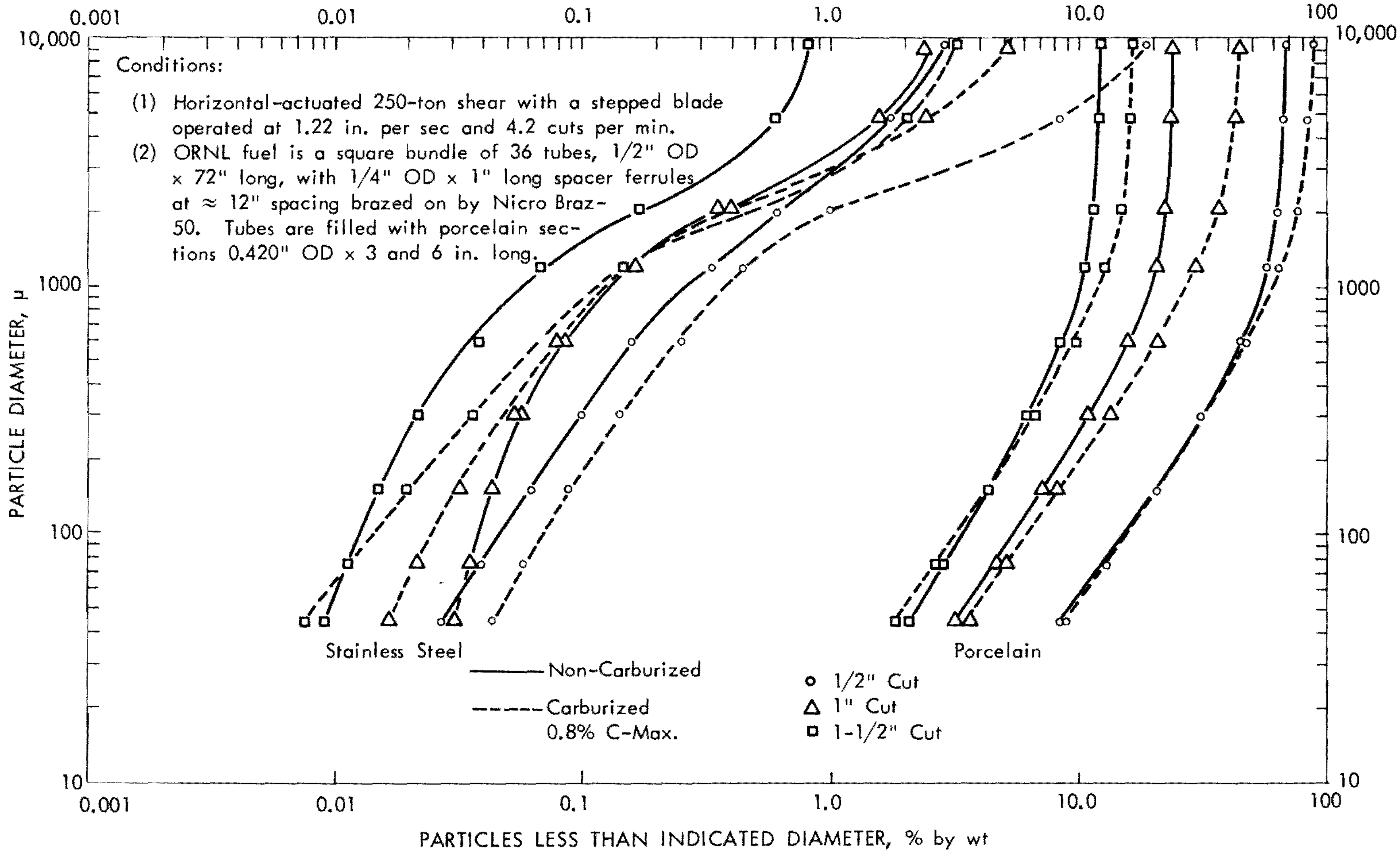

Fig. 2.8. Porcelain and stainless steel dislodged from shearing of ORNL Mark I fuel into various lengths.

originally present in the batch; and the porcelain dislodged < 9520 μ was 99, 37.5, 30, 20, and 15% by weight, respectively, of the original amount present (Figure 2.9). Shearing of the Yankee type assembly which has a 53% smaller cross section than the ORNL Mark I prototype fuel assembly resulted in compaction of 10 to 24 tubes in ~20% of the cuts made with the leading edge of the stepped blade on all cut lengths above the 1/4 in. lengths. The amount of particles produced in the fractions < 4760 μ was ~38% by weight less than comparable cuts made on an ORNL Mark I assembly.

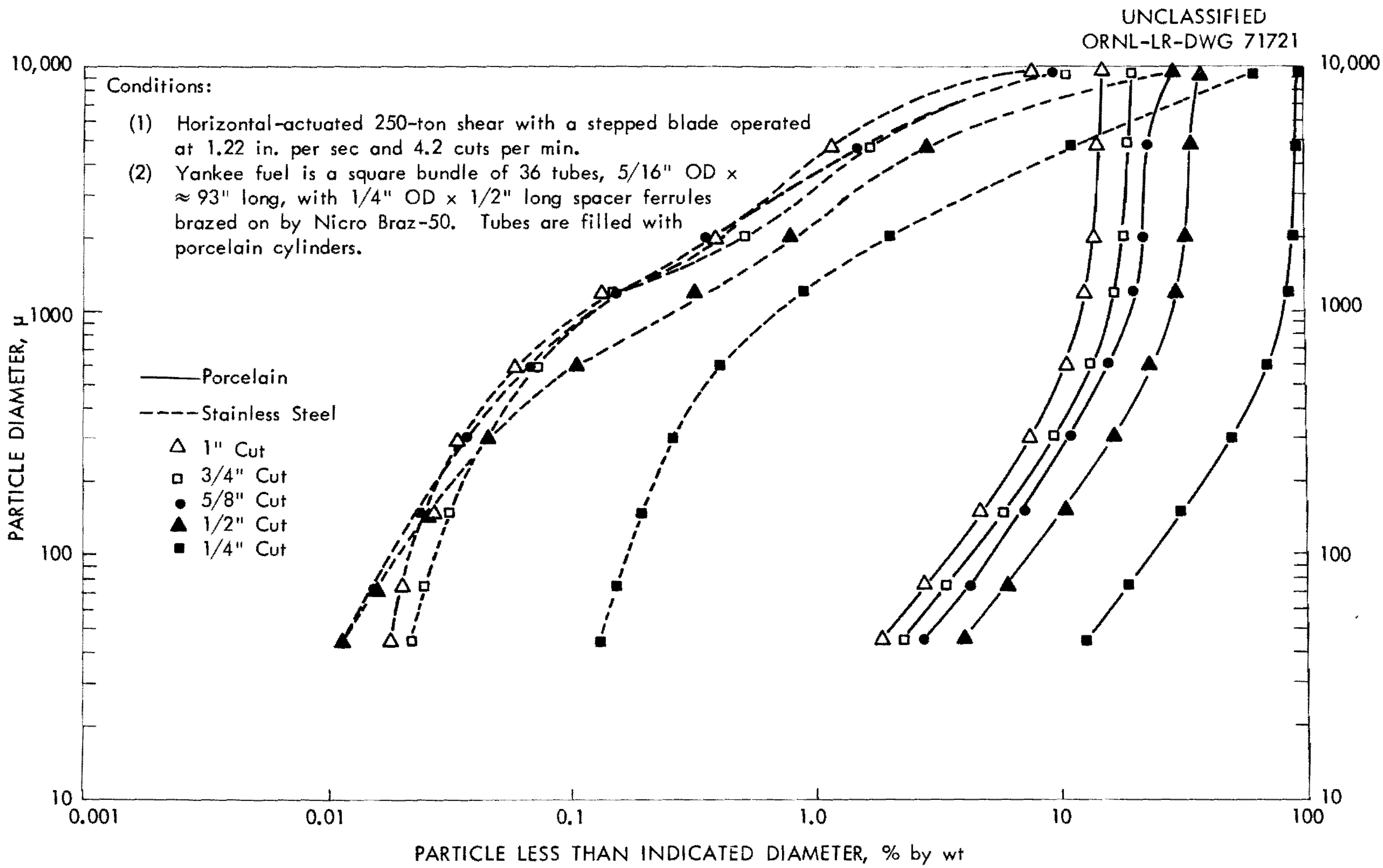

Fig. 2.9. Porcelain and stainless steel dislodged from shearing of Yankee prototype into various lengths.

3.0 TRANSURANICS

P. A. Haas

3.1 Material Evaluation - G. A. West

Protective coatings and some plastic materials of construction are being evaluated for radiation, wear and chemical resistance as related to the TrU process environment where nuclides must be contained or easily decontaminated from structural surfaces.

All materials undergoing evaluation are being irradiated in a cobalt-60, γ source at 1×10^6 rads/hr intensity and 40-50°C. The plastics are being exposed in air and the coatings are being exposed in both air and deionized water because they may become submerged in water in actual use. The protective coatings exhibiting the best resistance in both air and deionized water are (1) Amercoat-66, epoxy, 1×10^9 rads, (2) Amercoat No. 74-B Surfacer w/fiberglass cloth and No. 66 gloss seal coat, epoxy, 1×10^9 rads, (3) Amercoat No. 74-B Surfacer w/No. 74 seal, epoxy, 7×10^8 rads, (4) U. S. Stoneware systems No. 6 and 7, 1×10^9 rads. The phenolic base coatings, Plasite Nos. 7100, 7122, and 7155 on concrete by the Wisconsin Protective Coating Company, exhibits excellent resistance in air to 1×10^9 rads but failed in the deionized water at this exposure. The same coatings on metal are satisfactory in both air and deionized water at the 1×10^9 rads exposure (Table 3.1). Irradiation of all coatings will continue to failure. An "Epoxy Joint Sealer" by the Sika Chemical Corp. exhibits questionable failure (dependent upon the proposed use) at 5×10^8 rads in air by retaining some elasticity while progressively expanding ~50%.

Test strips of the Amercoat Corporation's polyvinyl chloride sheet material, 3/32 in. thick x 44 in. wide, with seams heat welded giving a continuous smooth surface has been installed in areas of heavy foot traffic for 34 days. The Amercoat Corporation's method of welding the seams and the traffic test results appears good enough that the vinyl sheets will be installed on a laboratory floor for further evaluation.

Table 3.1. Results of Radiation Exposure to Materials

Source: Co^{60} at 1 x 10^6 rads/hr intensity.

Conditions: Specimens exposed in air and in deionized water at 40-50°C.

Material	Applied on		Exposed to	Failed		OK		Irradiation to be Continued	
	Concrete	Steel	Rads	in air	in water	in air	in water	Yes	No
Epoxy Coating									
Amercoat No. 66	X		1 x 10^8			X	X	X	
Amercoat No. 66		X	1 x 10^9			X	X	X	
Amercoat No. 74 Surfacer w/fiberglass and No. 66 top	X		1 x 10^9			X	X	X	
Amercoat No. 74 primer w/74-B surfacer		X	9 x 10^8		X	X		Air Only	
Amercoat No. 74-B Surfacer w/No. 74 seal, grey	X		7 x 10^8			X	X	X	
Amercoat No. 74-B Surfacer w/No. 74 seal, white		X	7 x 10^8			X	X	X	
Prufcoat primastic	X		3 x 10^8	X	X				X
w/No. 4000 top		X	3 x 10^8		X				X
		X	1 x 10^9	X					X
Plasite No. 9009, Wisconsin	X		5 x 10^8		X				X
Protective Coating Corp.		X	5 x 10^8		X				X
	X		1 x 10^9			X		Air Only	
		X	1 x 10^9			X		Air Only	
Wilbur and Williams-TileCote	X		1 x 10^8			X	X	X	
Phenolic Coating									
Plasite No. 7100	X		1 x 10^9		X	X		Air Only	
		X	1 x 10^9			X	X	X	
Plasite No. 7122	X		1 x 10^9		X	X		Air Only	
		X	1 x 10^9			X	X	X	
Plasite No. 7155	X		1 x 10^9		X	X		Air Only	
		X	1 x 10^9			X	X	X	
Polyester Coating									
Prufcoat-Epoxy modified	X		5 x 10^8	X	X				X
polyester		X	5 x 10^8		X				
		X	8 x 10^8			X		Air Only	
Wilbur and Williams	X		1 x 10^8		X				
No. 1712 w/liquid glass	X		2 x 10^8			X		Air Only	
Vinyl Coating									
Amercoat 86-99 system	X		7 x 10^8		X	X		Air Only	
Nukemite-40		X	8 x 10^8	X	X				X
Prufcoat P-62 w/HSV	X		1 x 10^9	X					
	X		5 x 10^8		X				X
		X	1 x 10^9			X		Air Only	
		X	2 x 10^8		X				
Prufcoat P-50 w/HSV		X	1 x 10^9			X		Air Only	
		X	2 x 10^8		X				
U. S. Stoneware System 1		X	2 x 10^8		X				
		X	1 x 10^9	X					X
System 2		X	2 x 10^8		X				
		X	1 x 10^9	X					X

Table 3.1. Continued

Material	Applied on: Concrete	Applied on: Steel	Exposed to Rads	Failed: in air	Failed: in water	OK: in air	OK: in water	Irradiation to be Continued: Yes	Irradiation to be Continued: No
U. S. Stoneware System 4		X	2×10^8		X				
		X	1×10^9	X					X
System 5		X	2×10^8		X				
		X	1×10^9	X					X
System 6		X	1×10^9			X	X	X	
System 7		X	1×10^9			X	X	X	
System 8		X	2×10^8		X				
		X	1×10^9	X					X
System 9		X	2×10^8		X				
		X	1×10^9	X					X
System 10		X	1×10^8		X				
		X	1×10^9	X					X
Miscellaneous Materials									
Sika Chemical Company's Colma joint sealer (Thiokol Rubber) Type-SL			4×10^7	X					X
Type-NS			4×10^7	X					X
Sika Chemical Company's Epoxy joint sealer			5×10^8	X					X
Dow Cornings (silicone rubber):									
Silastic RTV-501			5×10^8	X					X
Silastic RTV-731			5×10^8	X					X
Amercoat-Knoblock (vinyl sheet)			5×10^8	X					X
Penton (chlorinated polyether)-									
coating		X	5×10^7	X					X
sheet No. K51			5×10^7	X					X
sheet No. 9215			5×10^7	X					X
Armalon - "tetrafluorethylene coated glass fabric"			5×10^7	X					X

4.0 VOLATILITY

R. W. Horton

4.1 Salt Recycle Studies - W. W. Pitt, V. L. Fowler

A considerable portion of the operating costs of the Fluoride Volatility Process is the cost of ZrF_4 in the initial fluoride salt charge for each batch. One method of reducing this cost is to use the waste salt from each batch as part of the initial charge of the following one. The purpose of the present study is to investigate the problems associated with the recycle of salt.

Experimental Equipment and Procedure. The dissolution vessel used was the Mark II INOR-8 vessel originally used in the INOR-8 series of dissolution studies. Two molten salt transfer dip legs were added; one an autoresistance heated double wall line, the other welded directly to the vessel wall. A 6 in. i.d. Inconel vessel was used as the salt makeup tank. The HF supply and off-gas system were the same as used in previous dissolution studies (Figure 4.1).

The simulated Zircaloy-2 elements were loaded in the dissolver and the 30 lb salt charge in the makeup tank. After melting the salt was transferred to the dissolver through one of the dip legs. Dissolution of the Zircaloy-2 was then carried out at 600-650°C using an HF flow rate of 2.7 to 3.7 lb/hr. At the end of the dissolution, the salt was transferred out of the dissolver through the bottom transfer line to an open container. Core samples of the salt were taken while the salt was still molten. After freezing, the salt was crushed and enough of the waste salt used to provide 30 lb of ~35 mol % ZrF_4 salt for the following run. This normally required 27 lb of waste salt and 3 lb of fresh NaF-LiF salt.

Experimental Results. The data from the four runs which have been made to date are shown in Table 4.1. The Zr-2 specimens were of assorted sizes and shapes, so no inference can be made about dissolution rates. However, one can get an indication of the trend of corrosion product buildup in the waste salt. The primary purpose of this first run was to shakedown the equipment and establish test procedures. No major difficulties were experienced during salt transfers and dissolution except for off-gas line plugging. The salt transfers have been surprisingly easy for all types of vessel entry (dip legs and bottom).

Future Plans. It is planned to make a series of dissolutions at as near the same run conditions (HF rate, temperature, cross section) as possible, varying only the length of the elements. Waste salt from each run will be used as part of the initial charge for the following run. It is anticipated that the effect of element length on dissolution rate will be correlated, and also that an equilibrium concentration of corrosion products will be indicated for the salt recycle process.

