SEQUOYAH NUCLEAR PLANT

UNITS 1 & 2

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

Supplemental Information

First Half 1981

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SUPPLEMENTAL INFORMATION

FIRST HALF 1981

1. Regulatory Limits

a. Fission and Activation Gases:

(1) Instantaneous -

Shield Building	$\leq$ 2.2E+04 µCi/sec
Auxiliary Building	$\leq$ 1.16E+04 µCi/sec
Condenser Vacuum Exhaust	$\leq$ 1.47E+03 µCi/sec
Service Building	$\leq$ 4.0E+02 µCi/sec

NOTE: Limits established by TVA's Radiological Hygiene Branch such that technical specifications will not be violated unless the total plant release rate exceeds the sum of the individual vent release rates as noted above.

b. & c. Iodines and particulates, half-lives >8 days

(1) Instantaneous -

Shield Building	$\leq$ 6.2E-02 µCi/cc
Auxiliary Building	$\leq$ 6.1E-01 µCi/cc

NOTE: Limits established by TVA's Radiological Hygiene Branch such that technical specifications will not be violated unless the total plant release rate exceeds the sum of the individual vent release rates as noted above.

d. Liquid effluent: Σ MPC $\leqq$ 1.0 (ref. 10 CFR 20, Appendix B, note 3C, Table II, column 2).

e. Tritium

(1) Liquid - $\leq$ 3.0E-3 µCI/cc (ref. 10 CFR 20 Table II, column 2)

(2) Airborne - (ref. 10 CFR 20, Table I, column 2)

Shield Building	$\leq$ 2.0E-07 µCi/cc (Ref. 10 CFR 20, Table II, Column 1)
Auxiliary Building	$\leq$ 2.0E-07 µCi/cc (Ref. 10 CFR 20, Table II, Column 1)
Service Building	$\leq$ 9.0 µCi/sec (Established by Radiological Hygiene Branch)
Condenser Vacuum Exhaust	$\leq$ 4.46E+02 µCi/sec (Established by Radiological Hygiene Branch)

2. Maximum Permissible Concentrations

   a. Fission and Activation Gases: Not Applicable

   b. Iodines: Not Applicable

   c. Particulates, half-lives >8 days: Not Applicable

   d. Liquid effluents: sum of indv. MPC ratios $\leq$ 1.0 (ref. 10 CFR 20, Appendix B, note 1)

3. Average Energy - Not Applicable

4. Measurements and Approximations of Total Radioactivity

   a., b. & c. Fission and Activation Gases, Iodines, and Particulates:

   a. Fission and Activation Gases

   Airborne effluent gaseous activity is continuously monitored and recorded. Additional grab samples from the shield, auxiliary, service and condenser vacuum exhausts are taken and analyzed at least monthly to determine the quantity of noble gas activity released for the month based on the average vent flowrates recorded for the sampling period. Also, noble gas samples are collected and evaluated for the shield and auxiliary buildings following startup, shutdown or a rated thermal power changes exceeding 15% within one hour. The vent flowrates for the shield auxiliary, service buildings, and condenser vacuum exhaust are determined and recorded twice a shift.

   The quantity of noble gases released through the shield building due to purging or venting of containment and releases of waste gas decay tanks are also determined.

   The total noble gas activity released for the month is then determined by summing all of the activity released from each vent for all sampling periods, the activity released from purging or venting of containment, and the activity released from waste gas decay tank(s).

   Allowance is made for a plus or minus one sigma counting error associated with the gamma isotopic analyses.

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4. Measurements and Approximations of Total Radioactivity (Continued)

b. & c. Iodines and Particulates

Iodine and particulate activity is continuously monitored and recorded. Charcoal and particulate samples are taken from the shield auxiliary building exhausts and analyzed at least weekly to determine the total activity released from the plant based on the average vent flowrates recorded for sampling period.

Also, particulate and charcoal samples are taken from the auxiliary and shield buildings once per 24 hours for 7 days following startup, shutdown or a rated thermal power change exceeding 15% within one hour. The quantity of iodine and particulate released from each vent during each sampling period is then determined using the average vent flowrates recorded for the sampling period and activity concentration.

The vent flowrates form the shield and auxiliary buildings are recorded twice a shift.

The total particulate and iodine activity released for the month is then determined by summing all of the activity released from the shield and auxiliary buildup for all sampling periods.

Allowance is made for a plus or minus one sigma counting error associated with the gamma isotopic analyses.

d. Liquid Effluents - Fission and Activation Products - Dissolved and Entrained Gases

(1) Batch - Radwaste

Total gamma isotopic activity concentrations are determined on each batch of liquid effluent prior to release. The total curie content of a released batch is determined by summing each nuclide's concentration and multiplying by the total volume discharged. The total activity released during a month is then determined by summing the activity content of each batch discharged during the month.

4. Measurements and Approximations of Total Radioactivity (Continued)

(2) Batch - Condensate Demineralizer System

Total gamma isotopic activity concentrations are determined on each batch of liquid effluent during the release. The sample for analysis is collected at 20% level of each tank. A small number of samples have indicated the presence of activity which is being attributed to contamination of sampling and analysis containers and not as primary-to-secondary leaking. This problem is now being addressed by a complete separation and disposal of all sampling and analysis containers following their use. When a primary-to-secondary leak has been affirmed, the total curie content of a released batch will be determined prior to release by summing each nuclide's concentration and multiplying by the total volume discharged. The total activity released during the month will be determined by summing the activity content of each batch discharged during the month.

(3) Continuous Releases - Turbine Building Sump and Steam Generator Blowdown

The turbine building sump and steam generator blowdown (when going to the cooling tower blowdown) are sampled on a daily basis. A composite sample is then prepared proportionate to the daily release volume and analyzed weekly. The presence of activity reflected in this report is also being attributed to sample contamination during analysis. When a primary-to-secondary leak has been affirmed the total curie content of a release period will be determined by summing each nuclide's concentration and multiplying by the total volume discharged. The total activity released during the month will then be determined by summing the content of each weekly composite.

e. Liquid Effluents - Gross Alpha, P-32 and H-3

A monthly composite of all four release points is prepared and analyzed for gross alpha, P-32 and H-3. The monthly composite is prepared from each batch or release period proportionate to volume released. A weighted decay correction is applied to the P-32 analysis only.

4. Measurements and Approximations of Total Radioactivity (Continued)

f. Liquid Effluents - SR-89 and SR-90, Fe-55

A quarterly composite of all four release points is prepared from the monthly composite and analyzed for SR-89, SR-90 and Fe-55. A weighted decay correction is applied to the SR-89 and SR-90 analysis. The midpoint of the quarter is used in the analysis of Fe-55.

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4. Measurements and Approximations of Total Radioactivity (Continued)

Allowance is made for plus or minus one sigma counting error associated with the total gamma isotopic analyses.

5. Batch

		Value		Units
		1st Quarter	2nd Quarter	
a.	Liquid			
(1)	Number of batches released	302	400	Each
(2)	Total time period for batch releases	38,581	61,827	Minutes
(3)	Maximum time period for a batch release	1,743	456	Minutes
(4)	Average time period for batch releases	127	156	Minutes
(5)	Minimum time period for a batch release	15	22	Minutes
(6)	Average stream flow during periods of effluent into a flowing stream:	(a)	(a)	

(a) See Radiological Hygiene Branch's portion of semi-annual effluent release report.

b.	Gaseous			
(1)	Number of batches released	6	19	Each
(2)	Total time period for batch releases	7,488	17,078	Minutes
(3)	Maximum time period for a batch release	3,798	1,440	Minutes
(4)	Average time period for batch releases	1,248	899	Minutes
(5)	Minimum time period for a batch release	80	60	Minutes

6. Abnormal Releases

a.	Liquid			
(1)	Number of Releases	0	0	
(2)	Total Activity Released	0.00E-01	0.00E-01	Ci

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6. Abnormal Releases (Continued)

b. Gaseous

(1)	Number of Releases	0	0
(2)	Total Activity Released	0.00E-01	0.00E-01 Ci

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BATCH LIQUID EFFLUENTS - RADWASTE

	Unit	1st Quarter	Total % Error	2nd Quarter	Total % Error
A. Fission and Activation Products					
1. Total Releases	Curies	1.25E+00	±1.0E+01	1.60E-01	±1.0E+01
2. Average Diluted Conc. During Period of All Identified Isotopes	µCi/ml	1.12E-06		9.04E-08	
3. Percent of Applicable Limit ($\sum_{i=1}^{4}$ MPC ≤ 1)	%	5.18E+00		2.29E+00	
B. Tritium					
1. Total Release	Curies	3.96E+00	±1.0E+01	2.29E+01	1.0E+01
2. Average Diluted Conc. During Period	µCi/ml	3.55E-06		1.29E-05	
3. Percent of Applicable Limit (3.0E-03 µCi/ml)	%	1.18E-01		4.31E-01	
C. Dissolved and Entrained Gases					
1. Total Release	Curies	8.40E-01	±1.5E+01	1.26E+00	±1.5E+01
2. Average Diluted Conc. During Period	µCi/ml	7.53E-07		7.12E-07	
3. Percent of Applicable Limit (2.0E-04 µCi/ml)	%	3.77E-01		3.56E-01	
D. Gross Alpha Radioactivity					
1. Total Release	Curies	0.00E-01	±1.5E+01	0.00E-01	±1.5E+01
E. Volume of Waste Release					
(Before Dilution)	Liters	6.03E+06	±1.0E+01	9.30E+06	±1.0E+01
F. Volume of Dilution Water for Period	Liters	1.11E+09	±1.0E+01	1.76E+09	±1.0E+01

NOTE: Percent of applicable limit is based on identified isotope concentration after dilution, related to their appropriate MPC concentration and sum of all the isotope fractions compared to 1.0.