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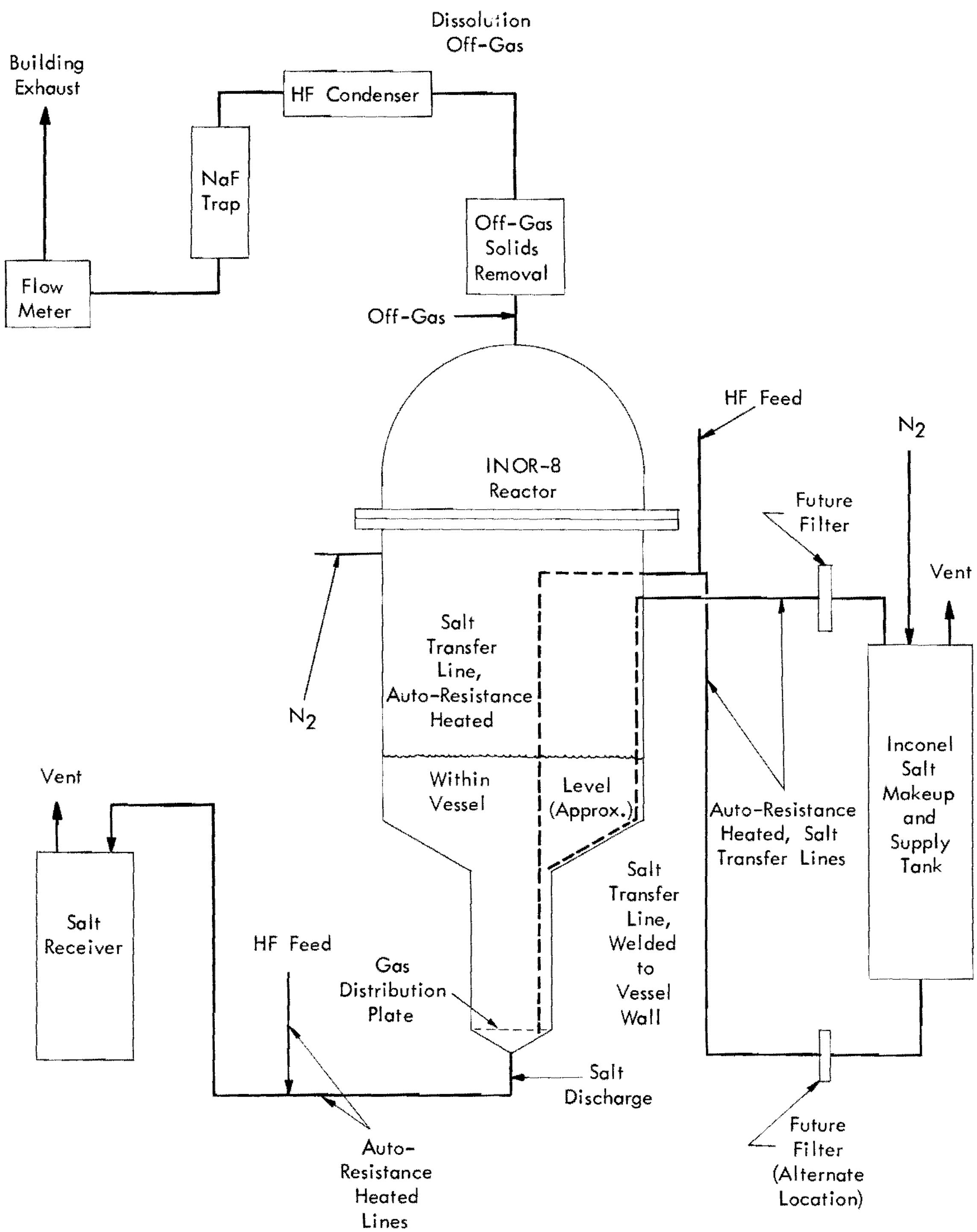

Fig. 4.1. Fluoride volatility process salt recycle equipment studies.

Table 4.1. Corrosion Product Concentration

(at end of run)

Run	HF Flow Rate (lb/hr)	Dissolution Rate $\left(\frac{mg}{cm^2\text{-min}}\right)$	C. P. Concentration (ppm) Fe	Ni	Cr	Mo	Sn
1	3.7	1.7	1700	70	1900	10	< 250
2	3.4	2.2[a]	70	43	247	5	< 210
3	2.7	2.6[a]	3600	360	2800	< 70	1000
4	3.1	3.2	2000	750	2400	40	70

[a]Rough estimate only, due to unknown surface area of elements.

5.0 WASTE PROCESSING

J. C. Suddath

The purpose of the waste processing program is to develop the waste calcination process and to determine the necessary data for the design of the Hanford pot calcination pilot plant. This report will cover waste calcination test R-65, a TBP-25 calcination. The purpose of test R-65 was to determine if mercury could be transferred from the calcination pot to the off-gas line and to the calciner condenser for condensation and return to the evaporator. A vapor sampler on the evaporator condensate to measure conductivity was also tested.

Forty-two per cent of the mercury fed to the calciner pot ended up in the evaporator at the completion of test R-65. The off-gas line between the calciner and the calciner condenser was electrically heated and operated at a temperature between 180-470°C. The calciner flanged top and the calciner condenser inlet also were heated to a temperature of ~180°C. Twenty-eight per cent of the mercury was found to be plated out in the off-gas system. Of the 28%, ~20% was located above the baffle section of the calciner vessel and 8% in the 1 in. off-gas line between the calciner top and the calciner condenser.

The evaporator condensate vapor sampler was operated satisfactorily, however, its rate was boilup dependent and insufficient sample was obtained during the latter part of the test.

5.1 Test Results - C. W. Hancher

Test R-65 was a standard TBP-25 test using the continuous evaporator, 470 liters of feed were fed to the system in 23 hrs at an average rate of 20.6 liters/hr (Table 5.1). The feed to water ratio was 3.1. The nitrate balance was 102% and the aluminum balance was 95%. The mercury recovery balance was 80%. The wet test meter used to measure the off-gas was not in operating condition during this test, therefore, there was no method to measure the off-gas, however, it would not appear to be excessive. The resulting solid had a bulk density of 0.68 g/cc and had the following concentration:

Aluminum	47% by weight
Iron	0.94% by weight
Mercury	0.58% by weight
Nitrate	0.07% by weight

The mercury concentration at the top of the solid was 1%. There was some mercury deposited between the top of the solid and the baffle that could not be sampled. This quantity would probably account for the missing 20% in the recovery balance.

Table 5.1. Material Balance for Waste Calciner Test - R-65

	NO_3, g, %	Al, g, %	Fe, g, %	Hg, g, %
IN				
Feed, g	195,636	22,276	114.2	2380
g/liter	411	46.8	0.24	5.0
OUT				
Evap., g	16,050	2,050	30.0	1000
%	8.2	9.2	26.3	42
Cond., g	183,872	5.05	1.8	640 off-gas
%	94	-	1.6	28
Solid, g	283	19,035	405	240
%	-	85.5	352	10
Total, %	102.2	94.7	379.6[a]	80

Other Results

System feed rate, liters/hr	476/23 = 20.6
Total feed, liter	476
Water-feed ratio, ratio	3.1
Feed time, hr	23
Calciner time, hr	6
Bulk density, g/cc	0.68
Off-gas, cu ft	Out
NO_3 in solid, %	0.07

[a]High iron in solid may have been corrosion products from system.

One of the stated purposes of this test was to see if the mercury in the calcination pot could be removed and transferred to the evaporator through the calciner off-gas and calciner condenser. If this is possible, the mercury could be withdrawn from the evaporator at the end of each test or allowed to build up from a number of tests and then withdrawn. A steam generator was installed to introduce steam into the secondary off-gas line at a rate of 1.5-2.0 liters of water per hour to purge the secondary off-gas line and help sweep the mercury vapor through the primary off-gas line during operation. This amount of steam purged to the secondary off-gas line kept the secondary off-gas line absolutely free of mercury deposit, however the primary off-gas line, even with heating to 180-470°C, had a very heavy coating of yellow mercury oxide. About 8% of the mercury fed to the system ended up in the primary off-gas line. Forty-two per cent of the mercury fed to the system ended up in the evaporator, 9% remained with the solids even though the average calcination temperature was in excess of 860°C (Table 5.2). The calcination pot was electrically heated with heating tape from the top of the baffle to the above flanged section where the primary off-gas line decreases its diameter to 1 in. This section was held at ~180-200°C. Twenty per cent of the mercury fed to the system accumulated in this section of the calcination equipment. It is felt that if this equipment could be held at a higher temperature, ~400-450°C, for a long enough period of time and with enough sweep gas most of this mercury could be transferred to a cooler section of the equipment.

5.2 System Controls

The system controlled very excellently during this test with one exception. The evaporator density control reset set at 10 min failed to function during the latter part of the test. This failure resulted in a higher than necessary boilup rate in the evaporator which caused evaporator concentration to be higher than the set point for ~8-10 hrs resulting in the evaporator density control being out of control 53% of the 24 hr test time (Table 5.3 and Figure 5.1). The other controls operated very satisfactorily.

The evaporator vapor conductivity cell worked satisfactorily, however its rate was boilup sensitive and decreased to a rate ~15-20 cc per min during the later part of the test which is much too slow considering the cell holdup of ~400 cc. During this period of time the control was switched to the conductivity cell downstream of the evaporator condenser which operates on the total evaporator condensate.

The temperatures of the calciner furnace, the calciner skin, and the temperatures of the interior of the calciner pot have been plotted on a 5 min frequency using the data acquired by the automatic data logger and have been processed by a computer. These figures (Figure 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, and 5.9) show the trend of the solid depositing radially from the wall of the calciner toward the center. A thermal conductivity of the radially growing solid has been calculated on an hourly basis using a calciner condensate heat balance and are shown in

Table 5.2. Mercury Deposition at End of Test R-65

In to System	2380 g	
Out of System		
Evaporator Heel	1000 g	42%
Calciner Pot Top	522 g	20%
Off-gas Line	101 g	8%
Evaporator Condensate	18 g	

Table 5.3. Test R-65 Control Limits

	Over Limits % of time	Over Limits No. of times	Under Limits % of time	Under Limits No. of times	% of Time Out of Control	Total Control Time	Control Limits + and -
Calciner Liquid Level	3.12	1	1.56	2	4.68	16	95-20
Evaporator Density	53.41	1	0	0	53.4	24	± 5
Evap. Liquid Level	0	0	0	0	0	24	± 20
Evap. Temperature Conductivity	0.63	2	5.55	6	6.18	24	± 15
Evap. Vapor Pressure	0	0	1.04	1	1.04	24	± 2

	Prop. Band %	Reset min	Set Point % of scale	Control Scale
Calciner Liquid Level	200	240	60	~58 to 62 liters
Evaporator Density	100	10	35	1.0-2.0 g/cc
Evap. Liquid Level	50	10	50	22-27 liters
Evaporator Conductivity	200	10	50	1.2-2.0 $\underline{M}$ HNO_3
Evap. Vapor Pressure	20	1.0	40	-5 to +5 psig

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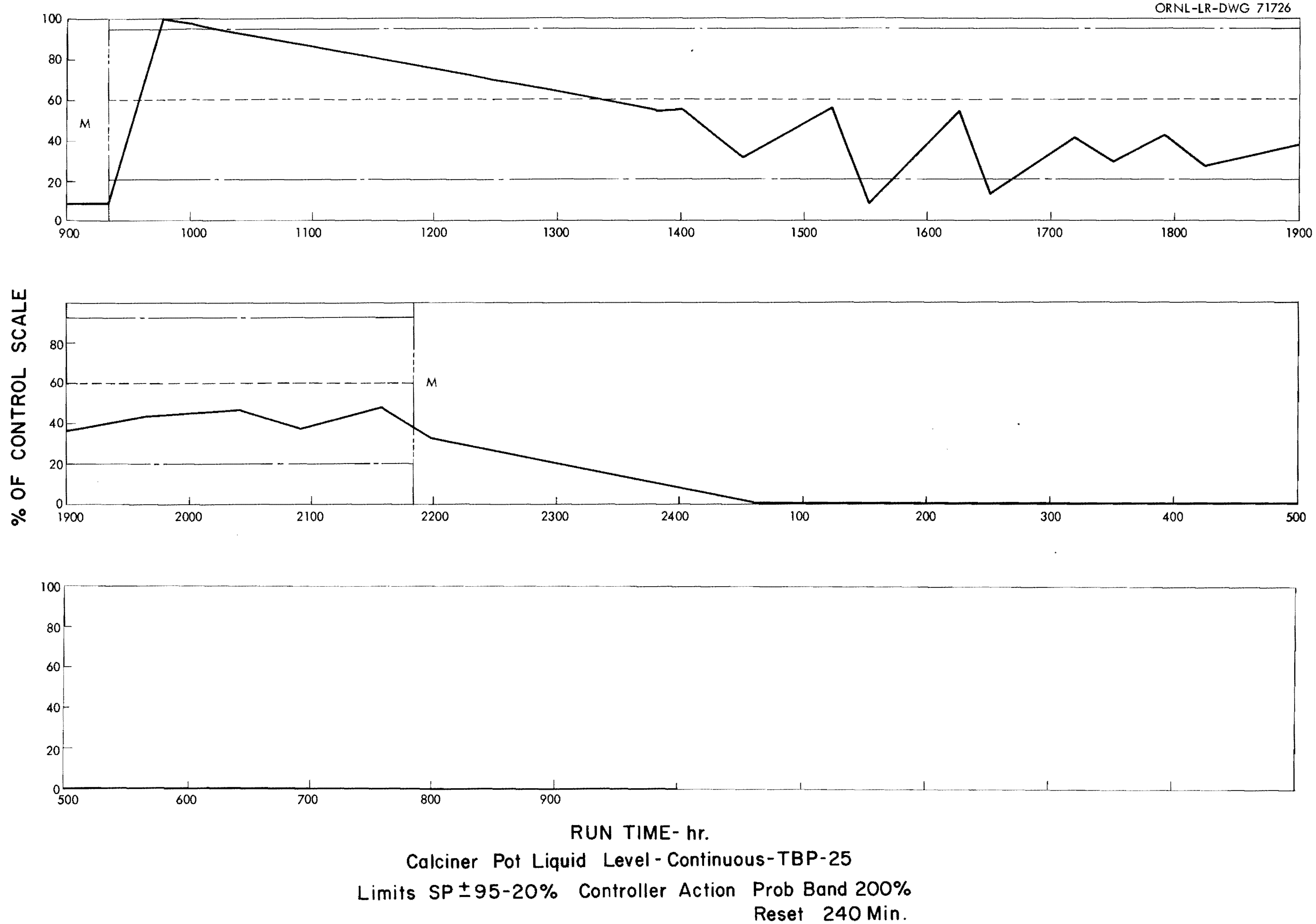

Fig. 5.1. Waste calcination and evaporation control - Test 65 - calciner pot liquid level.

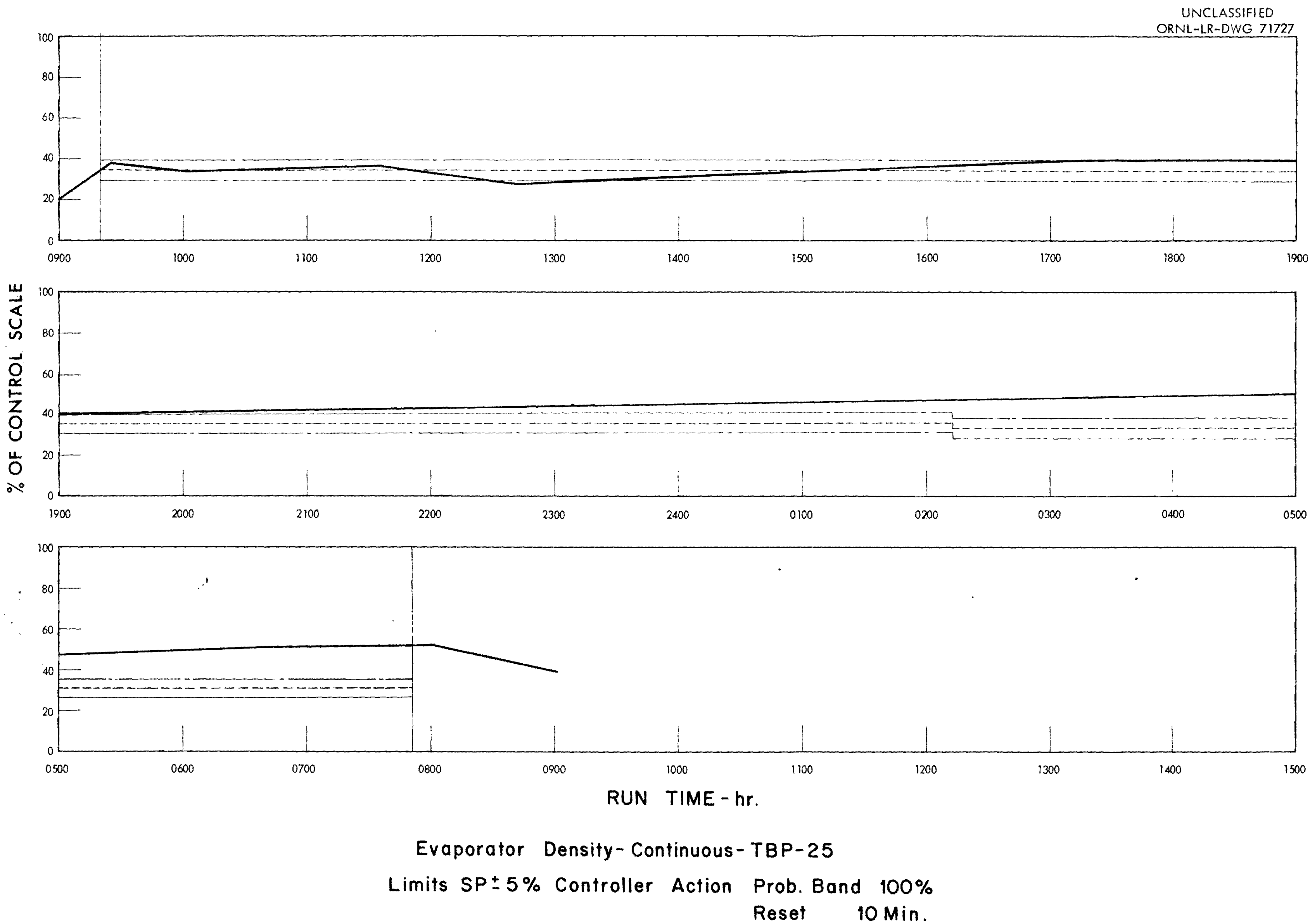

Fig. 5.1. Waste calcination and evaporation control - Test 65 - evaporator density.

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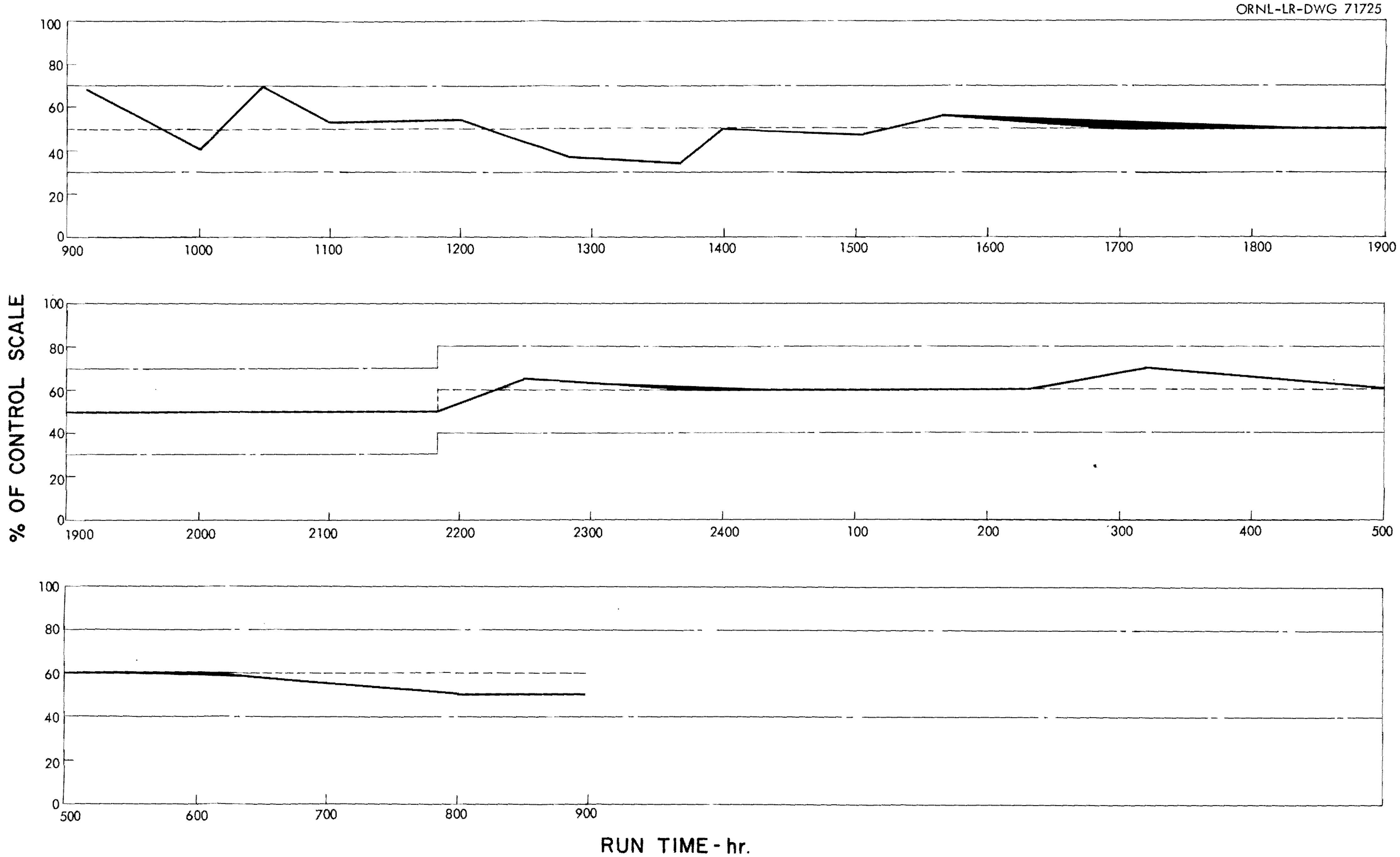

Evaporator Liquid Level - Continuous - TBP-25

Limits SP ± 20% Controller Action - Prob. Band 50%
Reset 10 Min.

Fig. 5.1. Waste calcination and evaporation control - Test 65 - evaporator liquid level.

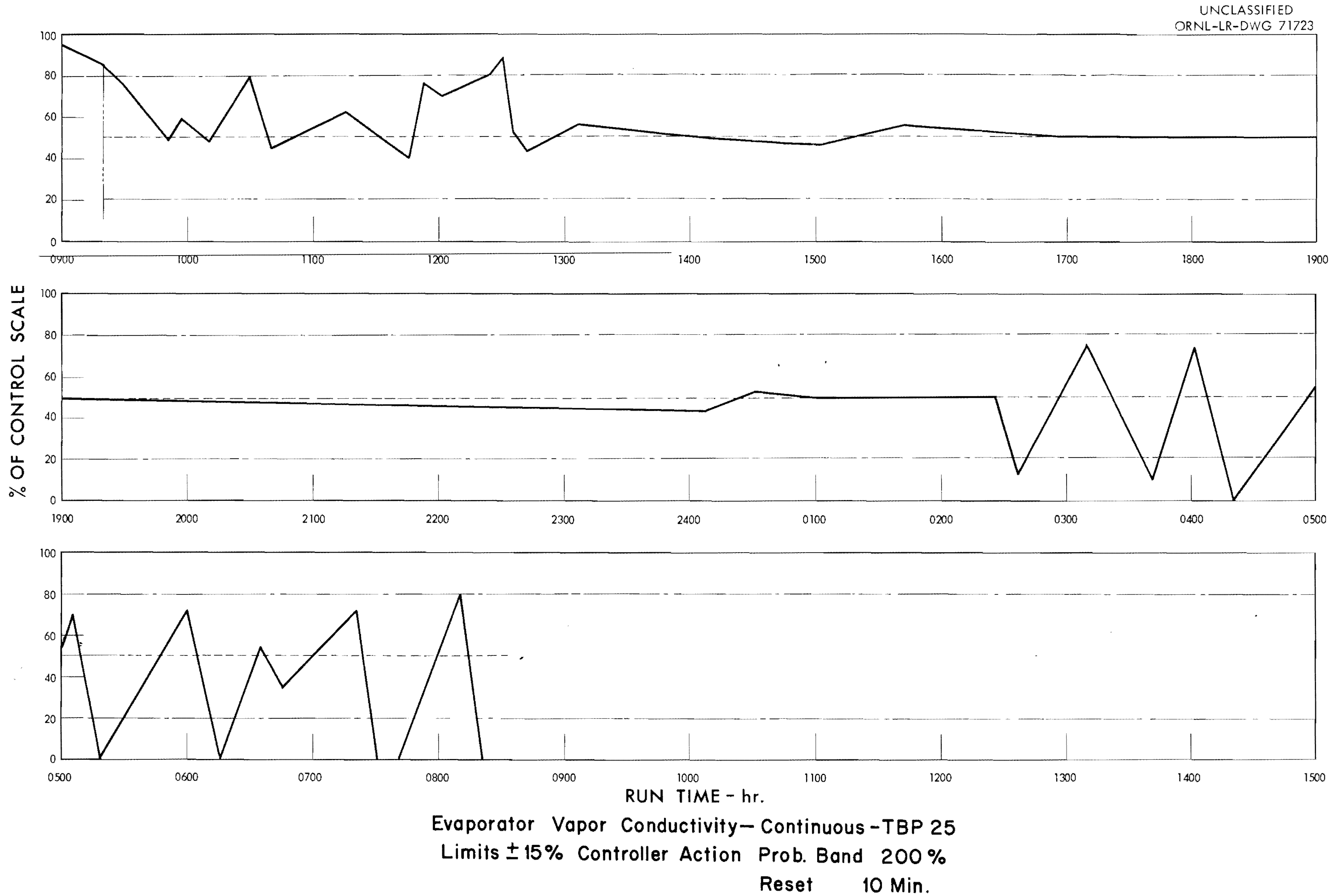

Fig. 5.1. Waste calcination and evaporation control - Test 65 - evaporator vapor conductivity.

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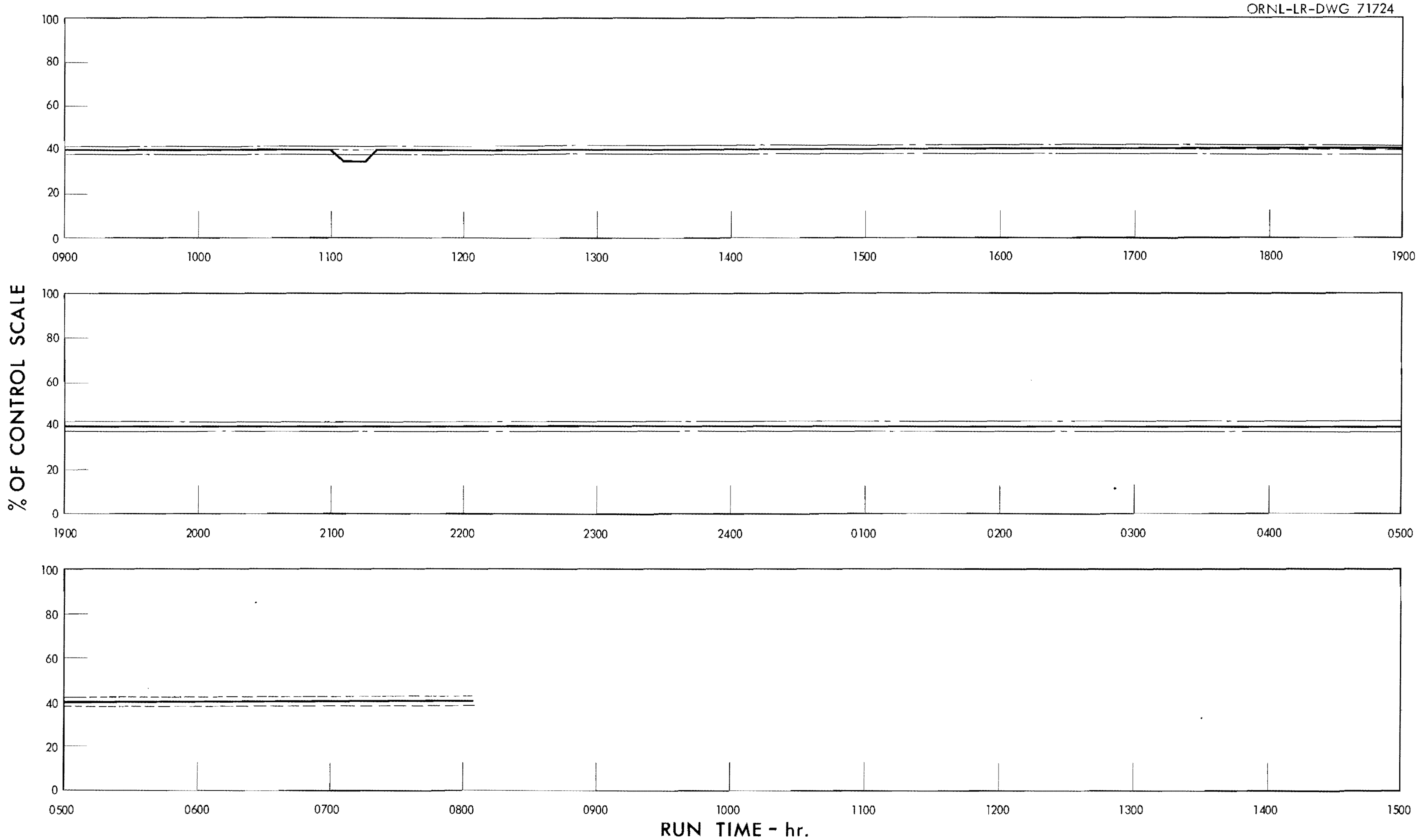

Evaporator Vapor Pressure - Continuous - TBP 25

Limits SP ± 2% Controller Action Prob. 20 %

Reset 1 min

Fig. 5.1. Waste calcination and evaporation control - Test 65 - evaporator vapor pressure.

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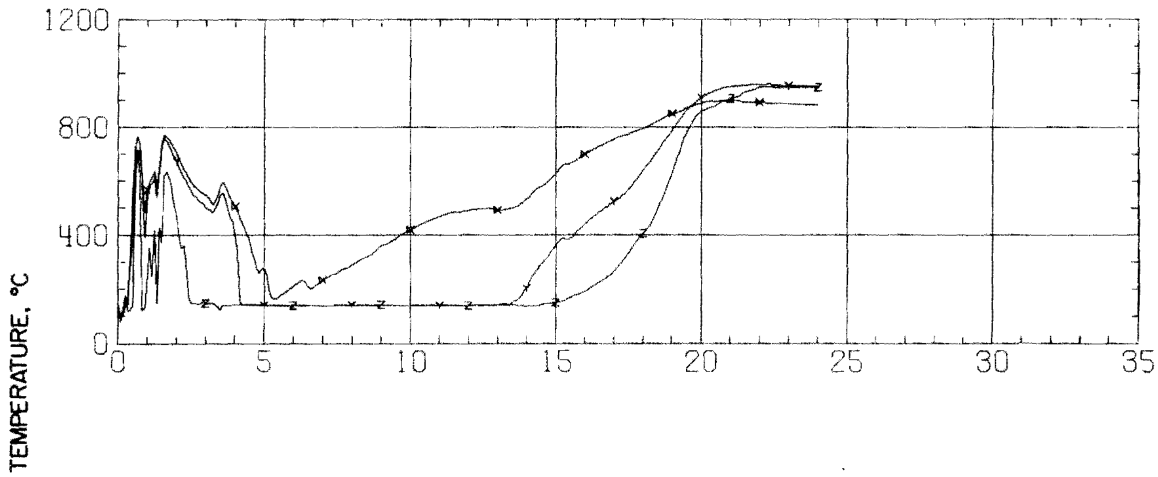

RUN TIME, hr

Elevation	Distance from Bottom of Calciner, in.
X	72
Y	58
Z	45

Fig. 5.2. Calciner center line zone temperatures R-65.

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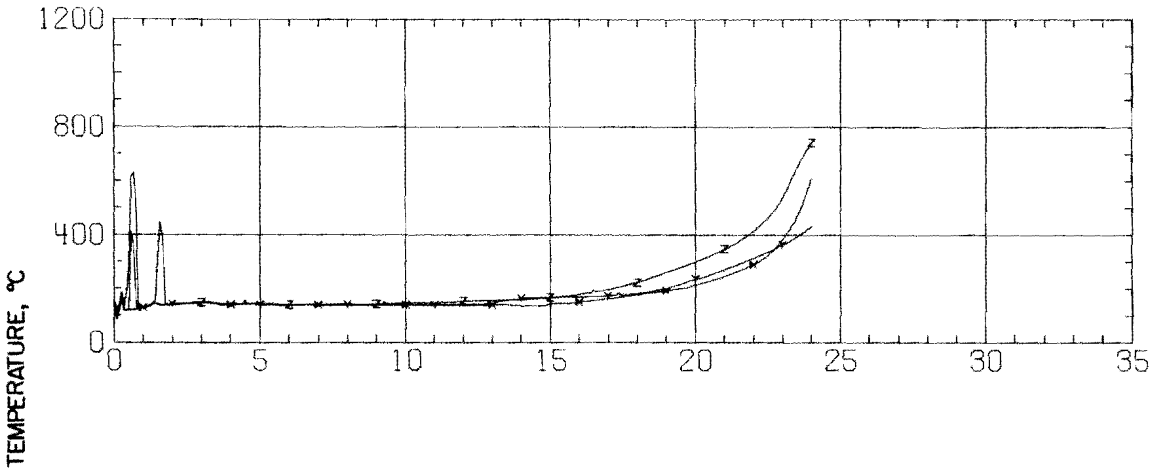
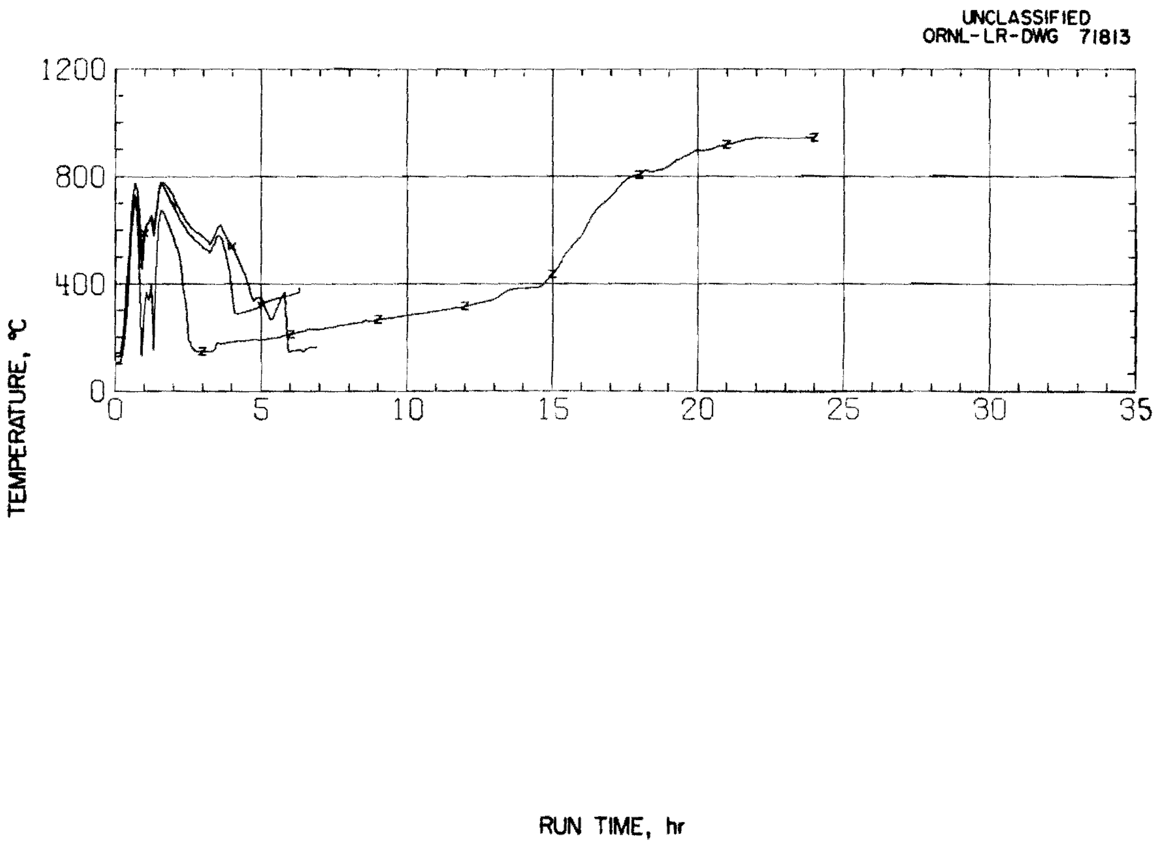


RUN TIME, hr

Elevation	Distance from Bottom of Calciner, in.
X	32
Y	19
Z	6

Fig. 5.3. Calciner center line zone temperatures R-65.