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BATCH LIQUID RELEASES - RADWASTE

G. Isotope Summary	Curies	First Quarter	Second Quarter
1. Strontium-89		1.62E-03	0.00E-01
2. Strontium-90		0.00E-01	3.36E-04
3. Cesium-134		0.00E-01	4.41E-03
4. Cesium-137		3.02E-05	1.75E-02
5. Iodine-131		9.90E-03	7.96E-03
6. Cobalt-58		4.22E-01	2.97E-02
7. Cobalt-60		3.28E-02	2.60E-03
8. Iron-59		3.44E-02	1.83E-03
9. Zinc-65		2.50E-04	1.83E-05
10. Manganese-54		2.71E-01	6.10E-03
11. Chromium-51		1.90E-01	2.23E-02
12. Zirconium-Niobium-95		4.55E-02	1.75E-03
13. Molybdenum-99		0.00E-01	0.00E-01
14. Technetium-99m		4.94E-05	9.61E-05
15. Barium-Lanthanum-140		2.48E-02	1.89E-03
16. Cerium-141		0.00E-01	0.00E-01
17. Sodium-24		1.01E-04	1.06E-04
18. Fluorine-18		0.00E-01	0.00E-01
Total for Period		1.03E+00	9.66E-02

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bATCH LIQUID RELEASES - RADWASTE

G. Isotope Summary	Curies	First Quarter	Second Quarter
Others (Not Required for Reg. Guide 1.21)			
1. Xenon-133		7.96E-01	1.25E+00
2. Xenon-135		3.24E-04	1.30E-03
3. Iodine-133		1.84E-03	1.02E-04
4. Cesium-136		0.00E-01	1.39E-03
5. Argon-41		7.20E-06	1.29E-06
6. Xenon-131m		4.32E-02	1.02E-02
7. Cerium-144		1.72E-02	0.00E-01
8. Rhodium-105		1.87E-05	1.61E-03
9. Tellurium-132		0.00E-01	8.15E-07
10. Tungsten-187		5.02E-03	0.00E-01
11. Phosphorus-32		1.88E-01	8.19E-03
12. Iron-55		1.41E-03	5.17E-02
Total for Period		1.05E+00	1.32E+00

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

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BATCH LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

CONDENSATE REGENERANTS (TO TURBINE BUILDING SUMP)

		Unit	1st Quarter	Total % Error	2nd Quarter	Total % Error
A.	Fission and Activation Products					
1.	Total Releases	Curies	1.03E-02	±1.0E+01	1.00E-02	±1.0E+01
2.	Average Diluted Conc. During Period of All Identified Isotopes	µCi/ml	1.04E-06		8.34E-07	
3.	Percent of Applicable Limit ($\sum_{i=1}^{N}$ MPC ≤ 1)	%	3.43E+00		2.78E+00	
	NOTE: Percent of applicable limit is based on identified isotope concentration after dilution, related to their appropriate MPC concentration and sum of all the isotope fractions compared to 1.0.					
B.	Tritium					
1.	Total Release	Curies	3.27E-02	±1.0E+01	0.00E-01	1.0E+01
2.	Average Diluted Conc. During Period	µCi/ml	3.30E-06		0.00E-01	
3.	Percent of Applicable Limit (3.0E-03 µCi/ml)	%	1.10E-01		0.00E-01	
C.	Dissolved and Entrained Gases					
1.	Total Release	Curies	9.92E-03	±1.5E+01	4.51E-05	±1.5E+01
2.	Average Diluted Conc. During Period	µCi/ml	1.00E-06		3.76E-09	
3.	Percent of Applicable Limit (2.0E-04 µCi/ml)	%	5.00E-01		1.88E-03	
D.	Gross Alpha Radioactivity					
1.	Total Release	Curies	0.00E-01	±1.5E+01	0.00E-01	±1.5E+01
E.	Volume of Waste Release					
	(No Dilution)	Liters	9.91E+06	±1.0E+01	1.20E+07	±1.0E+01

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BATCH LIQUID RELEASES

CONDENSATE REGENERANTS (TO TURBINE BUILDING SUMP)

G. Isotope Summary	Curies	First Quarter	Second Quarter
1. Strontium-89		0.00E-01	0.00E-01
2. Strontium-90		0.00E-01	0.00E-01
3. Cesium-134		0.00E-01	0.00E-01
4. Cesium-137		0.00E-01	0.00E-01
5. Iodine-131		0.00E-01	0.00E-01
6. Cobalt-58		9.58E-04	0.00E-01
7. Cobalt-60		6.93E-05	4.54E-06
8. Iron-59		1.05E-04	0.00E-01
9. Zinc-65		0.00E-01	0.00E-01
10. Manganese-54		5.62E-05	0.00E-01
11. Chromium-51		2.62E-03	0.00E-01
12. Zirconium-Niobium-95		2.05E-04	0.00E-01
13. Molybdenum-99		0.00E-01	0.00E-01
14. Technetium-99m		0.00E-01	0.00E-01
15. Barium-Lanthanum-140		0.00E-01	0.00E-01
16. Cerium-141		0.00E-01	0.00E-01
17. Sodium-24[1]		1.04E-03[1]	1.00E-02[1]
18. Fluorine-18		0.00E-01	0.00E-01
Total for Period		5.05E-03	1.00E-02

[1]Special steam generator moisture carryover test.

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BATCH LIQUID RELEASES

CONDENSATE REGENERANTS (TO TURBINE BUILDING SUMP)

G. Isotope Summary	Curies	First Quarter	Second Quarter
Others (Not Required for Reg. Guide 1.21)			
1. Xenon-133		9.92E-03	4.51E-05
2. Xenon-135		0.00E-01	0.00E-01
3. Iodine-133		0.00E-01	0.00E-01
4. Cesium-136		0.00E-01	0.00E-01
5. Manganese-56		0.00E-01	0.00E-01
6. Antimony-122		0.00E-01	0.00E-01
7. Cerium-144		6.41E-06	0.00E-01
8. Copper-64		0.00E-01	0.00E-01
9. Arsenic-76		0.00E-01	0.00E-01
10. Arsenic-74		0.00E-01	0.00E-01
11. Phosphorus-32		0.00E-01	0.00E-01
12. Iron-55		5.28E-03	0.00E-01
Total for Period		1.52E-02	4.51E-05

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CONTINUOUS LIQUID RELEASES

(Turbine Building Sump)

	Unit	1st Quarter	Total % Error	2nd Quarter	Total % Error
A. Fission and Activation Products					
1. Total Releases	Curies	6.92E-01	±1.0E+01	3.04E-02	±1.0E+01
2. Average Diluted Conc. During Period of All Identified Isotopes	µCi/ml	3.33E-06		6.39E-08	
3. Percent of Applicable Limit ($\sum_{i=1}^{N} MPC \leq 1$)	%	1.99E+00		4.15E+00	
B. Tritium					
1. Total Release	Curies	1.98E-01	±1.0E+01	2.43E-01	1.0E+01
2. Average Diluted Conc. During Period	µCi/ml	9.52E-07		5.11E-07	
3. Percent of Applicable Limit (3.0E-03 µCi/ml)	%	3.17E-02		1.70E-02	
C. Dissolved and Entrained Gases					
1. Total Release	Curies	0.00E-01	±1.5E+01	1.61E-02	±1.5E+01
2. Average Diluted Conc. During Period	µCi/ml	0.00E-01		3.38E-08	
3. Percent of Applicable Limit (2.0E-04 µCi/ml)	%	0.00E-01		1.69E-02	
D. Gross Alpha Radioactivity					
1. Total Release	Curies	0.00E-01	±1.5E+01	0.00E-01	±1.5E+01
E. Volume of Waste Release					
(No Dilution)	Liters	2.08E+08	±1.0E+01	4.76E+08	±1.0E+01

NOTE: Percent of applicable limit is based on identified isotope concentration after dilution, related to their appropriate MPC concentration and sum of all the isotope fractions compared to 1.0.