Elevation	Distance from Bottom of Calciner, in.
X	72
Y	58
Z	45

Fig. 5.4. Calciner inside near wall zone temperatures R-65.

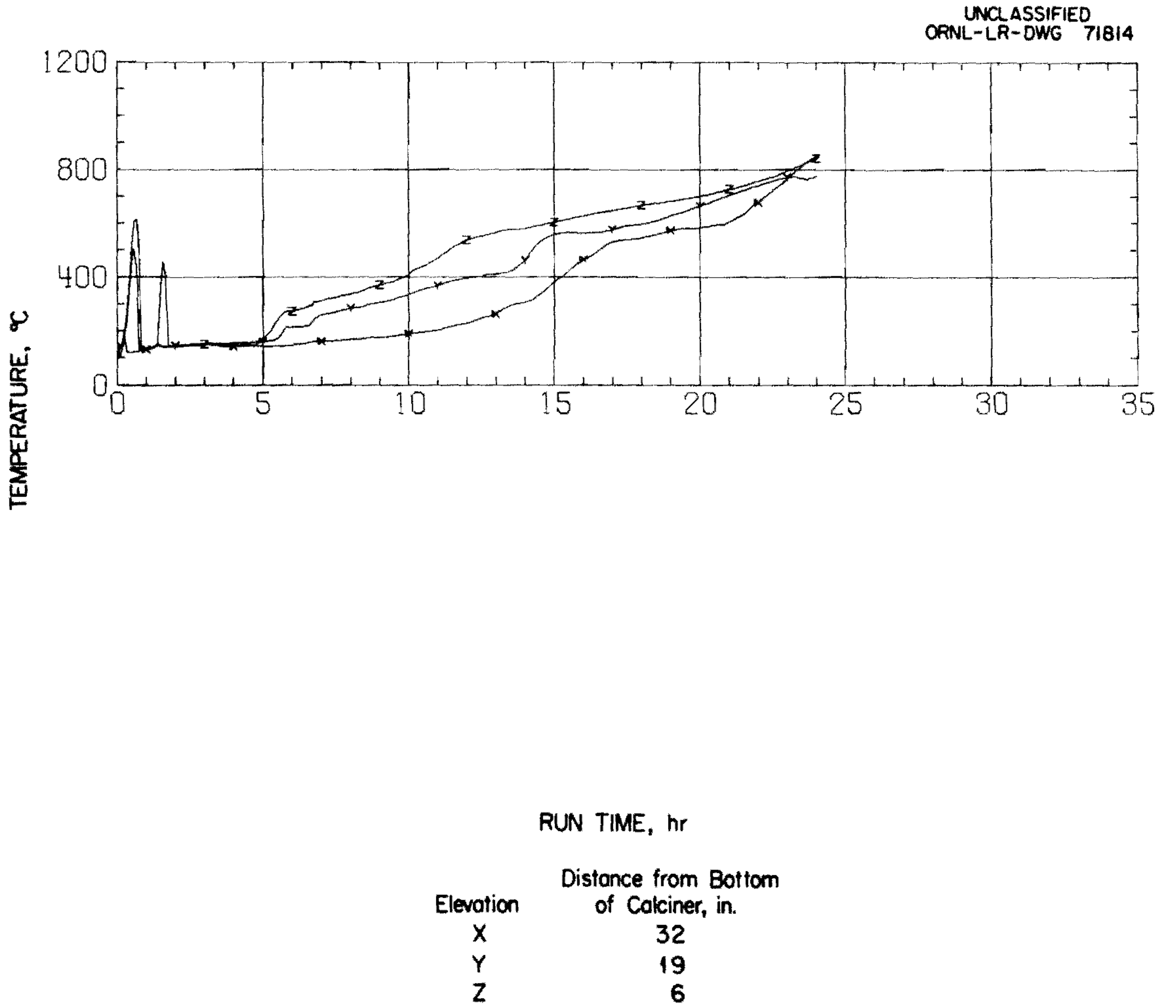
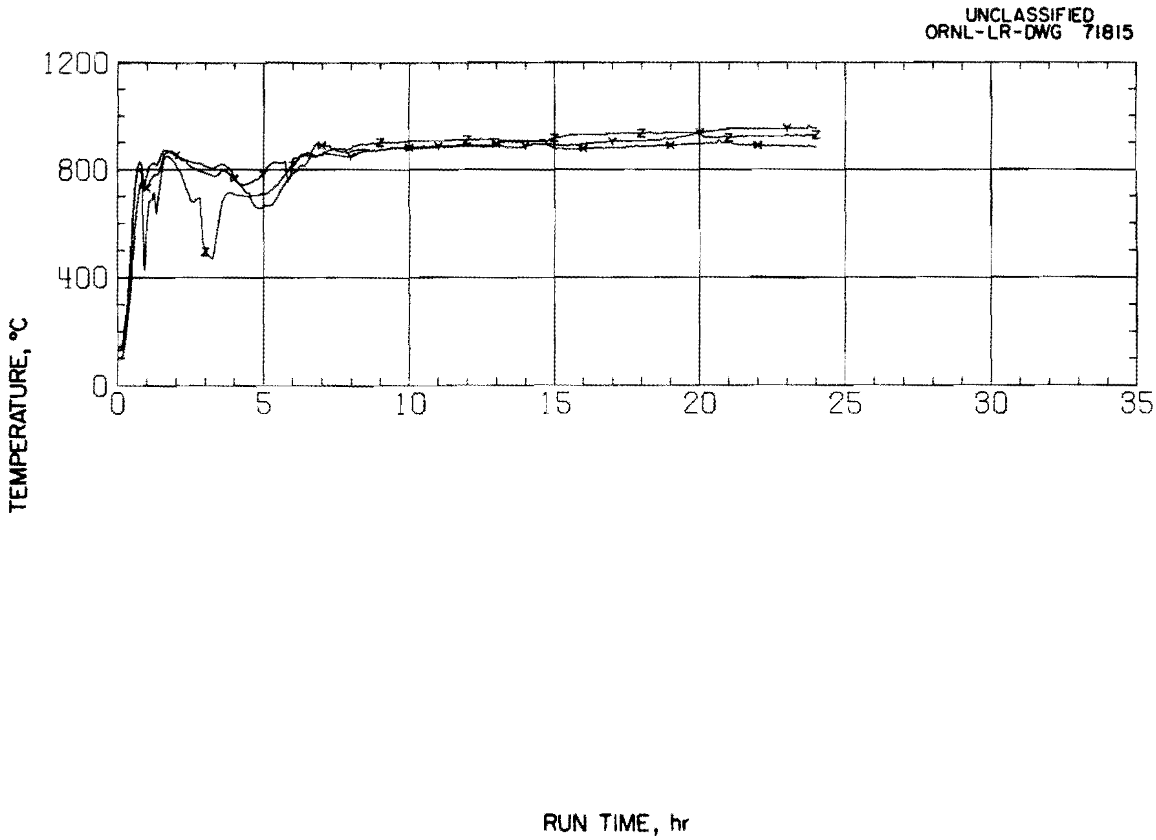


Fig. 5.5. Calciner inside near wall zone temperatures R-65.



Elevation	Distance from Bottom of Calciner, in.
X	72
Y	58
Z	45

Fig. 5.6. Calciner surface zone temperatures R-65.

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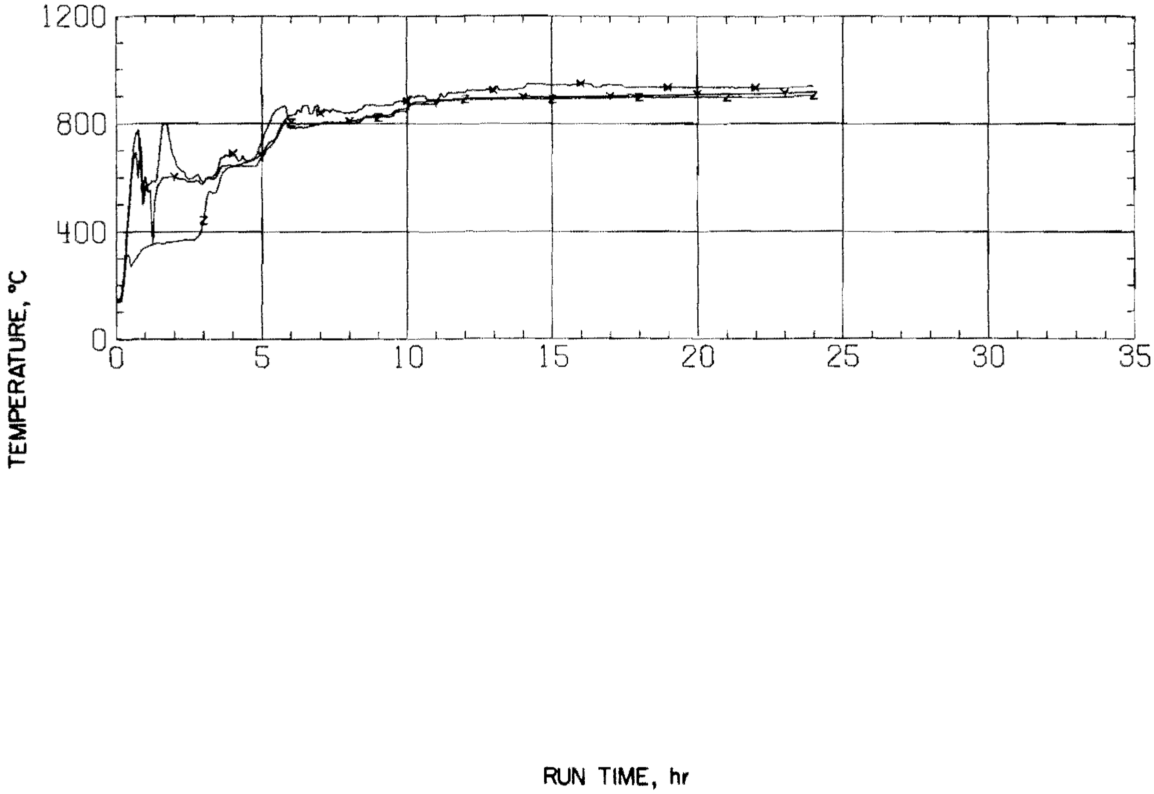
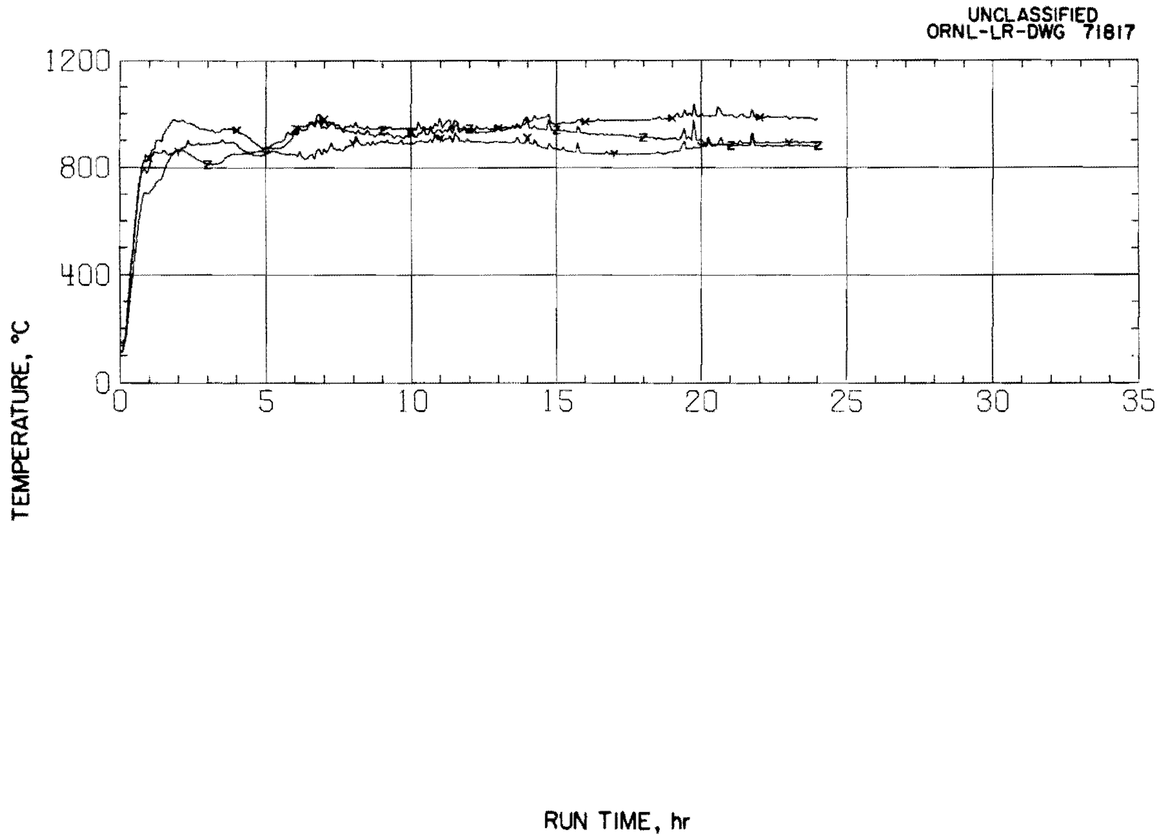


Elevation	Distance from Bottom of Calciner, in.
X	32
Y	19
Z	6

Fig. 5.7. Calciner surface zone temperatures R-65.



Elevation	Distance from Bottom of Calciner, in.
X	72
Y	58
Z	45

Fig. 5.8. Calciner furnace zone temperatures R-65.

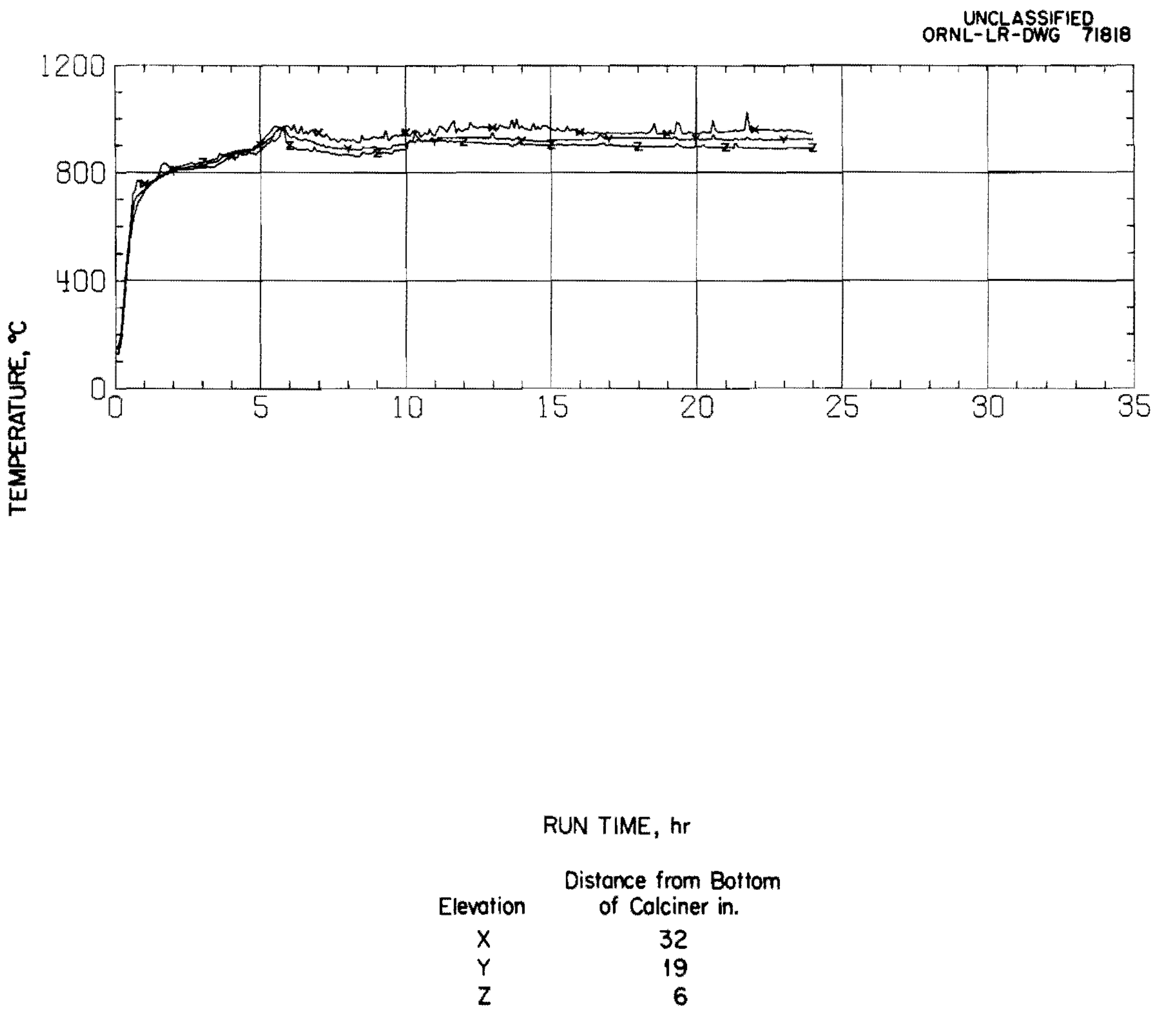


Fig. 5.9. Calciner furnace zone temperatures R-65.

Table 5.4. A number of important hourly system variables and parameters have been tabulated in Tables 5.5 and 5.6.

The feed volume, water volume, calcined additive volume and evaporator condensate volume are shown as cumulative values. These values are measured volumes taken at the hourly sample time. The temperatures and concentrations are sampled on the hour and only reflect the concentration or temperature at that time. If a column was not sampled or was not recorded, a minus zero (-0) will appear in the table. The calciner furnace heat balance is the summation of the 6 kilowatt meters for the six zones of the calcination furnace reported as hundred-thousanths Btus. The calciner condensate heat balance is a heat balance of the water side of the calciner condenser reported as hundred-thousanths Btus. The evaporator heat balance is a water side heat balance on the evaporator condensate heat exchanger reported as hundred-thousanths of Btus.

Table 5.4. Test R-65 Pot Calciner Cake Thermal Conductivity during Operation

Test Hour	Btu-hr-ft-°F K from Skin to Center	K from Skin to Edge	Cake Volume, liters
1	0.212	0.215	4.118
2	0.632	0.680	9.325
3	1.023	1.063	14.961
4	1.095	1.121	20.878
5	1.082	1.235	26.043
6	0.888	1.054	30.181
7	0.785	0.808	33.152
8	0.912	1.055	36.396
9	0.945	0.978	39.349
10	0.863	0.813	41.779
11	1.008	0.882	44.287
12	0.880	0.739	46.283
13	0.657	0.548	47.682
14	0.627	0.578	48.879
15	0.886	0.741	50.320
16	0.859	0.843	51.555
17	0.495	0.627	52.172
18	1.183	1.605	53.367
19	0.547	0.740	53.777
20	1.511	1.869	54.572
21	0.799	1.362	54.982
Ave.	0.84	0.92	

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Table 5.5

HOURLY SYSTEM VARIABLES AND PARAMETERS - PART A

TEST NO R-65 FEED TYPE - TBP-25 OPERATION MODE - CONTINUOUS

RUN TIME	FEED	WATER	CALCINER ADDITIVE	EVAP. COND.	CALCINER FURNACE	CALCINER COND.	EVAP. COND.	SYSTEM OFF-GAS	EVAP. DENSITY
HOURS	LITERS	LITERS	LITERS	LITERS	(HUNDRED-THOUSANDS OF BTUS)			CU FT	GM/CC
1	59.	0.	-0.	54.	1.37	0.96	1.83	-0.	1.34
2	110.	0.	-0.	223.	2.94	2.16	3.61	-0.	1.39
3	153.	125.	-0.	445.	4.44	3.47	6.41	-0.	1.38
4	196.	303.	-0.	677.	6.01	4.84	10.94	-0.	1.34
5	252.	477.	-0.	908.	7.51	6.04	17.09	-0.	1.31
6	295.	655.	-0.	1070.	8.95	6.99	22.24	-0.	1.35
7	341.	769.	-0.	1213.	10.04	7.68	25.87	-0.	1.38
8	368.	882.	-0.	1323.	10.86	8.44	28.78	-0.	1.40
9	390.	969.	-0.	1398.	11.47	9.12	31.04	-0.	1.40
10	410.	1022.	-0.	1473.	12.29	9.69	32.58	-0.	1.41
11	426.	1079.	-0.	1546.	12.91	10.27	33.97	-0.	1.41
12	440.	1136.	-0.	1617.	13.52	10.74	35.22	-0.	1.42
13	453.	1193.	-0.	1675.	14.07	11.07	36.45	-0.	1.42
14	453.	1250.	-0.	1705.	14.62	11.35	37.48	-0.	1.42
15	453.	1280.	-0.	1762.	15.09	11.68	37.85	-0.	1.42
16	453.	1337.	-0.	1762.	15.44	11.97	38.28	-0.	1.44
17	453.	1337.	-0.	1788.	15.85	12.11	38.49	-0.	1.44
18	453.	1363.	-0.	1794.	16.26	12.37	38.91	-0.	1.45
19	459.	1363.	-0.	1824.	16.60	12.49	39.12	-0.	1.45
20	459.	1393.	-0.	1824.	16.87	12.68	39.33	-0.	1.48
21	459.	1393.	-0.	1858.	17.21	12.77	39.54	-0.	1.52
22	467.	1419.	-0.	1867.	17.35	12.86	39.74	-0.	1.53
23	476.	1419.	-0.	1867.	17.48	13.01	39.96	-0.	1.56

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HOURLY SYSTEM VARIABLES AND PARAMETERS - PART B

TEST NO R-65 FEED TYPE - TBP-25 OPERATION MODE - CONTINUOUS

RUN TIME	EVAP. LIQUID H+	EVAP.MAJOR CATION FE OR AL	CALCINER COND. H+	EVAP COND. H+	EVAP.COND. MAJOR ION FE OR AL	EVAP. COND. RU	EVAP. LIQUID TEMP.	EVAP. VAPOR TEMP.	CALCINER FEED TEMP.	CALCINER OFF-GAS TEMP.
HOURS	MOLAR	GM/LITER	MOLAR	MOLAR	GM/LITER	GM/LITER	DEG.C	DEG.C	DEG.C	DEG.C
1	1.70	58.8	5.20	1.90	0.003	-0.	111.	110.	104.	350.
2	1.18	72.0	5.00	1.54	0.003	-0.	112.	114.	108.	470.
3	1.94	66.6	7.00	2.34	0.003	-0.	112.	114.	107.	365.
4	1.67	58.2	6.06	1.52	0.002	-0.	109.	112.	104.	345.
5	2.09	51.4	6.77	1.16	0.003	-0.	108.	110.	104.	226.
6	1.47	63.0	7.15	1.37	0.003	-0.	110.	112.	105.	215.
7	1.17	70.4	7.79	1.54	0.003	-0.	112.	114.	106.	202.
8	0.97	75.6	8.02	1.66	0.002	-0.	114.	116.	108.	186.
9	0.70	76.0	6.95	1.66	0.002	-0.	115.	116.	106.	182.
10	0.62	78.9	6.89	1.65	0.003	-0.	116.	116.	107.	192.
11	1.19	79.9	6.70	1.68	0.004	-0.	116.	116.	107.	193.
12	0.58	80.6	7.20	1.64	0.002	-0.	117.	116.	106.	192.
13	0.64	82.4	7.61	1.82	0.004	-0.	116.	116.	106.	180.
14	0.49	83.1	9.64	1.62	0.002	-0.	117.	116.	106.	222.
15	0.39	84.9	8.85	1.50	0.003	-0.	118.	115.	106.	225.
16	0.38	68.5	9.32	1.59	0.002	-0.	118.	110.	107.	240.
17	0.61	83.4	7.30	1.54	0.003	-0.	118.	110.	106.	242.
18	0.78	87.0	7.75	1.74	0.003	-0.	118.	110.	107.	202.
19	0.65	89.7	5.15	1.92	0.003	-0.	119.	110.	107.	229.
20	0.47	88.8	4.51	1.86	0.003	-0.	120.	110.	107.	198.
21	0.24	95.7	3.26	1.93	0.003	-0.	121.	110.	109.	206.
22	0.05	98.9	2.35	1.41	0.003	-0.	123.	110.	108.	198.
23	0.	108.0	2.02	1.66	0.003	-0.	126.	112.	109.	181.

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Table 5.6. R-65 Hourly Detailed Data

CALCINER CENTERLINE TEMPERATURES. RUN NO. 65. TBP25 WASTE.

(TEMPERATURES ARE DEGREES CENTIGRADE)
(MAX RATES ARE DEG C /HR FOR THE 5 MIN PERIOD OF GREATEST CHANGE)

		RUN	ZONE 1		ZONE 2		ZONE 3		ZONE 4		ZONE 5		ZONE 6	
DATE	TIME	TIME HR	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE
5/10	1000	1	409.	2095.	429.	2732.	269.	6176.	266.	-4813.	169.	3488.	124.	-595.
5/10	1100	2	688.	996.	665.	1216.	449.	3360.	200.	-2953.	139.	59.	138.	56.
5/10	1200	3	601.	-303.	565.	-323.	217.	-1566.	143.	30.	145.	52.	144.	18.
5/10	1300	4	543.	407.	494.	-560.	140.	203.	142.	-35.	144.	-41.	143.	-32.
5/10	1400	5	359.	-444.	157.	-2166.	141.	-15.	140.	-24.	143.	156.	142.	-18.
5/10	1500	6	190.	-684.	139.	-9.	139.	18.	138.	-12.	139.	-9.	140.	-12.
5/10	1600	7	219.	-203.	140.	29.	140.	-27.	139.	-41.	140.	27.	140.	21.
5/10	1700	8	265.	97.	140.	12.	140.	9.	138.	-18.	139.	12.	140.	12.
5/10	1800	9	324.	103.	140.	-21.	140.	-9.	138.	24.	139.	-12.	140.	-29.
5/10	1900	10	390.	91.	140.	32.	140.	3.	138.	-12.	140.	18.	144.	85.
5/10	2000	11	448.	76.	140.	18.	140.	53.	137.	-15.	140.	9.	147.	12.
5/10	2100	12	483.	65.	141.	-24.	139.	9.	137.	9.	141.	9.	150.	12.
5/10	2200	13	476.	31.	141.	-27.	140.	12.	138.	27.	143.	21.	154.	27.
5/10	2300	14	506.	96.	159.	180.	140.	-15.	138.	-21.	156.	27.	158.	15.
5/11	0	15	583.	130.	296.	257.	143.	38.	137.	44.	166.	12.	163.	18.
5/11	100	16	671.	178.	399.	175.	172.	65.	146.	24.	169.	12.	172.	24.
5/11	200	17	732.	79.	486.	135.	228.	115.	157.	21.	172.	9.	188.	130.
5/11	300	18	777.	76.	578.	170.	337.	175.	171.	29.	178.	113.	210.	32.
5/11	400	19	824.	69.	719.	220.	511.	277.	185.	24.	191.	35.	243.	50.
5/11	500	20	872.	62.	861.	170.	773.	402.	202.	32.	219.	44.	280.	44.
5/11	600	21	896.	36.	936.	87.	884.	75.	231.	44.	253.	44.	324.	65.
5/11	700	22	894.	-44.	956.	20.	927.	117.	268.	71.	293.	62.	381.	93.
5/11	800	23	890.	-69.	956.	-69.	948.	-15.	333.	141.	339.	58.	471.	187.
5/11	900	24	885.	-27.	953.	-18.	947.	15.	487.	345.	398.	85.	652.	243.

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TEMPERATURES 2.5 INCHES FROM CENTER OF CALCINER. RUN NO. 65. TBP25 WASTE.

(TEMPERATURES ARE DEGREES CENTIGRADE)
(MAX RATES ARE DEG C /HR FOR THE 5 MIN PERIOD OF GREATEST CHANGE)

		RUN	ZONE 1		ZONE 2		ZONE 3		ZONE 4		ZONE 5		ZONE 6	
DATE	TIME	TIME HR	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE
5/10	1000	1	427.	1831.	464.	-1981.	394.	-4026.	312.	-4811.	252.	-3788.	128.	-699.
5/10	1100	2	705.	931.	670.	1058.	507.	3673.	208.	-3134.	141.	71.	141.	65.
5/10	1200	3	627.	-280.	572.	-283.	281.	-1645.	145.	32.	148.	24.	148.	24.
5/10	1300	4	579.	331.	518.	-1064.	166.	307.	145.	-55.	147.	-53.	153.	-24.
5/10	1400	5	411.	-436.	300.	-908.	183.	15.	144.	12.	149.	88.	159.	50.
5/10	1500	6	285.	-2636.	345.	74.	200.	44.	145.	18.	185.	157.	234.	186.
5/10	1600	7	155.	83.	0.	0.	225.	74.	156.	29.	228.	119.	272.	171.
5/10	1700	8	0.	0.	0.	0.	240.	35.	164.	27.	271.	35.	325.	38.
5/10	1800	9	0.	0.	0.	0.	258.	86.	173.	29.	295.	56.	354.	73.
5/10	1900	10	0.	0.	0.	0.	275.	24.	182.	27.	319.	62.	387.	71.
5/10	2000	11	0.	0.	0.	0.	273.	24.	196.	21.	354.	62.	441.	113.
5/10	2100	12	0.	0.	0.	0.	309.	24.	217.	50.	385.	62.	506.	85.
5/10	2200	13	0.	0.	0.	0.	330.	35.	246.	56.	404.	25.	552.	45.
5/10	2300	14	0.	0.	0.	0.	371.	77.	292.	93.	428.	122.	574.	40.
5/11	0	15	0.	0.	0.	0.	398.	141.	339.	110.	526.	164.	592.	73.
5/11	100	16	0.	0.	0.	0.	518.	195.	424.	99.	563.	-34.	616.	31.
5/11	200	17	0.	0.	0.	0.	663.	221.	500.	96.	567.	34.	630.	31.
5/11	300	18	0.	0.	0.	0.	778.	136.	539.	31.	589.	40.	658.	31.
5/11	400	19	0.	0.	0.	0.	824.	122.	559.	40.	610.	48.	676.	31.
5/11	500	20	0.	0.	0.	0.	872.	81.	580.	23.	647.	51.	692.	34.
5/11	600	21	0.	0.	0.	0.	906.	60.	593.	59.	687.	51.	715.	37.
5/11	700	22	0.	0.	0.	0.	934.	42.	642.	133.	725.	51.	743.	54.
5/11	800	23	0.	0.	0.	0.	944.	-21.	727.	197.	759.	56.	776.	63.
5/11	900	24	0.	0.	0.	0.	944.	18.	815.	166.	770.	-93.	820.	78.

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Table 5.6. Continued

CALCINER SKIN TEMPERATURES. RUN NO. 65. TBP25 WASTE.

(TEMPERATURES ARE DEGREES CENTIGRADE)
(MAX RATES ARE DEG C /HR FOR THE 5 MIN PERIOD OF GREATEST CHANGE)

		RUN	ZONE 1		ZONE 2		ZONE 3		ZONE 4		ZONE 5		ZONE 6	
DATE	TIME	TIME HR	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE
5/10	1000	1	463.	1494.	541.	1984.	498.	-4239.	490.	-1990.	483.	-2263.	274.	1253.
5/10	1100	2	821.	403.	845.	431.	769.	1118.	676.	1256.	560.	-2468.	356.	57.
5/10	1200	3	813.	-227.	828.	-99.	680.	-2034.	608.	-371.	588.	-142.	378.	535.
5/10	1300	4	782.	152.	806.	-216.	614.	767.	644.	481.	621.	243.	586.	871.
5/10	1400	5	697.	-365.	756.	-212.	703.	59.	672.	-238.	648.	207.	669.	303.
5/10	1500	6	715.	229.	813.	-971.	756.	153.	767.	325.	754.	-307.	825.	-591.
5/10	1600	7	844.	361.	849.	104.	852.	176.	847.	-403.	789.	60.	798.	-51.
5/10	1700	8	873.	-167.	852.	87.	874.	67.	843.	170.	804.	60.	801.	30.
5/10	1800	9	872.	57.	866.	101.	894.	96.	858.	131.	821.	68.	815.	134.
5/10	1900	10	879.	54.	878.	39.	901.	24.	875.	120.	842.	150.	834.	147.
5/10	2000	11	885.	30.	881.	42.	907.	-42.	895.	194.	872.	146.	880.	340.
5/10	2100	12	883.	48.	886.	-33.	910.	15.	910.	197.	870.	78.	886.	24.
5/10	2200	13	890.	54.	887.	-57.	912.	-15.	922.	125.	892.	21.	888.	21.
5/10	2300	14	903.	66.	864.	-63.	907.	-42.	925.	-156.	896.	41.	890.	30.
5/11	0	15	901.	-221.	892.	39.	907.	54.	944.	161.	897.	-24.	890.	-27.
5/11	100	16	876.	-24.	891.	24.	926.	48.	943.	-59.	898.	27.	892.	-21.
5/11	200	17	879.	54.	900.	24.	931.	18.	941.	-120.	900.	33.	894.	-24.
5/11	300	18	883.	84.	906.	21.	934.	21.	937.	-113.	902.	69.	896.	27.
5/11	400	19	887.	24.	910.	95.	935.	-42.	934.	-30.	905.	15.	897.	21.
5/11	500	20	893.	30.	925.	36.	937.	57.	934.	33.	907.	18.	897.	-21.
5/11	600	21	896.	-105.	944.	30.	920.	-116.	934.	-27.	908.	36.	898.	-30.
5/11	700	22	891.	-90.	951.	-33.	923.	-54.	934.	48.	910.	-18.	898.	24.
5/11	800	23	887.	-27.	952.	33.	924.	-60.	932.	-33.	911.	33.	896.	42.
5/11	900	24	885.	-57.	953.	140.	925.	-42.	936.	36.	914.	30.	901.	30.