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CONTINUOUS LIQUID RELEASES

(Turbine Building Sump)

G. Isotope Summary	Curies	First Quarter	Second Quarter
1. Strontium-89		0.00E-01	0.00E-01
2. Strontium-90		0.00E-01	0.00E-01
3. Cesium-134		0.00E-01	0.00E-01
4. Cesium-137		0.00E-01	3.16E-03
5. Iodine-131		0.00E-01	5.83E-03
6. Cobalt-58		2.71E-01	1.51E-02
7. Cobalt-60		0.00E-01	0.00E-01
8. Iron-59		0.00E-01	0.00E-01
9. Zinc-65		0.00E-01	0.00E-01
10. Manganese-54		0.00E-01	6.30E-03
11. Chromium-51		3.73E-01	0.00E-01
12. Zirconium-Niobium-95		2.88E-02	0.00E-01
13. Molybdenum-99		0.00E-01	0.00E-01
14. Technetium-99m		0.00E-01	0.00E-01
15. Barium-Lanthanum-140		0.00E-01	0.00E-01
16. Cerium-141(1)		0.00E-01	0.00E-01
17. Sodium-24		0.00E-01	0.00E-01
18. Fluorine-18		0.00E-01	0.00E-01
Total for Period		6.73E-01	3.04E-02

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CONTINUOUS LIQUID RELEASES

(Turbine Building Sump)

G. Isotope Summary	Curies	First Quarter	Second Quarter
Others (Not Required for Reg. Guide 1.21)			
1. Xenon-133		0.00E-01	1.61E-02
2. Xenon-135		0.00E-01	0.00E-01
3. Iodine-133		0.00E-01	0.00E-01
4. Cesium-136		0.00E-01	0.00E-01
5. Manganese-56		0.00E-01	0.00E-01
6. Antimony-122		0.00E-01	0.00E-01
7. Antimony-124		0.00E-01	0.00E-01
8. Copper-64		0.00E-01	0.00E-01
9. Arsenic-76		0.00E-01	0.00E-01
10. Arsenic-74		0.00E-01	0.00E-01
11. Phosphorus-32[1]		1.92E-02[1]	0.00E-01
12. Iron-55		0.00E-01	0.00E-01
Total for Period		1.92E-02	1.61E-02

[1]Reported in Special Report 81-3

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BATCH LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

STEAM GENERATOR BLOWDOWN

		Unit	1st Quarter	Total % Error	2nd Quarter	Total % Error
A.	Fission and Activation Products					
	1. Total Releases	Curies	8.85E-04	±1.0E+01*	0.00E-01	±1.0E+01
	2. Average Diluted Conc. During Period of All Identified Isotopes	µCi/ml	2.44E-08		0.00E-01	
	3. Percent of Applicable Limit ($\sum_{i=1}^{N}$ MPC ≤ 1)	%	1.22E-01		0.00E-01	
	NOTE: Percent of applicable limit is based on identified isotope concentration after dilution, related to their appropriate MPC concentration and sum of all the isotope fractions compared to 1.0.					
B.	Tritium					
	1. Total Release	Curies	0.00E-01	±1.0E+01	0.00E-01	1.0E+01
	2. Average Diluted Conc. During Period	µCi/ml	0.00E-01		0.00E-01	
	3. Percent of Applicable Limit (3.0E-03 µCi/ml)	%	0.00E-01		0.00E-01	
C.	Dissolved and Entrained Gases					
	1. Total Release	Curies	0.00E-01	±1.5E+01	0.00E-01	±1.5E+01
	2. Average Diluted Conc. During Period	µCi/ml	0.00E-01		0.00E-01	
	3. Percent of Applicable Limit (2.0E-04 µCi/ml)	%	0.00E-01		0.00E-01	
D.	Gross Alpha Radioactivity					
	1. Total Release	Curies	0.00E-01	±1.5E+01	0.00E-01	±1.5E+01
E.	Volume of Waste Release					
	(Before Dilution)	Liters	3.44E+06	±1.0E+01	5.82E+05	±1.0E+01
F.	Volume of Dilution Water for Period	Liters	3.29E+07	±1.0E+01	1.27E+07	±1.0E+01

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BATCH LIQUID RELEASES

STEAM GENERATOR BLOWDOWN

G. Isotope Summary	Curies	First Quarter	Second Quarter
1. Strontium-89		0.00E-01	0.00E-01
2. Strontium-90		0.00E-01	0.00E-01
3. Cesium-134		0.00E-01	0.00E-01
4. Cesium-137		0.00E-01	0.00E-01
5. Iodine-131		0.00E-01	0.00E-01
6. Cobalt-58		0.00E-01	0.00E-01
7. Cobalt-60		0.00E-01	0.00E-01
8. Iron-59		0.00E-01	0.00E-01
9. Zinc-65		0.00E-01	0.00E-01
10. Manganese-54		0.00E-01	0.00E-01
11. Chromium-51		0.00E-01	0.00E-01
12. Zirconium-Niobium-95		0.00E-01	0.00E-01
13. Molybdenum-99		0.00E-01	0.00E-01
14. Technetium-99m		0.00E-01	0.00E-01
15. Barium-Lanthanum-140		0.00E-01	0.00E-01
16. Cerium-141		0.00E-01	0.00E-01
17. Sodium-24		0.00E-01	0.00E-01
18. Fluorine-18		0.00E-01	0.00E-01
Total for Period		0.00E-01	0.00E-01

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BATCH LIQUID RELEASES

STEAM GENERATOR BLOWDOWN

G. Isotope Summary	Curies	First Quarter	Second Quarter
Others (Not Required for Reg. Guide 1.21)			
1. Xenon-133		0.00E-01	0.00F-01
2. Xenon-135		0.00E-01	0.00E-01
3. Iodine-133		0.00E-01	0.00E-01
4. Cesium-136		0.00E-01	0.00E-01
5. Manganese-56		0.00E-01	0.00E-01
6. Antimony-122		0.00E-01	0.00E-01
7. Antimony-124		0.00E-01	0.00E-01
8. Copper-64		0.00E-01	0.00E-01
9. Arsenic-76		0.00E-01	0.00E-01
10. Arsenic-74		0.00E-01	0.00E-01
11. Phosphorus-32[1]		8.85E-04[1]	0.00E-01
12. Iron-55		0.00E-01	0.00E-01
Total for Period		8.85E-04	0.00E-01

[1]Reported in Special Report 81-3.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

FIRST HALF 1981

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

(Ground Level Releases)

Summation of All Releases	Unit	1st Quarter	Total % Error	2nd Quarter	Total % Error
A. Fission and Activation Products					
1. Total Releases	Ci	4.07E+03	±1.0E+01	6.25E+02	±1.0E+01
2. Average Release Rate for Period	µCi/sec	5.23E+02		7.95E+01	
3. Percent of Technical Specification Limit (2.6×10^{5} µCi/sec)	%	2.35E-01		3.57E-02	
B. Iodines					
1. Total Iodine-131	Ci	1.16E-08	±1.0E+01	7.44E-04	±1.0E+01
2. Average Release Rate for Period	µCi/sec	1.49E-09		9.46E-05	
3. Percent of Technical Specification Limit (1.141E-01 µCi/sec)	%	6.37E-07		4.05E-02	
C. Particulates					
1. Particulates with half-lives >8 Days	Ci	1.16E-02	±1.5E+01	5.45E-04	±1.5E+01
2. Average Release Rate for Period	µCi/sec	1.49E-03		6.93E-05	
3. Percent of Technical Specification Limit (1.277E-01 µCi/sec)	%	1.17E+00		5.43E-02	
4. Gross Alpha Radioactivity	Ci	0.00E-01		0.00E-01	
D. Tritium					
1. Total Release	Ci	2.75E-02	±1.0E+01	1.28E-01	±1.0E+01
2. Average Release Rate for Period	µCi/sec	3.54E-03		1.63E-02	
3. Total Volume Discharged From Site	CC	8.43E+14		9.32E+14	±1.0E+01
4. Percent of Technical Specification Limit (2.0E-07 µCi/cc)	%	1.63E-02		6.87E-02	

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

FIRST HALF 1981

GASEOUS EFFLUENTS GROUND LEVEL RELEASE

	Unit	First Quarter	Second Quarter
1. Fission Gases			
Krypton-85	Ci	0.00E-01	0.00E-01
Krypton-85m	Ci	0.00E-01	3.86E-01
Krypton-87	Ci	0.00E-01	0.00E-01
Krypton-88	Ci	0.00E-01	0.00E-01
Xenon-133	Ci	4.06E+03	5.56E+02
Xenon-135	Ci	8.30E-02	6.29E+01
Xenon-135m	Ci	0.00E-01	0.00E-01
Xenon-138	Ci	0.00E-01	0.00E-01
Others (Specify) Xe-131m	Ci	8.23E-00	2.18E-01
Argon-41	Ci	0.00E-01	2.55E+00
Unidentified Xe-133m	Ci	4.93E-02	3.39E+00
Total for Period		4.07E+03	6.25E+02
2. Iodines			
Iodine-131	Ci	1.16E-08	7.44E-04
Iodine-133	Ci	0.00E-01	1.54E-03
Iodine-135	Ci	0.00E-01	0.00E-01
Total for Period		1.16E-08	2.28E-03