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CALCINER FURNACE TEMPERATURES. RUN NO. 65. TBP25 WASTE.

(TEMPERATURES ARE DEGREES CENTIGRADE)
(MAX RATES ARE DEG C /HR FOR THE 5 MIN PERIOD OF GREATEST CHANGE)

		RUN	ZONE 1		ZONE 2		ZONE 3		ZONE 4		ZONE 5		ZONE 6	
DATE	TIME	TIME HR	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE	AVG TEMP	MAX RATE
5/10	1000	1	550.	1358.	543.	1345.	467.	976.	551.	1457.	523.	1327.	503.	1377.
5/10	1100	2	927.	367.	853.	469.	793.	345.	795.	364.	777.	127.	782.	201.
5/10	1200	3	957.	-104.	884.	293.	838.	-78.	813.	42.	818.	72.	823.	101.
5/10	1300	4	939.	146.	892.	-110.	830.	152.	832.	107.	847.	93.	856.	227.
5/10	1400	5	898.	-107.	853.	-128.	857.	99.	857.	224.	882.	117.	888.	146.
5/10	1500	6	886.	418.	853.	41.	905.	301.	931.	307.	941.	-328.	945.	-543.
5/10	1600	7	957.	504.	848.	433.	958.	307.	953.	-361.	920.	-116.	884.	194.
5/10	1700	8	949.	-295.	873.	287.	952.	-319.	926.	-173.	893.	-116.	870.	-57.
5/10	1800	9	926.	-205.	893.	317.	948.	-212.	923.	313.	890.	122.	868.	143.
5/10	1900	10	918.	251.	892.	-215.	946.	-155.	936.	-466.	897.	132.	879.	123.
5/10	2000	11	939.	-278.	909.	355.	953.	406.	946.	-289.	922.	349.	918.	284.
5/10	2100	12	941.	-382.	905.	436.	957.	-444.	966.	-549.	931.	90.	917.	-72.
5/10	2200	13	935.	-146.	895.	-45.	946.	150.	968.	359.	931.	257.	909.	-51.
5/10	2300	14	955.	343.	896.	-257.	953.	320.	972.	-424.	924.	-274.	905.	108.
5/11	0	15	977.	-403.	879.	-259.	946.	-498.	966.	340.	919.	45.	903.	-39.
5/11	100	16	968.	114.	862.	418.	934.	-275.	957.	221.	923.	-30.	902.	-42.
5/11	200	17	974.	92.	850.	-99.	925.	-39.	947.	-105.	927.	158.	903.	-140.
5/11	300	18	976.	-42.	850.	39.	916.	-39.	947.	-24.	928.	54.	899.	87.
5/11	400	19	982.	-120.	853.	71.	908.	-71.	952.	-481.	928.	-18.	897.	-30.
5/11	500	20	997.	364.	871.	-353.	915.	923.	953.	535.	925.	92.	897.	132.
5/11	600	21	977.	407.	886.	-313.	887.	-337.	954.	549.	925.	218.	893.	-81.
5/11	700	22	992.	359.	893.	443.	885.	-532.	963.	-846.	924.	134.	874.	239.
5/11	800	23	986.	-131.	893.	51.	880.	-54.	959.	-63.	923.	-33.	871.	45.
5/11	900	24	983.	104.	892.	-114.	880.	-54.	951.	-60.	924.	36.	890.	59.

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Table 5.6. Continued

EVAPORATOR HEAT BALANCE. RUN NO. 65. TBP25 WASTE.

(ENTHALPY BASE IS ZERO DEGREES CENTIGRADE)

DATE	TIME	RUN HOUR	HEAT FROM STEAM KWH	TOTAL HEAT IN KWH	HEAT TO CONDENSATE KWH	TOTAL HEAT OUT KWH	PUMP COOLER COEFFICIENT B/HR/SF/DF	INTERVAL HEAT LOSS KWH	CUMULATIVE HEAT LOSS KWH
5/10	1000	1	30.0	32.4	38.5	39.0	0.	-6.6	-6.6
5/10	1100	2	73.7	75.6	80.6	81.3	1.8	-5.5	-12.1
5/10	1200	3	83.5	89.6	90.2	91.1	2.6	-1.3	-13.3
5/10	1300	4	121.0	128.2	144.7	145.5	2.1	-17.4	-30.7
5/10	1400	5	156.0	163.8	169.5	170.2	1.7	-6.5	-37.2
5/10	1500	6	167.7	175.8	185.9	186.6	0.9	-10.8	-47.9
5/10	1600	7	131.9	138.0	132.7	133.7	0.	4.3	-43.7
5/10	1700	8	98.4	103.6	99.8	100.9	0.	2.7	-41.0
5/10	1800	9	80.7	84.2	82.9	83.6	0.	0.6	-40.4
5/10	1900	10	63.8	67.1	68.4	69.1	0.	-2.0	-42.5
5/10	2000	11	55.9	58.3	60.2	60.8	0.	-2.5	-45.0
5/10	2100	12	51.9	54.3	50.3	50.8	0.	3.5	-41.5
5/10	2200	13	42.3	45.3	46.4	46.9	0.	-1.6	-43.1
5/10	2300	14	35.5	37.7	44.5	44.9	0.	-7.1	-50.3
5/11	0	15	24.2	25.2	36.0	36.3	0.	-11.1	-61.4
5/11	100	16	5.5	7.4	28.5	28.7	0.	-21.3	-82.7
5/11	200	17	4.4	4.4	24.1	24.3	0.	-17.9	-102.6
5/11	300	18	4.4	5.1	16.4	16.5	0.	-11.4	-114.0
5/11	400	19	4.3	4.3	16.7	16.9	0.	-12.6	-126.6
5/11	500	20	4.3	5.2	16.6	16.7	0.	-11.5	-138.1
5/11	600	21	4.3	4.2	17.3	17.4	0.	-13.2	-151.4
5/11	700	22	4.3	5.2	16.9	17.0	0.	-11.8	-163.2
5/11	800	23	4.3	4.2	16.8	16.7	0.	-12.6	-176.0
5/11	900	24	4.3	5.3	17.8	17.9	0.	-12.5	-188.5

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PROCESS LIQUIDS INVENTORY. RUN NO. 65. TBP25 WASTE.

DATE	TIME	RUN HOUR	PROCESS FEED LITERS	PROCESS WATER LITERS	EVAPORATOR CHANGE LITERS	CALCINER ADDITIVE LITERS	CALCINER CHANGE LITERS	CALCINER CALC. FEED LITERS	EVAPORATOR COND. VOL LITERS	CUMUL. H2O/FEED RATIO
5/10	1000	1	64.5	0.	17.5	0.	6.3	22.1	41.8	0.
5/10	1100	2	34.3	0.	3.0	0.	6.3	35.6	46.0	0.
5/10	1200	3	52.6	124.9	0.1	0.	6.3	47.0	172.1	0.7
5/10	1300	4	28.4	177.9	-2.2	0.	6.3	45.7	203.2	1.5
5/10	1400	5	52.1	174.1	1.7	0.	3.1	51.0	222.4	1.9
5/10	1500	6	51.4	177.9	-1.7	0.	0.3	42.7	231.7	2.2
5/10	1600	7	34.2	113.5	0.2	0.	0.6	33.4	168.0	2.1
5/10	1700	8	23.8	113.6	1.4	0.	-0.1	27.9	136.9	2.3
5/10	1800	9	6.2	87.1	-0.3	0.	-0.4	22.9	95.0	2.5
5/10	1900	10	35.4	53.0	-0.1	0.	0.2	22.5	89.3	2.4
5/10	2000	11	9.8	56.8	-0.0	0.	-0.1	19.3	67.7	2.5
5/10	2100	12	10.1	56.8	0.1	0.	0.1	17.6	67.7	2.6
5/10	2200	13	31.6	56.8	2.9	0.	0.1	16.1	86.3	2.5
5/10	2300	14	7.0	56.8	1.5	0.	-0.7	12.8	64.0	2.6
5/11	0	15	-1.2	30.3	-1.6	0.	-0.7	10.4	32.4	2.7
5/11	100	16	0.	56.8	-0.6	0.	-1.0	8.5	59.4	2.8
5/11	200	17	0.8	0.	0.7	0.	-0.0	6.8	1.1	2.8
5/11	300	18	0.4	26.5	0.0	0.	0.0	5.7	27.9	2.8
5/11	400	19	0.0	0.	-1.7	0.	0.0	5.6	2.7	2.8
5/11	500	20	1.2	30.3	1.2	0.	0.0	4.0	31.3	2.9
5/11	600	21	-0.7	0.	-1.1	0.	-0.0	3.9	1.3	2.9
5/11	700	22	0.0	26.5	1.6	0.	0.0	3.8	25.9	2.9
5/11	800	23	0.0	0.	-2.0	0.	-0.0	3.3	3.8	2.9
5/11	900	24	8.2	34.1	14.0	0.	0.0	0.9	29.2	3.0

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Table 5.6. Continued

CALCINER HEAT BALANCE, RUN NO. 65, TBP25 WASTE.

(ENTHALPY BASE IS ZERO DEGREES CENTIGRADE)

DATE	TIME	RUN HOUR	CALCINER VAPOR DEG C	TOTAL HEAT IN KWH	FURNACE HEAT IN KWH	CUMULATIVE FURNACE HEAT KWH	TOTAL HEAT OUT KWH	INTERVAL HEAT LOSS KWH	CUMULATIVE HEAT LOSS KWH
5/10	1000	1	179.0	46.1	44.0	44.0	11.5	34.6	34.6
5/10	1100	2	415.6	46.9	43.0	87.0	24.9	22.0	56.6
5/10	1200	3	402.5	61.9	56.0	143.0	34.0	27.9	84.5
5/10	1300	4	373.6	39.7	34.0	177.0	32.2	7.4	91.9
5/10	1400	5	280.1	52.2	46.0	223.0	36.4	15.8	107.7
5/10	1500	6	209.7	47.1	42.0	265.0	30.5	16.6	124.4
5/10	1600	7	194.2	36.1	32.0	297.0	23.5	12.6	137.0
5/10	1700	8	187.0	28.5	25.0	322.0	20.0	8.5	145.5
5/10	1800	9	193.4	23.8	21.0	343.0	16.8	7.0	152.5
5/10	1900	10	193.2	23.8	21.0	364.0	16.2	7.6	160.0
5/10	2000	11	200.5	21.4	19.0	383.0	14.3	7.1	167.2
5/10	2100	12	196.3	20.2	18.0	401.0	12.8	7.4	174.5
5/10	2200	13	196.1	18.0	16.0	417.0	11.8	6.2	180.7
5/10	2300	14	205.3	17.6	16.0	433.0	10.2	7.4	188.2
5/11	0	15	219.1	14.3	13.0	446.0	8.6	5.7	193.9
5/11	100	16	234.5	12.1	11.0	457.0	7.5	4.5	198.4
5/11	200	17	239.1	11.9	11.0	468.0	5.6	6.3	204.7
5/11	300	18	231.2	11.7	11.0	479.0	4.8	6.9	211.6
5/11	400	19	220.6	9.7	9.0	488.0	4.7	5.0	216.6
5/11	500	20	211.3	9.5	9.0	497.0	3.5	6.0	222.6
5/11	600	21	202.4	9.5	9.0	506.0	3.4	6.1	228.7
5/11	700	22	195.7	7.5	7.0	513.0	3.3	4.2	232.9
5/11	800	23	204.7	8.4	8.0	521.0	3.0	5.4	238.3
5/11	900	24	183.3	9.1	8.0	529.0	6.7	2.4	240.7

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Table 5.6. Continued

CALCINER LIQUID LEVEL CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

DATE	TIME	RUN HOUR	AVERAGE CALCINER LIQ. LEV. LITERS	AVERAGE DEVIATION FROM SET PT LITERS	R.M.S. DEVIATION FROM SET PT LITERS	MAXIMUM DEVIATION FROM SET PT LITERS	AVERAGE CALCINER FEED RATE LITERS/HR	FEED VALVE POSITION PERCENT OPEN
			CONTROLLER ON MANUAL AT START OF RUN					
5/10	920		CONTROLLER CHANGE. NEW PARAMETERS ARE SET POINT 60.0P/C BANDWIDTH 200 RESET 4H CONTROL RANGE 25.0P/C					
	920		2.1	-26.0			6.9	66.8
	925		2.6	-25.4			9.3	66.8
	930		3.1	-24.9			13.9	66.7
	935		3.7	-24.4			17.9	68.4
	940		4.2	-23.9			23.9	21.2
	945		4.7	-23.3			34.1	73.1
	950		5.2	-22.8			47.4	75.1
	955		5.8	-22.5			48.4	76.3
5/10	1000		CONTROLLER TO MANUAL					
5/10	1000	1	3.4				21.4	49.4
5/10	1040		CONTROLLER CHANGE. NEW PARAMETERS ARE SET POINT 60.0P/C BANDWIDTH 200 RESET 4H CONTROL RANGE 25.0P/C					
	1040		10.5	-17.6			31.6	89.4
	1045		11.0	-17.0			35.6	89.4
	1050		11.5	-16.5			36.8	89.6
	1055		12.1	-16.0			38.9	89.8
	1100		12.6	-15.5			43.1	90.5
5/10	1100	2	9.7				36.0	88.1
	1105		13.1	-14.9			44.2	88.9
	1110		13.6	-14.4			45.2	89.4
	1115		14.2	-13.9			45.9	89.7
	1120		14.7	-13.4			44.7	90.5
	1125		15.2	-12.8			44.5	90.6
	1130		15.7	-12.3			46.3	90.5
	1135		16.3	-11.6			47.9	90.5
	1140		16.8	-11.3			49.1	89.7
	1145		17.3	-10.7			48.5	89.1
	1150		17.8	-10.2			50.4	90.0
	1155		18.4	-9.7			50.9	90.5
	1200		18.9	-9.2			47.9	90.5
5/10	1200	3	16.0	-12.1	12.2	-14.9	47.1	90.0
	1205		19.4	-8.6			46.6	90.7
	1210		19.9	-8.1			48.2	90.6
	1215		20.5	-7.6			50.1	90.8
	1220		21.0	-7.1			47.3	90.8
	1225		21.5	-6.5			43.0	91.1
	1230		22.0	-6.0			41.8	100.0
	1235		22.6	-5.5			42.9	76.9
	1240		23.1	-5.0			43.2	90.3
	1245		23.6	-4.4			43.8	89.0
	1250		24.1	-3.9			45.7	98.8
	1255		24.7	-3.4			47.8	89.3
	1300		25.2	-2.9			51.1	89.7
5/10	1300	4	22.3	-5.8	6.0	-8.6	46.0	91.5
	1305		25.7	-2.3			55.2	88.8
	1310		26.2	-1.8			54.8	88.9
	1315		26.9	-1.1			54.4	89.4
	1320		27.1	-1.0			48.8	39.4
5/10	1400	5	27.5	-0.5	1.0	-2.3	50.9	86.8
	1420		28.9	0.8			46.3	73.4
	1425		29.0	1.0			46.4	58.7
	1430		29.0	1.0			44.7	67.1
	1435		29.0	1.0			42.9	67.0
	1440		29.0	0.9			40.8	66.6
	1445		28.9	0.9			38.8	67.3
5/10	1500	6	28.8	0.8	0.8	1.0	42.4	71.1
	1525		28.9	0.9			38.3	67.3
	1530		29.7	1.6			42.3	52.6
	1535		29.9	1.8			37.3	49.7
	1540		29.8	1.7			34.3	48.4
	1545		29.7	1.7			31.8	46.4
	1550		29.5	1.4			27.6	48.5
	1555		29.3	1.3			26.0	49.5
	1600		29.2	1.1			27.3	49.9
5/10	1600	7	29.1	1.1	1.2	1.0	33.2	59.6
	1605		29.0	0.9			26.7	51.9
	1625		29.0	0.9			34.7	52.5
	1630		29.6	1.5			37.3	42.5
	1635		29.7	1.6			28.4	38.6
	1640		29.6	1.6			26.9	38.1
	1645		29.5	1.5			27.4	37.9
	1650		29.4	1.3			24.5	37.4
	1655		29.3	1.3			24.2	37.5
	1700		29.1	1.1			24.6	38.9
5/10	1700	8	29.2	1.1	1.2	1.6	27.8	46.3
	1705		29.0	1.0			24.5	41.4
	1720		28.9	0.8			23.9	42.3
	1725		29.0	1.0			24.0	40.2
	1730		29.1	1.1			26.5	36.8
	1735		29.1	1.1			22.7	35.3
	1740		29.0	1.0			18.3	35.4
	1745		29.0	0.9			23.4	35.8
5/10	1800	9	28.9	0.9	0.9	1.1	22.7	38.9
	1805		28.9	0.8			26.4	37.0
	1810		29.1	1.0			24.7	34.0
	1815		29.2	1.1			22.2	31.8
	1820		29.2	1.2			22.6	29.1
	1825		29.2	1.1			23.7	28.7
	1830		29.1	1.1			23.7	27.9

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Table 5.6. Continued

CALCINER LIQUID LEVEL CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

DATE	TIME	RUN HOUR	AVERAGE CALCINER LIQ. LEV. LITERS	AVERAGE DEVIATION FROM SET PT LITERS	R.M.S. DEVIATION FROM SET PT LITERS	MAXIMUM DEVIATION FROM SET PT LITERS	AVERAGE CALCINER FEED RATE LITERS/HR	FEED VALVE POSITION PERCENT OPEN
SET POINT			60.0P/C	BANDWIDTH 220	RESET 4H	CONTROL RANGE	25.0P/C	
	1835		29.1	1.1			21.2	27.7
	1840		29.1	1.0			21.3	27.7
	1845		29.0	1.0			21.4	27.6
	1850		29.0	1.0			19.7	27.4
	1855		29.0	0.9			21.4	27.4
	1900		28.9	0.9			15.9	27.6
5/10	1900	10	29.1	1.0	1.0	1.2	22.0	29.5
	1905		28.9	0.9			23.2	27.5
5/10	2000	11	28.8	0.8	0.8	0.9	19.5	26.9
	2100		28.9	0.9			16.2	22.6
5/10	2100	12	28.7	0.7	0.7	0.7	17.6	25.7
	2105		28.9	0.4			19.7	22.6
5/10	2150		CONTROLLER TO MANUAL					
5/10	2200	13	28.8				15.8	20.0
5/10	2300	14	28.7				13.0	0.
5/11	0	15	27.9				10.3	0.
5/11	100	16	27.0				8.4	0.
5/11	200	17	26.6				6.6	0.
5/11	300	18	25.6				5.9	0.
5/11	400	19	26.6				5.4	0.
5/11	500	20	26.6				4.1	0.
5/11	600	21	26.6				4.0	0.
5/11	700	22	26.5				3.6	0.
5/11	800	23	26.0				3.6	0.

END OF TABLE

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EVAPORATOR PRESSURE CONTROLLER DATA. RUN NO. 65. TBP25 WASTC.

DATE	TIME	RUN HOUR	AVERAGE EVAPORATOR PRESSURE PSIG	AVERAGE DEVIATION FROM SET PT PSI	R.M.S. DEVIATION FROM SET PT PSI	MAXIMUM DEVIATION FROM SET PT PSI	AVERAGE OFF GAS RATE CFM	OFF GAS VALVE POSITION PERCENT OPEN
SET POINT			40.1P/C	BANDWIDTH 20	RESEF 1M	CONTROL RANGE	5.0P/C	
5/10	1000	1	-1.1	-0.1	0.1	-0.2	0.1	11.7
5/10	1100	2	-1.1	-0.1	0.1	-0.3	0.1	19.5
	1105		-1.6	-0.6			0.1	26.8
	1110		-1.7	-0.7			0.1	27.1
	1115		-1.7	-0.7			0.1	22.1
5/10	1200	3	-1.2	-0.2	0.3	-0.7	0.1	11.2
5/10	1300	4	-1.1	-0.1	0.1	-0.1	0.1	12.1
5/10	1400	5	-1.1	-0.1	0.1	-0.1	0.1	11.4
5/10	1500	6	-1.1	-0.1	0.1	-0.1	0.2	13.4
5/10	1600	7	-1.1	-0.1	0.1	-0.2	0.2	6.4
5/10	1700	8	-1.1	-0.1	0.1	-0.1	0.2	4.4
5/10	1800	9	-1.1	-0.1	0.1	-0.1	0.2	4.4
5/10	1900	10	-1.1	-0.1	0.1	-0.1	0.2	4.2
5/10	2000	11	-1.1	-0.1	0.1	-0.1	0.2	4.2
5/10	2100	12	-1.1	-0.1	0.1	-0.1	0.2	4.1
5/10	2200	13	-1.1	-0.1	0.1	-0.1	0.2	4.5
5/10	2300	14	-1.1	-0.1	0.1	-0.1	0.2	4.7
5/11	0	15	-1.1	-0.1	0.1	-0.1	0.2	5.9
5/11	100	16	-1.1	-0.1	0.1	-0.1	0.2	4.3
5/11	200	17	-1.1	-0.1	0.1	-0.1	0.2	5.1
5/11	300	18	-1.1	-0.1	0.1	-0.1	0.2	4.8
5/11	400	19	-1.1	-0.1	0.1	-0.1	0.2	5.3
5/11	500	20	-1.1	-0.1	0.1	-0.1	0.2	7.8
5/11	600	21	-1.1	-0.1	0.1	-0.1	0.2	7.0
5/11	700	22	-1.1	-0.1	0.1	-0.1	0.2	7.7
5/11	800	23	-1.1	-0.1	0.1	-0.1	0.2	7.6

END OF TAPLE

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Table 5.6. Continued

EVAPORATOR DENSITY CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

DATE	TIME	RUN HOUR	AVG EVAP DEN G/CC	AVG DEV S.P. G/CC	RMS DEV S.P. G/CC	MAX DEV S.P. G/CC	STEAM PRESS S.P. PSIG	AVG STEAM PRESS PSIG	AVG DEV S.P. PSI	RMS DEV S.P. PSI	MAX DEV S.P. PSI	AVERAGE STEAM COND RATE LITERS/HR	AVERAGE EVAPORATOR COND RATE LITERS/HR	STEAM CHEST HEAT TRANSF COEFF. B/H/SF/DF	STEAM VALVE POSITION PERCENT OPEN
CONTROLLER ON MANUAL AT START OF RUN															
5/10	920	CONTROLLER CHANGE. NEW PARAMETERS ARE													
		SET POINT 35.0		BAND WIDTH 100			RESET 10M			CONTROL RANGE 5.0					
		SECONDARY SYSTEM		BAND WIDTH 50			RESET 3M			CONTROL RANGE 5.0					
	920		1.28	-0.07			22.8	22.0	-0.8			74.2	24.1		6.3
5/10	1000	1	1.30				13.3	25.7				57.8	47.8	0.	2.6
	1030		1.23	-0.12			27.7	28.3	0.7			105.5	81.4		6.1
	1035		1.25	-0.10			25.7	27.0	1.3			151.7	87.5		6.1
	1040		1.24	-0.11			27.0	26.9	2.0			157.0	107.3		6.0
	1045		1.25	-0.10			28.8	28.4	-0.4			162.4	124.9		5.9
	1050		1.25	-0.10			28.8	29.8	0.9			167.5	134.3		6.1
5/10	1100	2	1.30	-0.05	0.07	-0.12	21.2	22.9	1.6	1.8	2.5	121.8	103.2	798.2	5.1
	1150		1.29	-0.06			26.7	27.4	0.7			183.9	138.5		7.0
5/10	1200	3	1.34	-0.01	0.02	-0.06	19.9	21.3	1.4	1.5	2.2	141.1	115.8	902.1	5.6
	1235		1.28	-0.07			26.9	29.0	2.1			223.6	152.8		12.1
	1240		1.26	-0.09			28.9	29.3	0.4			257.9	187.8		15.2
	1245		1.26	-0.09			28.8	29.7	0.8			275.7	213.2		15.8
	1250		1.27	-0.08			26.9	29.4	0.4			283.2	229.6		15.9
5/10	1300	4	1.31	-0.04	0.05	-0.09	24.2	25.8	1.6	1.9	3.0	211.7	171.0	1017.6	9.5
	1400		1.29	-0.06			29.1	31.2	2.1			275.5	238.8		15.9
5/10	1400	5	1.31	-0.04	0.04	-0.06	27.9	28.8	0.9	1.1	2.1	261.5	231.3	1049.0	11.2
	1405		1.29	-0.06			29.1	31.0	1.9			284.6	243.3		15.8
	1410		1.29	-0.06			29.2	31.0	1.7			288.7	248.6		15.1
5/10	1500	6	1.31	-0.04	0.04	-0.06	29.0	29.9	0.9	1.1	1.7	279.0	252.7	1070.6	13.2
5/10	1600	7	1.34	-0.01	0.01	-0.02	26.2	27.5	1.3	1.5	2.5	214.4	197.5	936.0	6.9
5/10	1700	8	1.39	0.03	0.03	0.04	23.4	24.3	0.9	1.4	2.7	158.2	144.0	845.0	5.9
	1710		1.40	0.05			21.6	22.0	0.4			142.2	122.1		5.5
5/10	1800	9	1.37	0.02	0.03	0.05	23.5	24.9	1.4	1.6	2.3	131.0	115.7	720.2	5.3
5/10	1900	10	1.39	0.04	0.04	0.05	22.6	23.4	0.8	1.0	2.0	105.2	92.5	649.6	4.6
	1905		1.41	0.06			20.9	22.5	1.6			99.0	88.9		4.5
	1910		1.41	0.06			21.6	22.5	0.8			94.9	89.0		4.6
	1915		1.41	0.06			21.6	22.0	0.4			95.1	88.7		4.5
	1920		1.41	0.06			21.6	22.1	0.4			95.4	88.0		4.6
	1925		1.41	0.06			21.6	22.0	0.4			95.4	87.0		4.6
	1930		1.41	0.06			20.9	22.1	1.2			94.7	84.5		4.5
	1935		1.41	0.06			20.9	22.1	1.2			90.7	83.0		4.5
	1940		1.41	0.06			20.8	22.0	1.3			87.0	82.7		4.5
	1945		1.41	0.06			20.8	22.1	1.3			87.1	82.6		4.4
	1950		1.41	0.06			20.9	22.0	1.2			87.3	82.7		4.5
	1955		1.41	0.06			20.8	22.1	1.3			87.1	82.7		4.4
	2000		1.41	0.06			20.9	22.1	1.3			87.3	82.4		4.4
5/10	2000	11	1.41	0.06	0.06	0.06	21.1	22.2	1.1	1.1	1.6	91.1	84.9	623.9	4.5
	2005		1.41	0.06			19.4	21.9	2.5			86.9	81.2		4.4
	2010		1.41	0.06			19.2	22.0	2.9			86.2	77.8		4.3
	2015		1.41	0.06			20.8	22.0	1.2			86.6	79.8		4.2
	2020		1.41	0.06			19.4	22.0	2.6			86.4	80.1		4.2
	2025		1.41	0.06			19.5	21.9	2.4			85.6	79.3		4.2
	2030		1.41	0.06			19.3	21.8	2.5			85.6	75.7		4.2
	2035		1.41	0.06			19.3	21.9	2.6			85.6	72.5		4.1
	2040		1.41	0.06			19.4	22.0	2.6			85.4	72.3		4.2
	2045		1.41	0.06			19.2	22.1	2.9			85.4	72.5		4.2
	2050		1.41	0.06			19.2	21.9	2.7			85.0	72.7		4.1
	2055		1.41	0.06			19.4	21.8	2.5			85.2	73.0		4.1
	2100		1.41	0.06			19.4	22.0	2.7			85.4	73.0		4.1
5/10	2100	12	1.41	0.06	0.06	0.06	19.4	21.9	2.5	2.5	2.9	85.7	75.6	583.8	4.2
	2105		1.41	0.06			19.4	22.0	2.6			85.0	73.0		4.2
	2110		1.41	0.06			19.0	22.0	3.0			84.6	70.3		4.2
	2115		1.41	0.06			19.2	21.9	2.7			84.4	67.3		4.0
	2120		1.41	0.06			19.2	21.9	2.7			85.0	66.7		4.1
	2125		1.41	0.06			19.2	21.9	2.7			73.0	66.6		4.0
	2130		1.41	0.06			19.0	22.0	3.0			59.7	66.2		4.0
	2135		1.41	0.06			19.1	22.0	2.9			59.4	65.6		4.0
	2140		1.41	0.06			19.1	22.0	2.9			59.9	65.6		4.1
	2145		1.41	0.06			19.1	22.0	2.9			59.1	65.6		4.0
	2150		1.41	0.06			19.1	21.9	2.8			58.5	65.4		4.0
	2155		1.41	0.06			19.1	21.9	2.8			58.5	65.6		4.0
	2200		1.41	0.06			19.1	22.0	2.9			58.8	65.4		4.0
5/10	2200	13	1.41	0.06	0.06	0.06	19.1	22.0	2.8	2.8	3.0	67.8	66.6	465.6	4.0
	2205		1.41	0.06			19.0	21.9	2.9			58.8	64.8		4.0
	2210		1.41	0.06			19.1	22.0	2.9			58.5	65.2		4.1
	2215		1.41	0.06			19.1	21.9	2.7			58.8	65.4		3.6
	2220		1.41	0.06			18.1	21.9	3.9			58.8	65.0		3.5
	2225		1.41	0.06			19.1	21.9	2.7			59.1	64.6		3.4
	2230		1.41	0.06			19.1	22.0	2.9			58.8	64.6		3.4
	2235		1.41	0.06			19.1	21.8	2.7			58.5	64.8		3.4
	2240		1.41	0.06			19.1	21.9	2.8			58.5	65.0		3.4
	2245		1.41	0.06			19.1	21.7	2.6			58.5	64.6		3.3
	2250		1.41	0.06			19.1	21.8	2.7			58.5	64.4		3.1
	2255		1.41	0.06			19.2	21.6	2.4			58.2	63.2		3.2
	2300		1.41	0.06			19.1	21.6	2.5			54.9	61.2		3.1
5/10	2300	14	1.41	0.06	0.06	0.06	19.0	21.8	2.8	2.8	3.7	50.0	64.2	382.3	3.5
	2305		1.41	0.06			19.2	21.8	2.6			51.5	60.4		3.1
	2310		1.41	0.06			19.3	21.5	2.2			47.6	55.4		2.3
	2315		1.41	0.06			19.1	21.6	2.5			43.3	50.9		2.3
	2320		1.41	0.06			19.2	21.4	2.2			42.5	50.9		2.3
	2325		1.41	0.06			19.1	21.5	2.3			42.1	50.6		2.2
	2330		1.41	0.06			19.1	21.7	2.6			42.9	50.1		2.1

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Table 5.6. Continued

EVAPORATOR DENSITY CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

SET POINT 35.0 BAND WIDTH 100 RESET 10M CONTROL RANGE 5.0
SECONDARY SYSTEM BAND WIDTH 50 RESET 5M CONTROL RANGE 5.0

DATE	TIME	RUN HOUR	AVG EVAP DEN G/CC	AVG DEV S.P. G/CC	RMS DEV S.P. G/CC	MAX DEV S.P. G/CC	STEAM PRESS S.P. PSIG	AVG STEAM PRESS PSIG	AVG DEV S.P. PSI	RMS DEV S.P. PSI	MAX DEV S.P. PSI	AVERAGE STEAM COND RATE LITERS/HR	AVERAGE EVAPORATOR COND RATE LITERS/HR	STEAM CHEST HEAT TRANSF COEFF. B/H/SF/DF	STEAM VALVE POSITION PERCENT OPEN
	2335		1.41	0.06			19.2	21.0	1.8			43.3	50.1		1.8
	2340		1.41	0.06			19.2	21.2	2.1			42.5	50.1		2.3
	2345		1.41	0.06			19.1	21.1	2.0			35.5	50.1		0.8
	2350		1.41	0.06			19.1	21.0	1.9			26.3	49.9		0.4
	2355		1.41	0.06			19.2	21.0	1.8			23.8	50.1		0.9
	0		1.41	0.06			19.0	21.0	2.0			21.4	50.4		0.
5/11	0	15	1.41	0.06	0.06	0.06	19.1	21.3	2.2	2.2	2.6	37.2	51.1	252.5	1.7
	5		1.41	0.06			19.0	20.7	1.7			19.1	47.2		0.
	10		1.42	0.07			19.0	20.8	1.8			12.1	42.8		0.
	15		1.42	0.07			18.2	20.3	2.1			6.3	38.7		0.
	20		1.41	0.06			18.8	20.6	1.7			7.3	36.4		0.
	25		1.42	0.07			18.9	20.6	1.7			7.3	36.8		0.
	30		1.42	0.07			19.0	20.7	1.7			7.4	37.1		0.
	35		1.42	0.07			19.0	20.7	1.7			7.4	37.8		0.
	40		1.42	0.07			18.9	20.7	1.8			7.4	38.1		0.
	45		1.42	0.07			18.9	20.5	1.6			7.4	37.1		0.
	50		1.42	0.07			18.8	20.6	1.8			7.3	36.4		0.
	55		1.42	0.07			19.0	20.8	1.8			7.4	36.8		0.

5/11 100 CONTROLLER CHANGE. NEW PARAMETERS ARE
SET POINT 32.0 BAND WIDTH 100 RESET 10M CONTROL RANGE 5.0
SECONDARY SYSTEM BAND WIDTH 50 RESET 5M CONTROL RANGE 5.0

DATE	TIME	RUN HOUR	AVG EVAP DEN G/CC	AVG DEV S.P. G/CC	RMS DEV S.P. G/CC	MAX DEV S.P. G/CC	STEAM PRESS S.P. PSIG	AVG STEAM PRESS PSIG	AVG DEV S.P. PSI	RMS DEV S.P. PSI	MAX DEV S.P. PSI	AVERAGE STEAM COND RATE LITERS/HR	AVERAGE EVAPORATOR COND RATE LITERS/HR	STEAM CHEST HEAT TRANSF COEFF. B/H/SF/DF	STEAM VALVE POSITION PERCENT OPEN
	100		1.42	0.10			18.6	22.5	3.9			7.4	37.8		0.
5/11	100	16	1.42	0.07	0.07	0.10	18.8	20.8	1.9	2.0	3.9	8.2	38.1	50.1	0.
	105		1.42	0.10			18.5	20.7	2.2			7.4	38.1		0.
	110		1.42	0.10			18.3	20.7	2.4			7.4	38.1		0.
	115		1.42	0.10			18.2	20.5	2.3			7.4	37.8		0.
	120		1.42	0.10			18.2	20.6	2.3			7.4	37.1		0.
	125		1.42	0.10			18.2	20.7	2.5			7.4	37.1		0.
	130		1.42	0.10			18.1	20.7	2.6			7.3	37.5		0.
	135		1.42	0.10			18.2	20.7	2.5			7.4	38.1		0.
	140		1.42	0.10			18.1	20.6	2.5			7.4	38.1		0.
	145		1.41	0.09			18.2	20.7	2.5			7.3	37.8		0.
	150		1.42	0.10			17.9	20.7	2.7			7.3	37.1		0.
	155		1.42	0.10			18.1	20.6	2.5			7.3	37.1		0.
	200		1.42	0.10			17.9	20.6	2.7			7.3	37.1		0.
5/11	200	17	1.42	0.10	0.10	0.10	18.2	20.6	2.5	2.5	2.7	7.3	37.5	46.7	0.
	205		1.42	0.10			17.5	20.3	2.8			7.3	36.8		0.