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

FIRST HALF 1981

GASEOUS EFFLUENTS GROUND LEVEL RELEASE

3. Particulates	Unit	First Quarter	Second Quarter
Strontium-89	Ci	0.00E-01	1.53E-07
Strontium-90	Ci	0.00E-01	2.05E-07
Cesium-134	Ci	0.00E-01	0.00E-01
Cesium-137	Ci	0.00E-01	0.00E-01
Barium-140	Ci	0.00E-01	0.00E-01
Zirconium-95	Ci	0.00E-01	0.00E-01
Niobium-95	Ci	0.00E-01	1.96E-13
Cobalt-58	Ci	0.00E-01	6.13E-06
Technetium-99m	Ci	1.16E-02	0.00E-01
Chromium-51	Ci	1.22E-05	0.00E-01
Iron-59	Ci	0.00E-01	0.00E-01
Cobalt-60	Ci	0.00E-01	0.00E-01
Others (Specify) Rb-88	Ci	0.00E-01	5.39E-04
Lanthanum-140	Ci	0.00E-01	0.00E-01
Total for Period	Ci	1.16E-02	5.45E-04

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

FIRST HALF 1981

SOLID WASTE (RADIOACTIVE) SHIPMENTS

A. Solid Waste Shipped Off-Site for Burial or Disposal (not Irradiated Fuel)

1. Type of Waste	Unit	First Quarter	Second Quarter
a. Spent resins, filter sludges, evaorator bottoms, etc.	m^3	9.03E+00	1.812E+00
	Ci	1.264E-01	6.70E-01
b. Contaminated equip., etc.	Ci	0.00E+00	0.00E+00
c. Irradiated Components, Control Rods, etc.		None	None
d. Other (describe) Boxes and Drums	Boxes	0.00E-01	2.3E+01
	Drums	0.00E-01	3.47E+02
	Ci	0.00E-01	1.83E+00

2. Estimate of major nuclide composition (by type of waste)

		1st Quarter	2nd Quarter			
a. 1.	Chromium-51	1.08E+01	1.44E+01	%	1.37E-02	9.81E-02
2.	Zinc-65	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
3.	Iodine-131	7.00E-01	4.8E+00	%	8.80E-04	3.27E-02
4.	Cesium-137	6.00E-01	3.2E+00	%	7.5E-04	2.18E-03
5.	Cesium-134	0.00E-01	2.0E-01	%	0.00E-01	1.2E-03
6.	Cobalt-58	6.71E+01	2.43E+01	%	8.48E-02	1.66E-01
7.	Cobalt-60	7.4E+00	2.4E+00	%	9.36E-03	1.64E-02
8.	Zirconium-95	0.00E-01	1.1E+00	%	0.00E-01	7.48E-03
9.	Niobium-95	0.00E-01	1.6E+00	%	0.00E-01	1.07E-02

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

FIRST HALF 1981

SOLID WASTE (RADIOACTIVE) SHIPMENTS

2. Estimate of major nuclide composition (by type of waste)

			First Quarter	Second Quarter	Unit	First Quarter	Second Quarter
b.	10.	Lanthanum-140	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	11.	Antimony-124	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	12.	Strontium-90	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	13.	Manganese-54	1.17E+01	3.24E+01	%	1.48E-02	2.21E-01
	14.	Silver-110M	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	15.	Iron-59	9.0E-01	1.0E+00	%	1.13E-03	6.49E-03
	16.	Other Nuclides	8.0E-01	1.41E+01	%	1.02E-03	1.00E-01
c.		Irradiated Components, Control Rods, etc.					
		Spent Fuel Racks	None	None			
d.	1.	Chromium-51	0 00E-01	1.07E+01	%	0.00E-01	1.96E-01
	2.	Zinc-65	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	3.	Iodine-131	0.00E-01	7.0E-01	%	0.00E-01	1.28E-02
	4.	Cesium-137	0.00E-01	6.0E-01	%	0.00E-01	1.09E-02
	5.	Cesium-134	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	6.	Cobalt-58	0.00E-01	6.72E+01	%	0.00E-01	1.227E+00
	7.	Cobalt-60	0.00E-01	7.42+00	%	0.00E-01	1.35E-01
	8.	Zirconium-95	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	9.	Niobium-95	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

FIRST HALF 1981

SOLID WASTE (RADIOACTIVE) SHIPMENTS

2. Estimate of major nuclide composition (by type of waste)

			First Quarter	Second Quarter	Unit	First Quarter	Second Quarter
d.	10.	Lanthanum-140	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	11.	Antimony-124	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	12.	Strontium-90	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	13.	Manganese-54	0.00E-01	1.17E+01	%	0.00E-01	2.14E-01
	14.	Silver-110M	0.00E-01	0.00E-01	%	0.00E-01	0.00E-01
	15.	Iron-59	0.00E-01	9.0E-01	%	0.00E-01	1.65E-02
	16.	Other Nuclides	0.00E-01	8.0E-01	%	0.00E-01	1.46E-02

3. Solid Waste Disposition

Number of Shipments		Mode of Transportation	Destination
First Quarter	Second Quarter		
1	2	Sole Use - Truck	Chem Nuclear Systems, Inc. Barnwell, SC

B. Irradiated Fuel Shipments (Disposition)

Number of Shipments		Mode of Transportation	Destination
First Quarter	Second Quarter		
None	None	N/A	N/A

SEQUOYAH NUCLEAR PLANT

UNITS 1 & 2

PROCESS CONTROL PROGRAM CHANGES

The Sequoyah Nuclear Plant Process Control Program (PCP) was first issued and approved by the Commission in February, 1980. At the time of issuance, TVA had contracted with ANEFCO, Inc. to provide solidification services for Sequoyah. The PCP thus developed and approved reflected ANEFCO's urea-formaldehyde solidification process.

On July 15, 1980, the Sequoyah Plant Operations Review Committee (PORC) approved a change to the Sequoyah PCP. This change consisted only of the addition of an appendix which further detailed the ANEFCO process and its use with the Sequoyah radwaste systems. Therefore, since there was no "process" change it was deemed not reportable.

In September, 1980, a contract was negotiated with Chem-Nuclear Systems, Inc. to provide for Sequoyah solidification services. Chem-Nuclear provided TVA with a PCP upon issuance of the contract but it was not approved by the Plant Operations Review Committee until February, 1981. Between September, 1980 and February, 1981, no solidification was performed at Sequoyah. Final documentation, a formality, took until August, 1981 due to a document control handling error.

Attachment A of this report presents the currently approved Sequoyah PCP. It includes a PCP for the Chem-Nuclear system as well as the ANEFCO system. Either system can be used but contractually, only the Chem-Nuclear system will be used until a new contract is let.

The Chem-Nuclear system utilizes the urea-formaldehyde solidification process. Therefore, it has been determined that the change to the Chem-Nuclear system did not reduce the overall conformance of the solidified waste product as compared to the ANEFCO system previously approved for use by the Commission.

APPENDIX A

Sequoyah Nuclear Plant

SURVEILLANCE INSTRUCTION

SI-419

SOLID RADIOACTIVE WASTE TREATMENT SYSTEM-OPERABILITY VERIFICATION

Prepared By: John T. Dills

Revised By: D. A. Fraser

Submitted By: Warren H. Kinsey
Supervisor

PORC Review: 8/6/81
Date

Approved By: W F Cotton
Plant Manager

Date Approved: 8/6/81

DISTRIBUTION

1C · Plant Master File
____ Plant Superintendent
____ Assistant Plant Supt. (Oper.)
____ Assistant Plant Supt. (Maint.)
____ Assistant Plant Supt. (H&S)
____ Administrative Supervisor
____ Maintenance Supervisor (M)
____ Assistant Maintenance Supervisor (M)
____ Maintenance Supervisor (E)
____ Assistant Maintenance Supervisor (E)
____ Maintenance Supervisor (I)
1U · Results Supervisor
1C · Operations Supervisor
1U · Quality Assurance Supervisor
____ Health Physics Supervisor
____ Public Safety Services Supv.
____ Chief Storekeeper
____ Preop Test Program Coordinator
1C · Outage Director
1U · Chemical Engineer (Results)
1C · Radiochem Laboratory
____ Instrument Shop
____ Reactor Engineer (Results)
____ Instrument Engineer (Maint. I)
____ Mechanical Engineer (Results)
1U · Plant Services Supervisor
1C · Training Center Coordinator
____ Public Safety Services - SNP
1C · Shift Engineer's Office
1C · Unit Control Room
____ Health Physics Laboratory
1U · Nuclr Document Control Unit
1U · Plant Superintendent, WBNP
____ Plant Superintendent, BFNP
____ Plant Superintendent, BENP
1U · NEB-K
____ NRC-IE:II
____ Resident NRC Inspector - SNP
1C · NSRS-K
____ Technical Support Center
1C · Unit Control Room #2
1U · Compliance Section Staff Supervisor
____ _____
____ _____
____ _____
____ _____
____ _____

Rev. No.	Date	Revised Pages	Rev. No.	Date	Revised Pages
0	2/11/80	ALL			
1	7/15/80	5-21, Add 22-74			
2	1/29/81	2			
3	8/6/81	4-34			

The last page of this instruction is Number 74

1.0 SCOPE

1.1 Description

1.1.1 Establish and document the quarterly solid radwaste requirements in the Technical Specifications.

1.2 Objective

1.2.1 Satisfy surveillance requirements for the solid radwaste system at least once per 92 days as follows:

a. Verification of the existence of a valid contract for solidification to be performed by a contractor in accordance with a process control program (SR 4.11.3.1.b)

1.3 Frequency - 92 days

1.3.1 All Modes

a. Verify the existence of a valid solidification contract for processing radioactive wastes.