5/11 210 CONTROLLER CHANGE. NEW PARAMETERS ARE
SET POINT 28.0 BAND WIDTH 100 RESET 10M CONTROL RANGE 5.0
SECONDARY SYSTEM BAND WIDTH 50 RESET 5M CONTROL RANGE 5.0

DATE	TIME	RUN HOUR	AVG EVAP DEN G/CC	AVG DEV S.P. G/CC	RMS DEV S.P. G/CC	MAX DEV S.P. G/CC	STEAM PRESS S.P. PSIG	AVG STEAM PRESS PSIG	AVG DEV S.P. PSI	RMS DEV S.P. PSI	MAX DEV S.P. PSI	AVERAGE STEAM COND RATE LITERS/HR	AVERAGE EVAPORATOR COND RATE LITERS/HR	STEAM CHEST HEAT TRANSF COEFF. B/H/SF/DF	STEAM VALVE POSITION PERCENT OPEN
	210		1.42	0.14			17.5	20.2	2.7			7.3	36.8		0.
	215		1.42	0.14			0.	19.2	19.2			7.3	36.1		0.
	220		1.42	0.14			0.	18.0	18.0			7.2	32.7		0.
	225		1.41	0.13			-0.6	14.1	14.7			7.1	29.6		0.
	230		1.41	0.13			-0.5	14.0	14.5			7.1	30.4		0.
	235		1.41	0.13			-0.3	13.9	14.3			7.1	31.2		0.
	240		1.41	0.13			-1.0	14.1	15.0			7.1	30.8		0.
	245		1.41	0.13			0.	16.2	16.2			7.1	30.4		0.
	250		1.41	0.13			0.	17.4	17.4			7.1	30.0		0.
	255		1.41	0.13			0.	18.9	18.9			7.1	28.7		0.
	300		1.41	0.13			0.	20.2	20.2			7.1	28.7		0.
5/11	300	18	1.41	0.13	0.13	0.14	2.7	17.2	14.5	15.5	20.2	7.2	31.6	58.7	0.
	305		1.42	0.14			0.	20.1	20.1			7.1	28.7		0.
	310		1.42	0.14			0.	14.3	14.3			7.1	27.8		0.
	315		1.42	0.14			0.	13.7	13.7			7.1	29.5		0.
	320		1.41	0.13			0.	13.3	13.3			7.1	30.0		0.
	325		1.41	0.13			0.	13.6	13.6			7.1	29.6		0.
	330		1.41	0.13			0.	14.0	14.0			7.1	30.4		0.
	335		1.41	0.13			0.	14.1	14.1			7.1	30.0		0.
	340		1.42	0.14			0.	16.9	16.9			7.1	29.6		0.
	345		1.42	0.14			0.	17.8	17.8			7.1	29.1		0.
	350		1.42	0.14			0.	19.1	19.1			7.1	29.1		0.
	355		1.42	0.14			0.	20.2	20.2			7.1	30.4		0.
	400		1.43	0.15			0.	20.6	20.6			7.1	30.4		0.
5/11	400	19	1.42	0.14	0.14	0.15	0.	16.5	16.5	15.7	20.6	7.1	29.6	61.1	0.
	405		1.45	0.17			0.	18.4	18.4			7.1	30.0		0.
	410		1.42	0.14			0.	13.9	13.9			7.1	29.1		0.
	415		1.41	0.13			0.	14.0	14.0			7.1	27.8		0.
	420		1.41	0.13			0.	14.6	14.6			7.1	28.7		0.
	425		1.41	0.13			0.	16.3	16.3			7.1	29.6		0.
	430		1.41	0.13			0.	17.8	17.8			7.1	29.1		0.
	435		1.42	0.14			0.	19.2	19.2			7.1	29.9		0.
	440		1.42	0.14			0.	20.1	20.1			7.1	30.0		0.
	445		1.43	0.15			0.	20.6	20.6			7.1	29.1		0.
	450		1.44	0.16			0.	20.5	20.5			7.1	29.1		0.
	455		1.45	0.17			0.	20.6	20.6			7.1	30.0		0.
	500		1.45	0.17			0.	20.9	20.9			7.1	30.4		0.
5/11	500	20	1.43	0.15	0.15	0.17	0.	18.1	18.1	18.3	20.9	7.1	29.4	52.4	0.
	505		1.46	0.18			0.	20.7	20.7			7.1	30.0		0.
	510		1.47	0.19			0.	18.2	18.2			7.1	29.6		0.
	515		1.42	0.14			0.	14.3	14.3			7.1	29.1		0.
	520		1.42	0.14			0.	17.4	17.4			7.1	29.1		0.
	525		1.42	0.14			0.	18.2	18.2			7.1	29.1		0.
	530		1.42	0.14			0.	20.2	20.2			7.1	29.5		0.
	535		1.43	0.15			0.	20.6	20.6			7.1	29.9		0.
	540		1.44	0.16			0.	20.7	20.7			7.1	29.9		0.
	545		1.46	0.18			0.	21.5	21.5			7.1	29.1		0.

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Table 5.6. Continued

EVAPORATOR DENSITY CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

DATE	TIME	RUN HOUR	AVG EVAP DEN G/CC	AVG DEV S.P. G/CC	RMS DEV S.P. G/CC	MAX DEV S.P. G/CC	STEAM PRESS S.P. PSIG	AVG STEAM PRESS PSIG	AVG DEV S.P. PSI	RMS DEV S.P. PSI	MAX DEV S.P. PSI	AVERAGE STEAM COND RATE LITERS/HR	AVERAGE EVAPORATOR COND RATE LITERS/HR	STEAM CHEST HEAT TRANSF COEFF. B/H/SF/DF	STEAM VALVE POSITION PERCENT OPEN
	SET POINT		28.0		BAND WIDTH		100	RESET	10M		CONTROL RANGE	5.0			
	SECONDARY SYSTEM				BAND WIDTH		50	RESET	3M		CONTROL RANGE	5.0			
	550		1.48	0.20			0.	21.8	21.8			7.1	27.5		0.
	555		1.49	0.21			0.	22.3	22.3			7.1	29.9		0.
	600		1.50	0.22			0.	22.7	22.7			7.1	29.1		0.
5/11	600	21	1.45	0.17	0.17	0.22	0.	19.9	19.9	23.0	22.9	7.1	29.4	45.4	0.
	605		1.50	0.22			0.	21.6	21.6			7.1	29.5		0.
	610		1.50	0.22			0.	20.5	20.5			7.1	29.0		0.
	615		1.47	0.19			0.	20.3	20.3			7.1	28.6		0.
	620		1.43	0.15			0.	20.1	20.1			7.1	29.9		0.
	625		1.45	0.17			0.	20.7	20.7			7.1	29.5		0.
	630		1.43	0.20			0.	21.8	21.8			7.1	29.9		0.
	635		1.28	-0.00			0.	21.8	21.8			7.1	30.7		0.
	640		1.49	0.21			0.	21.6	21.6			7.1	30.7		0.
	645		1.49	0.21			0.	21.5	21.5			7.1	31.1		0.
	650		1.47	0.21			0.	22.0	22.0			7.1	30.3		0.
	655		1.48	0.20			0.	21.7	21.7			7.1	30.3		0.
	700		1.49	0.20			0.	22.7	22.7			7.1	29.8		0.
5/11	700	22	1.46	0.18	0.19	0.22	0.	21.4	21.4	21.4	22.9	7.1	29.9	43.0	0.
	705		1.50	0.22			0.	25.7	25.7			7.1	29.4		0.
	710		1.50	0.22			0.	25.6	25.6			7.1	29.4		0.
	715		1.50	0.22			0.	26.2	26.2			7.1	29.4		0.
	720		1.50	0.22			0.	25.1	25.1			7.1	29.9		0.
	725		1.50	0.22			0.	20.7	20.7			7.1	29.4		0.
	730		1.50	0.22			0.	20.7	20.7			7.1	29.4		0.
	735		1.48	0.20			0.	20.5	20.5			7.1	29.0		0.
	740		1.48	0.20			0.	21.7	21.7			7.1	28.6		0.
	745		1.49	0.21			0.	23.0	23.0			7.1	29.4		0.
5/11	750		CONTROLLER TO MANUAL												
5/11	800	23	1.49				0.4	24.2				7.1	29.6	43.0	0.

END OF TABLE

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Table 5.6. Continued

EVAPORATOR CONDENSATE CONDUCTIVITY CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

DATE	TIME	RUN HOUR	AVERAGE CONDENSATE ACIDITY MOLAR	AVERAGE DEVIATION FROM SET PT MOLAR	R.M.S. DEVIATION FROM SET PT MOLAR	MAXIMUM DEVIATION FROM SET PT MOLAR	AVERAGE WATER RATE LITERS/HR	WATER VALVE POSITION PERCENT OPEN
CONTROLLER ON MANUAL AT START OF RUN								
5/10	920	CONTROLLER CHANGE. NEW PARAMETERS ARE SET POINT 50.0P/C BANDWIDTH 200 RESET 10M CONTROL RANGE 10.0P/C						
	920		2.8	1.1				0.
	925		2.6	0.8				0.
	930		2.5	0.7				0.
	935		2.4	0.6				3.6
	940		2.0	0.3				4.2
5/10	1000	1	2.3				0.	1.8
	1020		2.1	0.4				15.4
	1025		2.3	0.6				26.9
	1030		2.4	0.7				39.9
5/10	1100	2	1.8	0.1	0.3	0.7	0.	21.9
	1155		2.3	0.6				76.2
	1200		2.2	0.4				84.7
5/10	1200	3	2.0	0.2	0.3	0.6	124.9	51.7
	1205		2.2	0.5				96.2
	1210		2.2	0.5				100.0
	1215		2.3	0.6				100.0
	1220		2.4	0.7				100.0
	1225		2.4	0.6				100.0
	1230		0.8	-0.9				0.
	1235		0.8	-0.9				45.7
	1255		1.3	-0.5				43.0
5/10	1300	4	1.7	-0.0	0.6	-0.9	177.9	66.5
5/10	1400	5	1.7	-0.0	0.1	-0.2	174.1	54.3
5/10	1500	6	1.7	-0.1	0.1	-0.1	177.9	54.5
5/10	1600	7	1.7	-0.1	0.1	-0.2	113.5	44.8
5/10	1700	8	1.7	-0.1	0.1	-0.2	113.6	36.7
5/10	1800	9	1.7	-0.1	0.1	-0.2	87.1	33.3
5/10	19094							
5/10	2000	11	1.7	-0.0	0.0	-0.1	56.8	25.9
5/10	2100	12	1.7	-0.0	0.0	-0.1	56.8	24.8
5/10	2200	13	1.7	-0.1	0.1	-0.1	56.8	20.9
5/10	2300	14	1.7	-0.0	0.1	-0.2	56.8	25.6
5/11	0	15	1.6	-0.1	0.2	-0.2	30.3	12.4
5/11	100	16	1.7	-0.1	0.1	-0.2	56.8	2.7
5/11	200	17	1.7	-0.1	0.1	-0.2	0.	0.1
	230		1.1	-0.7				0.
	235		0.8	-0.9				0.
	240		1.3	-0.5				0.
	300		2.1	0.4				0.
5/11	300	18	1.6	-0.1	0.4	-0.9	26.5	0.6
	305		2.3	0.5				5.1
	310		2.2	0.5				12.6
	320		0.9	-0.9				0.
	325		0.7	-1.1				0.
	330		0.9	-0.8				0.
	335		1.3	-0.4				0.
	350		2.0	0.3				0.
	355		2.2	0.4				0.
	400		2.2	0.5				3.2
5/11	400	19	1.6	-0.1	0.6	-1.1	0.	2.1
	405		2.5	0.5				12.1
	415		0.7	-1.0				0.
	420		0.5	-1.2				0.
	425		0.2	-0.9				0.
	430		1.2	-0.6				0.
	455		2.1	0.4				0.
	500		2.1	0.3				0.
5/11	500	20	1.5	-0.2	0.6	-1.2	30.3	1.6
	505		2.1	0.4				5.2
	515		1.1	-0.7				0.
	520		0.2	-1.5				0.
	525		0.7	-1.0				0.
	530		0.9	-0.6				0.
	535		1.3	-0.4				0.
	555		2.1	0.4				0.
	600		2.2	0.4				0.
5/11	600	21	1.5	-0.2	0.7	-1.3	0.	1.1
	605		2.2	0.5				7.0

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Table 5.6. Continued

EVAPORATOR CONDENSATE CONDUCTIVITY CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

SET POINT 50.0P/C BANDWIDTH [illegible] RESET 10M CONTROL RANGE 10.0P/C

DATE	TIME	RUN HOUR	AVERAGE CONDENSATE ACIDITY MOLAR	AVERAGE DEVIATION FROM SET PT MOLAR	R.M.S. DEVIATION FROM SET PT MOLAR	MAXIMUM DEVIATION FROM SET PT MOLAR	AVERAGE WATER RATE LITERS/HR	WATER VALVE POSITION PERCENT OPEN
	615		0.7	-1.1				0.
	620		0.3	[illegible]				0.
	625		0.8	-0.9				0.
	630		1.3	-0.4				0.
	645		1.4	-0.4				0.
	650		1.3	-0.4				0.
5/11	700	22	1.4	-0.6	0.6	-1.5	76.5	0.9
	705		2.0	0.5				0.
	710		2.1	0.4				0.
	715		2.2	0.4				0.
	720		2.2	0.5				6.5
	725		2.0	0.5				10.9
	730		0.9	-0.9				0.
	735		0.0	-1.7				0.
	740		0.5	-1.5				0.
	745		1.0	-0.8				0.
	800		2.0	0.3				0.
5/11	800	23	1.5	-0.2	0.8	-1.7	0.	1.4
	805		2.3	0.5				0.
	810		2.4	0.6				9.2
	815		2.2	0.5				15.1
	820		0.9	-0.9				0.
	825		-0.2	-1.9				0.
	830		0.5	-1.5				0.
	835		1.1	-0.7				0.
	840		1.0	-0.7				0.
	850		1.3	-0.5				0.

END OF TABLE

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EVAPORATOR LIQUID LEVEL CONTROLLER DATA. RUN NO. 65. TBP25 WASTE.

SET POINT 50.0P/C BANDWIDTH 50 RESET 2M CONTROL RANGE 20.0P/C

DATE	TIME	RUN HOUR	AVERAGE EVAPORATOR LIQ. LEV. LITERS	AVERAGE DEVIATION FROM SET PT LITERS	R.M.S. DEVIATION FROM SET PT LITERS	MAXIMUM DEVIATION FROM SET PT LITERS	AVERAGE EVAPORATOR FEED RATE LITERS/HR	FEED VALVE POSITION PERCENT OPEN
	905		0.8	-20.4			4.8	0.
	910		2.9	-18.3			51.1	100.0
	915		15.1	-6.1			130.9	100.0
5/10	920		CONTROLLER CHANGE.	NEW PARAMETERS ARE				
SET POINT			50.0P/C	BANDWIDTH 50	RESET 10M	CONTROL RANGE	20.0P/C	
5/10	1000	1	17.1	-4.1	8.4	-20.4	64.5	38.5
5/10	1100	2	20.2	-1.1	2.7	-4.2	54.3	32.3
5/10	1200	3	20.6	-0.6	1.0	-2.9	52.6	29.8
	1230		35.7	14.4			23.5	0.
5/10	1300	4	21.6	0.3	4.8	14.4	28.4	21.7
5/10	1400	5	20.6	-0.7	1.0	-2.2	52.1	32.8
5/10	1500	6	20.2	-1.1	1.3	-2.1	51.4	30.7
5/10	1600	7	20.5	-0.8	1.2	-2.1	54.2	25.9
5/10	1700	8	20.4	-0.8	1.3	-2.2	23.8	19.0
5/10	1800	9	20.2	-1.1	1.2	-2.2	6.2	13.7
5/10	1900	10	20.6	-0.7	0.7	-1.3	35.4	6.8
5/10	2000	11	20.3	-0.9	0.9	-1.3	9.8	5.5
5/10	2100	12	20.4	-0.9	0.9	-1.3	10.1	3.8
5/10	2150		CONTROLLER CHANGE.	NEW PARAMETERS ARE				
SET POINT			60.0P/C	BANDWIDTH 50	RESET 2M	CONTROL RANGE	20.0P/C	
5/10	2200	13	20.7	-1.2	1.5	-3.7	31.6	4.0
5/10	2300	14	24.4	0.4	0.6	0.8	7.0	0.3
5/11	0	15	24.1	0.1	0.4	0.8	-1.2	0.
5/11	100	16	23.0	-1.0	1.2	-2.6	0.	0.
5/11	200	17	23.2	-0.8	0.9	-2.3	0.8	0.
5/11	300	18	24.5	0.5	1.0	2.0	0.4	0.
5/11	400	19	24.6	0.6	1.8	3.4	0.0	0.
5/11	500	20	23.2	-0.8	1.5	-2.7	1.2	0.
5/11	600	21	23.9	-0.1	1.8	-2.6	-0.7	0.
5/11	700	22	23.4	-0.6	1.2	-2.6	0.0	0.
5/11	800	23	23.8	-0.2	1.4	-2.7	0.8	0.1
	840		32.7	8.7			4.6	0.
	845		37.7	13.9			9.3	0.
	850		37.8	13.8			4.7	0.
	855		39.9	15.9			4.8	0.

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