2.0 INSTRUCTIONS

2.1 Verify that the solidification contract in Appendix A of SI-419 is a valid contract by verifying that the expiration date is still applicable for solidifying radioactive wastes. Record the expiration date on data sheet 2.0.

2.2 Verify that the waste solidification vendor is using the process control program (plan) as described in Appendix B of SI-419 to solidify radioactive wastes. Record verification (yes or no) on data sheet 2.0.

2.3 Record date that step 2.1 and 2.2 were performed.

3.0 ACCEPTANCE CRITERIA

3.1 Acceptance criteria is given on the data sheet for each parameter monitored.

4.0 ACTION REQUIRED

4.1 The lead chemical laboratory analyst (SE 5) will review and approve the completed SI and will evaluate if data collected is valid and meets the acceptance critiera as noted in the surveillance instruction and acknowledges by signing the data coversheet.

SQNP
SI-419
Data Cover Sheet
Page 1 of 1
Rev. 2

SOLID RADIOACTIVE WASTE TREATMENT SYSTEM - OPERABILITY VERIFICATION

Unit 0

Performed By _____ Date _____
Analyst(s)

Data Reviewed and Approved: _____ Date _____
Lead Chemical Analyst (SE5)

Instruction No.	Data Sheet No.	Pages
SI-419	2.0	____

Were Technical Specification criteria satisfied? _____ yes _____ no
If criteria were not satisfied, notify the shift engineer who completes the following:

Was a limiting condition for operation violated?
_____ yes (explain in remarks) _____ no (explain in remarks)

Verified By _____ Date _____
Shift Engineer

Reason for test:

_____ Required by schedule
_____ Other (explain) _____

Review and Aproval of Test Results

_____ Date _____
Cognizant Chemical Engineer

QA Review of Test Results

QA Staff _____ Date _____

Remarks:

Unit 0

Procedure Step	Description	Data	Acceptance Criteria	Analyst Initials
2.1	Expiration date of contract for processing solid radwaste with _____ (Vendor I.D.)	___/___/___ MO DATE YEAR	Date for step 2.3 precedes date for step 2.1.	_____
2.2	Process control plan verified	YES/NO (circle one)	YES	_____
2.3	Performance date of SI step 2.1 and 2.2.	_____	NA	_____

NOTE: If date for step 2.3 supercedes date for step 2.1 or value for step 2.2 is NO, then immediately notify the chemical engineering associate (SE6) or cognizant chemical engineer to verify the waste solification contract (Appendix A) is presently applicable and that the vendor is using the approved process. Control program (plan) as described in Appendix B of SI-419 for processing radioactive waste for soliditation. Record date, time and person notified and any recommended corrective actions on datasheet.

REMARKS: _____

_____

_____

TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401
Telephone – 615 755 3011 Telex 55-8417
Telecopier – 615 755-321. ANSWERBACK – TVAPURTRFCTA

QUOTATION – CONTRACT

PLEASE TYPE OR PRINT AND RETURN ALL COPIES

Vendor Code	
Buying Code	[illegible]
Commodity Code	[illegible]
Account Number	7110 [illegible]
Request Date	November 1[illegible], 19[illegible]
TVA Reference No.	[illegible]
Contract Date	[illegible] 6, 1990
Total Amount	$ [illegible],00
Performance Date	[illegible]
Quotations Close	[illegible]

PLEASE QUOTE ON ITEMS LISTED

Project: Sequoyah Nuclear Plant

IF UNABLE TO QUOTE, PLEASE RETURN THIS FORM UNMARKED TO TVA

In compliance with this quotation and all conditions herein, the undersigned offers, and agrees if this bid be accepted within ___ days (30 days unless otherwise stated) to furnish any or all of the items at prices quoted.

Vendor: Chem-Nuclear Systems, Inc.
240 Stoneridge Drive, Suite 100
Columbia, South Carolina 29210

FOR TVA USE ONLY

ACCEPTANCE – Accepted only as to: Schedule I, Items B, C, D, E. Transportation Attachment 1 is made a part of this contract.
Confirming telephone award to [illegible] November [illegible], 1990.

Tennessee Valley Authority, By ______
(SG) [illegible] Purchasing A[illegible]

Vendor Reference No. [illegible]	Telephone 803-790-[illegible]
Telecopier (803) [illegible]	Telex
Date [illegible]	Signature (S) [illegible]

Point of shipment [illegible]
Point of manufacture
Method of shipment [illegible] Shipping weight [illegible]
No. of days after award for delivery [illegible]
TERMS ______ Unless otherwise qualified by bidder on this form: (1) discounts will be [illegible] than gross contract price, and (2) time in connection with discounts offered will be computed from date of delivery of supplies at destination or from date of receipt of correct bill whichever is later.

Ship by: Services

Consign to – Tennessee Valley Authority
Chem-Nuclear [illegible] Facilities [illegible]
[illegible], South Carolina

Mark: CONTRACT [illegible]
For: Sequoyah Nuclear Plant
Attn.: [illegible]

ITEM	ARTICLES OR SERVICES (Give Description or Catalog No.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	These items required on jobsite [illegible] Please quote: FOB Transport Prepaid If unable, show here: FOB				
	The attached "Schedule of Prices" pages 1 and 2 are made a part of this contract. The attached special specification, Mobile Radioactive Waste Solidification Specification, is made a part of this contract. The attached special conditions are made a part of this contract. The attached TVA Forms 6062 (General Conditions) and changes, 9923 (Equal Opportunity), 9925 (Equal Opportunity Information Reporting and Compliance Program)				

RECEIVED
CHATTANOOGA, TENN.
DIVISION OF NUCLEAR POWER
JAN 9 1991
MATERIALS UNIT

DATE	FIELD VOUCHER NO.	AMOUNT	STOREROOM OPERATION CHARGE DATE	FIELD VOUCHER NO.	AMOUNT
			C		
			D		

TVA USE ONLY
I certify that the articles or services listed above have been received in quality and quantity specified except as noted.

Date Material Received | G.B.L. | Carrier's Charges Paid $ | Collect $ | Receipt receiving material
Stock | Common Carrier | Freight | Express | Parcel Post | Vendor | TVA
Approved as reported above

TVA 9640 (OP-2-79) Copy

GENERAL CONDITIONS ON REVERSE SIDE ARE MADE A PART OF THIS CONTRACT.

Copy No. 11
1. Auditor 2. Contractor 3. Contract File 4. Purchasing A File 5. Accounting Office 6. Consignee 7. Requisitioner 9. Plant Accounting

ITEM NO.		QUANTITY	UNIT	UNIT PRICE (Quote each price and compute extension)	AMOUNT
	9041 (Affirmative Action For Handicapped Workers), 1547A (Walsh-Healey Act), and 9934 (Affirmative Action For Disabled Veterans and Veterans of the Vietnam Era) are made a part of this contract.				

Schedule of Prices

No. 81768-180449
Page No. 1

ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
Bidders quotation shall be based on the materials manpower and equipment necessary to complete the requirements of Schedule I items 1-5 and Schedule II items 1-5. All work shall be done in accordance with the attached specification.				
This agreement shall be an Indefinite Quantity Term Contract (IQT). Therefore, no maximum or minimum amounts are guaranteed.				
TVA reserves the right to make multiple awards, and/or to award by schedule.				
Schedule I (Where applicable, Contractor shall quote for both Demand and Full-Time service)	$8000.00 plus Demand		$8000.00 plus Full-Time	plus (See item below.
A. Rental and set-up of mobile solidification unit.	$600/day		$6000.00/Mo.	
B. Services of operator (Dollars/hour)	$30.00/hr.		$ 30.00 /hr.	(See #2 be
C. Solidification services utilizing masonry cement as a solidification agent. (Dollars per cubic foot of waste as measured at the connection between the TVA nuclear plant and Contractor's equipment).	$ 15.60/ft.^{3}		$ 15.60 /ft.^{3}	(See #3 b
D. Transportation (Shipping Cask without liner) (See Attachment 1)	$2695.00	Shipment	$2695.00	Shipment item
E. Disposable liner	$4170.00	liner	$4170.00/	liner be
Schedule II (Where applicable, Contractor shall quote for both Demand and Full-Time service)	$8000.00 plus		$8000.00	plus (S item
A. Same as above	$735/day		12,500/Mo.	
B. Same as above	$ 30.00/hr.		$ 30.00 /hr.	(See #2 be
C. Solidification services utilizing the DOW Chemical solidification process for low-level radioactive wastes. (Dollars per cubic foot of waste as measured at the connection between the TVA nuclear plant and Contractor's equipment).	$75.00/Ft.^{3}		$ 75.00 /ft.^{3}	(S item
D. Transportation (shipping cask without liner) (See Attachment 1)	$2695.00	Ship-ment	$ 2695.00	Ship-ment (Se #5
E. Disposable liner	$8585.00	liner	$ 8585.00/	liner
Note: (Transportation shall be from Sequoyah Nuclear Plant near Daisy, TN. to the Chem Nuclear Disposal Facility near Barnwell, SC).				

A 5031 (OP-9-73)

BIDDER Chem-Nuclear Systems, Inc.

Schedule of Prices

No. 81P68-100449
Page No. 2

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and complete extension)	AMOUNT
	Overtime Bidder shall state: $30.00/hour Hours constituting regular workday 8 a.m. to 5 p.m. Days constituting regular work week if other than Monday through Friday. NA Quality Assurance. Thirty (30) days from date of award, the Contractor shall satisfy all QA requirements specified by TVA. Should Contractor fail to satisfy the aforementioned requirements, TVA reserves the right to terminate the contract at no cost. Contractor shall notify TVA when 70% of award amount has been used. Full time use $8,000.00 fee is a one time charge. Demand use $8,000.00 fee is per set up if the unit leaves Sequoyah Station between solidifications. For Dow Solidification a metering batch tank is required. Should this service be elected a minimum 3 year rental period at an additional $8,760.00/month will be required or CNSI will sell batch tank equipment to TVA for $400,000.00. As stated herein pricing is based on a minimum 40 hour work week. Pricing is based on minimum of 95 cu.ft. of radwaste per liner. Transportation based on use of CNSI licensed 21-300 cask. Transportation based on use of CNSI licensed 14-195 or 21-300 casks. Pricing is based on minimum of 110 cu.ft. of radwaste per liner.				

TVA 5051 (DP-9-73)

BIDDER Chem-Nuclear Systems, Inc.

CHANGE OF CONTRACT

APPENDIX A THIS BLOCK TO BE COMPLETED BY TVA

Address all communication except invoices to
TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401

Telex 55-8417 Telephone 615-755-3011

ANSWERBACK-TVAPURTRFCTA

Telecopier 615-755-3214

CONTRACT NUMBER must be shown on all invoices, packages, shipping papers and correspondence.

VENDOR CODE	STATE OR COUNTRY CODE	TVA REFERENCE NO.	CHANGE NO.
	39	81P68-180440	1
BUYING CODE	COMMODITY CODE	CHANGE AMOUNT	
L F D W 5	9951	No change	
VENDOR REFERENCE NO.		CHANGE DATE	PERFORMANCE DATE
		1/12/81	11-26-80 thru 2-24-81
ACCOUNT NO.			
1711053-120			
PROJECT			
Sequoyah Nuclear Plant			

TO

Chem-Nuclear Systems, Inc.
240 Stoneridge Drive, Suite 100
Columbia, SC 29210

ONSITE MOBILE SOLIDIFICA
SERVICES FOR RADIOACTIVE

The attached Schedule III is hereby made a part of the contract.

Also, on page 2 of Schedule of Prices, Quality Assurance does read:

Thirty (30) days from date of award, ...

Should read:

Ninety (90) days from date of award, ...

RECEIVED
JAN 19 1981
MATERIALS UNIT

All other terms and conditions of the original contract and previous changes of contract (if any), shall apply.

Previous Total NOT TO EXCEED $100,000

Correct Total No change

7X

TENNESSEE VALLEY AUTHORITY
Division of Purchasing
By David H. Marks
(68) David H. Marks, Purchasing Agent
/mc

TVA 394 (DP-7-80)

Contractor Contract File Accounting Office

Articles or Services	Quantity	Unit	Unit Price	Amou
Schedule III (Where applicable, Contractor shall quote for both Demand and Full Time Service)				
	*1 $12,000 plus Demand		$8,000 Full Time	
A. Rental and set up of Mobile Solidification unit.	$500.00/day		$5,000.00/mo.	
B. Services of Operation (Dollars/hour)	*2 $30.00/hr.		$30.00/hr.	
C. Solidification services utilizing Urea Formaldehyde as a solidification agent. (Dollars per cubic foot of waste as measured at the connection between the TVA Nuclear Plant and Contractors equipment).	*3 $30.00		$30.00	
D. Transportation (shipping cask without liner) (See Attachment 1)	*4 $2,770.00		$2,770.00	
E. Disposable liner	$3,870.00		$3,870.00	

*1 See Item No. 1 of Page 2 Schedule of Prices perviously submitted.

*2 See Item No. 2 of Page 2 Schedule of Prices previously submitted.

*3 Pricing is based on minimum of 200 cu. ft. of radwaste per liner.

*4 See Item No. 4 of Page 2 Schedule of Prices previously submitted.

NOTE: Availability of urea formaldehyde solidification unit for demand type service is based on being released from service by another utility. This utility expects completion of services during week of 15 December 1980. Upon release above mentioned unit would be brought to Sequoyah Nuclear Station within days. Availability of Full Time services remains negotiable.

9 Bidder Chem Nuclear Systems, Inc.

SI-419 Rev. 3
APPENDIX A
 (THIS BLOCK TO BE COMPLETED BY TVA)

CHANGE OF CONTRACT

Address all communication except invoices to
TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401

Telex 55-8417 Telephone 615-755-3011

ANSWERBACK-TVAPURTRFCTA

Telecopier 615-755-3214

CONTRACT NUMBER must be shown on all invoices, packages, shipping papers and correspondence.

VENDOR CODE	STATE OR COUNTRY CODE	TVA REFERENCE NO.	CHANGE NO
	39	81P68-180449	2
BUYING CODE	COMMODITY CODE	CHANGE AMOUNT $	
L | E | D | W | 5	9951	No change	
VENDOR REFERENCE NO.		CHANGE DATE	PERFORMANCE DATE
		2/25/81	11/26/80 - 4/24/81
ACCOUNT NO.			
711053-120			
PROJECT			
Sequoyah Nuclear Plant			

TO

Chem-Nuclear Systems, Inc.
240 Stoneridge Drive, Suite 100
Columbia, SC 29210

ONSITE MOBILE SOLIDIFICATIO
SERVICES FOR RADIOACTIVE WA

The term of the contract is hereby extended from February 24, 1981, through April 24, 1981.

All other terms and conditions of the original contract and previous changes of contract (if any), shall apply.

Previous Total NOT TO EXCEED $100,000.00

Mansfield-7X

Correct Total No change

TENNESSEE VALLEY AUTHORITY
Division of Purchasing

By David H. Marks
(68) David H. Marks, Purchasing Agent

/mc

TVA 394 (DP-7-80)

Contractor Contract File -10- Accounting Office Requisitioner (2)

CHEM-NUCLEAR SYSTEMS, INC.

PROCESS CONTROL PROGRAM

PART I

Chem-Nuclear Systems, Inc., Process Control Program Using CNSI Portable Solidification System (Typical)

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1.0 PURPOSE

2.0 SYSTEM DESCRIPTION

- 2.1 Waste Transfer System
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- 3.2 Obtaining Test Specimens
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- 4.2 Test Solidification
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- 4.4 Alternate Solidification Parameter Selection

1.0 The purpose of the Process Control Program is to:

Provide assurance of the satisfactory solidification of wet radioactive waste and absence of significant free water in such waste prior to transport and disposal.

2.0 SYSTEM DESCRIPTION

The Portable Solidification Unit utilizes urea formaldehyde to convert all type of wet radioactive waste (filter sludges, spent resins, evaporator bottoms, boric acid solutions, and sodium sulfate solutions) into a solid matrix.

Sulfuric acid is added to a homogeneous mixture of wet radioactive waste and urea formaldehyde until solidification occurs.

The Portable Solidification System consists of the following subsystems: waste transfer, dewater, catalyst addition, air sparging, and off-gas vent system. The unit also contains a pneumatic control panel and an electric control panel.

2.1 Waste Transfer System

2.1.1 The major components of the waste transfer system are a 2-inch, teflon-lined hose with an outer stainless steel braiding and manual and air-operating ball valves.

2.1.2 Valve WS-1 (plant isolation) is an air-operated ball valve which will shut on a high level in the disposable liner.

2.1.3 Valve WS-3 and WS-4 (sample valves) and WS-2 (waste container isolation) are manually operated ball valves.

2.2 Dewatering System

2.2.1 The purpose of the dewatering system is to remove slurry water from the disposable container before solidification.

2.2.2 The major components of the dewatering system are:

1. A 1-1/2-inch air-driven, diaphragm-operated positive displacement pump.

2. A pressure gauge is located on both the suction and discharge side of the dewater pump.

3. The suction hose for the dewater pump is a 1-1/2-inch rubber suction hose. The discharge hose is a 1-1/2-inch teflon-lined hose with an outer steel braiding for over pressure protection.

4. Both sample and flush connection are available for the dewater system.

5. All valves in the dewater system are manually operated ball valves.

2.3 UF Transfer System

2.3.1 The purpose of the UF system is to store the UF until needed and then transfer UF to the disposable liner so it can be used in solidification.

2.3.2 The major components of the UF systems are:

1. UF stowage container which is usually a spare 300-cubic foot liner equipped with a PVC (polyvinyl chloride) stand pipe.

2. A 1-1/2-inch air-driven, diaphragm-operated positive displacement pump.

3. The pump is equipped with a suction and discharge pressure gauge and flush and sample connection.

2.4 Catalyst Addition System

2.4.1 The function of the catalyst addition system is to transfer the catalyst from the shipping container to the disposable liner for solidification.

2.4.2 The major components of the catalyst addition system are:

1. The catalyst transfer pump is a 3/4-inch centrifugal, constant-speed pump. The pump is equipped with a metering valve for regulating discharge flowrate and a recirculation line back to the suction side of the pump.

2. Check valves are placed in both the catalyst transfer line and the air sparging header to prevent any acid backing into the pneumatic control panel.

2.5 Air Sparging System

2.5.1 The function of the air sparging system is to mix the urea formaldehyde and radioactive waste and for drawing off free liquid remaining in the liner after solidification.

2.5.2 The major components of the air sparge system are the air sparge header which is placed inside the disposal liner, the control regulator, and gauge located at the pneumatic control panel.

2.6 Off-gas Vent System

2.6.1 The purpose of the off-gas vent system is to create a slight vacuum at the top of the liner to draw off radioactive airborne contamination and discharge it through the plant's stack gas system.

2.6.2 The major components of the off-gas vent system are the blower which is used to take a suction on the liner, a 1-1/2-inch spiroflex hose, and a vacuum breaker which will open a 1 psig to prevent the blower hose from collapsing.

2.6.3 The blower is normally mounted on the stand with valve WS-1 and the sample valves.

2.7 Pneumatic Control Panel

2.7.1 The purpose of the pneumatic control panel is to line up and deliver pressurized air at 100 ± 20 psig for the following functions.

1. Sparge Air
2. Fill Head Cooling
3. Camera Air
4. Plant Waste Connections
5. UF and Dewater Pump Control

2.7.2 All functions are equipped with a pressure regulator and a pressure gauge except fill head cooling air and camera air.

2.7.3 The pneumatic control panel is equipped with an air dryer for removing moisture from the supply air.

2.8 Electrical Control Console

2.8.1 The purpose of the electrical control console is to provide power and indication for the following components:

1. Pump and Valve Indication and Operation
2. Level Indication
3. Radiation level read-out
4. Remote Viewing Camera
5. Acid Pump
6. Off-gas Vent Blower

2.8.2 Pump and Valve Indication and Operation

1. Valve indication is supplied for valve WS-1 (plant isolation) at the electrical control console. The valve can be operated in either local or remote control.

2. An interlock is installed on the filling head to prevent WS-1 from being opened unless the fill head is positioned correctly on the barrel top liner and shut on a high pressure in the disposable liner.

3. Valve WS-1 will shut automatically on a high-high level condition in the disposable liner.

4. A red indicating light is on the electrical control console to indicate valve WS-1 is open and a green light exists to show when WS-1 is shut.

5. There is a 30-second time delay built in the automatic closing device for WS-1 to allow the operator time to prevent a premature closing of valve WS-1. WS-1 will shut automatically on a high-high level condition in the disposable liner.

2.8.3 Level Indication

1. Four different level positions are supplied. They are dewater level which is yellow, waste level which is black, UF level which is white and high level which is red. The level probes connect to the filling head by means of disposable dual banana jacks which are color coded for each level setpoint.

2. The level inside the disposable liner is indicated on the electrical control console by a series of level indicators. A level indicator exists for each probe (dewater, waste, UF, high). There is also a selector switch which will energize the dewater probe when in the sludge position. A white indicator shows when the correct level has been obtained.

2.8.4 A remote radiation detector monitors the waste passing through the waste transfer hose and may be positioned at any desired location.

2.8.5 The electrical control console contains a remote television monitor for viewing the contents of the disposable liner.

2.8.6 The acid pump and vent blower controls are identical in design and operation. They consist of an off/on switch and a red indication light to show when the equipment is energized and are equipped with overload circuits.

2.9 Fill Head Assembly

2.9.1 The fill head assembly is mounted atop the disposable liner and directs the flow of waste, catalyst, UF, and air to the liner.

2.9.2 The fill head is equipped with an adjustable high level switch which will shut valve WS-1 on a high level. The high level switch is a float-type switch.

2.9.3 A camera is mounted in the fill head and directed into the disposable liner.

3.0 SAMPLE COLLECTION AND ANALYSIS

3.1 Sample Procedure Overview and Implementation

3.1.1 This Section and Section 4.0 of the Process Control Program establish the program of sampling, analysis, test solidification, and evaluation which is necessary to ensure complete solidification of each type of wet radioactive waste.

3.1.2 Batch is defined as the waste required to fill one disposable liner to the level of the waste level probe.

3.1.3 If any test specimen fails to solidfy, the batch in the liner should not be solidified until a new test specimen can be obtained, alternative solidification parameters be determined, and a subsequent test verifies solidification.

3.1.4 If the first test specimen from a batch of waste fails to verify solidification, a sample will be collected and analyzed in accordance with the Process Control Program from each consecutive batch of the same type of wet waste until three (3) consecutive test specimens demonstrate solidification. At this point, the sampling requirement is again every tenth batch of each type of wet waste.

3.2 Obtaining Test Specimens

3.2.1 Radiological Precautions

1. All samples must be handled with proper radiological considerations to minimize employee exposure and to prevent the spread of contamination.

2. A "clean" and "contaminated" control area should be set up to prevent contamination spread.

3. Any requirements set forth by the facility's Health Physics Department must be complied with.

4. Disposal of completed test samples will be in the liner to be solidified.

3.2.2 Data Sheet PCP-1

1. Data Sheet PCP-1 (Attachment 1) will be used to collect data from each test specimen and will be maintained on file with the current sheet on top. A copy of Data Sheet PCP-1 will be maintained for each of the types of wet radioactive waste.

2. The following information is required on each test specimen:

    1. pH of waste
    2. Waste oil content (percent visual)
    3. Waste/UF ratio
    4. UF/Acid ratio

3. The following information will be required for all solidification evolutions.

    1. Waste type
    2. Batch number
    3. Level probe setpoints
    4. Sparge air pressure, flowrate, sparging time
    5. Total waste received
    6. Total UF added
    7. Total acid catalyst added

4. The batch number will range from 1 through 10 and on each tenth batch of each type of wet radioactive waste, a new set of process parameters will be determined. This practice will be followed for each type of wet radioactive waste.

P

3.2.3 Sampling Continuous Transfers of Waste

1. Evaporator bottoms or other hot samples should be collected and tested as quickly as possible to lessen the crystallization of any boric acid which may be present.

2. Resins and other sludges should be collected in wide-mouth bottles or other such containers from which the sample may be readily removed.

3. In the cases of resins or other waste in which large volume of flush water are involved, several consecutive samples ma have to be taken and the flush water decanted from the samp before a sufficient quantity of sample is obtained.

4. Sample volumes should normally be 1 liter. However, if rad tion levels make this impractical, smaller sample may be ob tained as appropriate.

5. Obtain the sample from either valve WS-4 after sufficient w has been transferred to the liner so that a representative ple is in the transfer line, or from the plant's routine sa point for the waste involved before its being transferred. the sample is collected at valve WS-4 at least 1/5 of the a cipated volume of waste to be transferred should have been received before taking the sample.

3.2.4 Sampling Multiple Transfers of Waste Per Batch

1. The sampling techniques of 3.2.3 above are applicable.

2. Each sample of the partial batch will be placed in appropriate storage until the entire batch of waste has been transferred to the liner.

3. For each partial transfer an estimate of the volume will be made.

4. Prepare a composite sample by determining the fraction which each transfer contributed to the total batch. Using the total sample volume required, multiply each transfer fraction by this volume to give the volume of each sample which is to be added to the composited sample.

3.3 Sample Analysis

3.3.1 General Sample Analysis Considerations

1. Specific techniques for chemistry analysis are not included in this PCP since there are several acceptable procedures for many of the analyses that may be required.

2. The solidification agents will require certain analysis and are included in this section for convenience.

3. All analytical results are to be recorded on Data Sheet PCP-1 maintained for that purpose.

3.3.2 For each new UF shipment, and periodically during storage, analyze a sample for specific gravity and pH.

3.3.3 Each container of catalyst should be analyzed before use for specific gravity and color (visual).

3.3.4 Evaporator bottoms should be analyzed for:

1. pH
2. Oil (percent visual)
3. Boron

3.3.5 Filter and other sludges should be analyzed for pH and visually checked for percent oil.

3.3.6 Resin beads will be characterized by analyzing the water surrounding the beads for pH.

3.3.7 All waste should undergo a qualitative test for foaming upon the addition of the catalyst. This can be accomplished by adding the catalyst to a small quantity of the waste in a beak and visually observing the results. Add antifoaming agent as needed to waste to eliminate foaming action.

4.0 TEST SOLIDIFICATION AND ACCEPTANCE CRITERIA

4.1 General Solidification Considerations

4.1.1 The standard ratios of UF/waste that are to be used on the first test solidification (unless other data shows different ratios should be used) are as follows:

1. Resin beads or other waste with a high precentage of solid material with a defined shape, use a ratio of 1 to

2. Filter sludges, evaporator bottoms, or other waste with a high percentage of dissolved or suspended solids use a ratio of 1 to 2.

4.1.2 If the pH of any waste was less than three, a caustic should be added to increase the pH to greater than three before the addition of the UF. Record the sample size and the amount of caustic added.

4.1.3 If foaming occurred in the waste sample, an antifoaming agent should be added to the waste before the addition of the UF. Record the sample size and the amount of antifoaming agent added.

4.1.4 If visual oil checks indicate concentrations greater than 1 percent, attempts to remove the oil should be initiated by skimming the top of the liquid or by the addition of demulsification agent(s).

4.2 Test Solidification

4.2.1 The waste sample should have the required pretreatment accomplished before the test solidification.

4.2.2 Prepare the test solidification vessel (normally a 1,000-ml disposable beaker) with a mixing device. This may be a disposable magnetic stirrer, a miniature air sparge system or other mechanical means of mixing the waste to UF.

4.2.3 Transfer a known representative volume of the waste (approximately 400 ml) to the test solidification vessel.

4.2.4 Add the appropriate volume of UF as determined by the applicable ratio.

4.2.5 Mix the waste and UF thoroughly. Then begin the catalyst addition until a pH of approximately 2 is obtained, then stop the addition of the catalyst.

4.2.6 As soon as the mixture begins to thicken, stop the mixing and allow the sample to remain undisturbed for at least 30 minutes.

4.2.7 If any free-liquid is noted on the top of the sample, transfer the liquid, by draining, into a clean, disposable volumetric beaker and record the amount of the liquid transferred. Calculate and record the percent of free-liquid present.

4.3 Solidification Acceptability

4.3.1 The sample solidification will be considered acceptable if the amount of free-liquid was equal to or less than 0.5 percent by volume or 1 gallon, whichever is less.

4.3.2 The waste solidification will be considered acceptable from a solid mass standpoint if it is evident from its physical appearance that the solidified waste will maintain its shape if moved from the vessel. This may be determined, for example by simply prodding with a stick or other rigid device and observing significant resistance to penetration.

4.3.3 If one or more of the above tests fails to meet the stated criteria, additional solidification parameters must be determined. This will also require the initiation of the additional solidification testing requirements for the next three batch types of waste which fail to solidify.

4.4 Alternate Solidification Parameter Selection

4.4.1 If unacceptable solidification resulted from excessive foaming the following items should be explored to reduce subsequent foaming. Solidification testing, as specified in Step 4.3 above, must be repeated and results recorded.

1. Adding additional or different antifoaming agent
2. Lowering the pH of the waste before the addition of the
3. Reduce the addition rate of the catalyst

4.4.2 If unacceptable solidification resulted from excessive free-liquid or a too-soft matrix, the UF/Waste ratios should be adjusted in increments of 0.5. For example, if the UF/waste ratio was 1 to 3 and the results were unsatisfactory, a ratio of 1 to 2.5 should be used. Solidification testing as specified in Step 4.3 above must be repeated and results recorded.

PART II

Chem-Nuclear Systems, Inc., Operating Procedures for the Portable Solidification Units (Typical)

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1.0 OPERATING PROCEDURE

1.1 Scope
1.1.1 Applicability
1.2 Prerequisites
1.3 Precautions
1.4 Detailed Procedure
1.4.1 Normal Operation
1.5 Reference Drawings

1.0 OPERATING PROCEDURE

1.1 Scope

This document provides instructions necessary for the operation of the Portable Solidification Unit during normal operation, resin transfer and dewatering, and system startup and securing.

1.1.1 Applicability

The instructions contained in this procedure are to be used by the operators of the Portable Solidification Units.

1.2 Prerequisites

1.2.1 The radioactive waste disposal system shall be in the shutdown mode of the operation before commencing Portable Solidification Unit startup.

1.2.2 New level setpoints for waste and urea formaldehyde will be determined by a test solidification of each tenth batch of each type of wet radioactive waste (filter sludges, spent resins, evaporator bottoms, boric acid solutions, and sodium sulfate solutions).

1.3 Precautions

1.3.1 At all times, the operator will follow the proper radiological precautions, to minimize the spread of contamination and to limit personal exposure to ionizing radiation.

1.3.2 When performing a dewatering evolution, the air sparge must be in operation. This is to prevent the resin from settling out and forming a semi-solid mass which will prevent adequate dewatering.

1.3.3 When dewatering a resin slurry, ensure that the proper filter screens are installed on the dewatering header.

1.3.4 If at any time during the operation of the Portable Solidificati Unit you cannot maintain normal parameters, secure operation anc contact the plant chemical engineer for assistance.

1.3.5 During all processing evolutions, the PSU operator(s) will wear assigned dosimetry.

1.3.6 During all operations of the PSU, the PSU operator(s) shall wear the proper clothing as required by Special Work Permit (SWP).

1.3.7 A radiation and contamination survey shall be performed after maintenance on any part of the PSU which could release contamination, and anytime good radiological precautions and procedures require surveys to be performed. The plant Health Physics Section shall perform this survey.

1.3.8 When receiving a resin slurry for dewatering only (no solidification) every effort must be made to ensure all water has been removed from the liner before transfer.

1.3.9 Before receiving waste, check the integrity of all hoses and transfer lines to ensure all lines are in operational condition.

1.3.10 Liners shall be shipped as soon as possible after solidification to reduce radiation levels in the area of the PSU (preferably within 72 hours after solidification).

1.4 Detailed Procedures

1.4.1 Normal Operation

1.4.1.1. Initial Conditions

See Chem-Nuclear Systems, Inc., Operation Procedure SD-OP-001.

NOTE: STEPS 1.4.1.1.1 THROUGH STEPS 1.4.1.1.22 MAY BE PERFORMED IN ANY SEQUENCE.

_____ 1. Health Physics shall survey the area for surface contamination and radiation levels.

_____ 2. Position the PSU, polymer stowage tank, and dispo liner(s) in the assigned position.

_____ 3. Establish the following plant services to the PSU

1. Electrical power; 480 volts, 70 amps
2. Service air; 25 SCFM at 100 ± 20 psi
3. Service water
4. Connect P11 to J11
5. Connect P6 to J6
6. Connect P13 to J13
7. Connect P7 to J7
9. Connect P10 to J10
10. Connect P8 to J8
11. Connect P9 to J9
12. Connect P5 to J5
13. Connect P12 to a convenient receptacal

_____ 4. Verify that the required amount of polymer, H_2SO_4 disposable liners, and lids are available.

_____ 5. Obtain an SWP from the Health Physics Section.

_____ 6. Establish control areas in the vicinity of the PS as specified by the SWP.

_____ 7. Connect the polymer transfer line between the pol stowage tank and the suction side of the polymer fer pump.

_____ 8. Using a crane, lift the filling head from its stowage tray and place into position for connection of the following:

1. UF transfer hose
2. Waste transfer hose
3. Dewater suction hose
4. Blower suction hose
5. Catalyst transfer hose
6. J2 to plug P2
7. J3 to plug P3
8. J1 to plug P1
9. J15 to plug P15

_____ 9. If necessary, remove valve WS-1 from the plant connection stand.

_____ 10. Following proper radiological precautions, remove any blank flanges from both valve WS-1 and utilities radwaste connection.

_____ 11. Attach valve WS-1 and the sample spool piece to the utilities radwaste connection and tighten securely.

_____ 12. Following proper radiological precautions, connect radwaste connection hose to the sample side of valve WS-1 and to valve WS-2 on the fill head assembly and tighten securely.

_____ 13. Connect the polymer transfer line to UF pump discharge valve, UF-1, and to UF liner isolation valve, UF-7.

_____ 14. Place the catalyst pump stand and the catalyst container in the assigned position.

_____ 15. Following proper safety precautions, connect the catalyst transfer line to the catalyst liner isolation valve, CT-5 and catalyst pump discharge valve, CT-1.

_____ 16. Connect catalyst suction hose and stand pipe to the suction side of the catalyst suction pump and install stand pipe and catalyst container.

_____ 17. Install the catalyst recirculation line between valve CT-4 and catalyst storage container.

_____ 18. Connect the dewatering suction hose to the dewatering suction valve, DW-1, and to the dewater liner isolation valve, DW-7.

_____ 19. Connect the dewater return line to the dewater pump discharge valve, DW-6, to the utility's dewater return connection.

_____ 20. Connect the discharge of the off-gas vent blower to the utility's vent system.

_____ 21. Connect the suction of the off-gas vent blower to the fill head assembly.

_____ 22. Make up the air sparging header and install the level leads at the setpoints determined by the most recent test solidification.

_____ 1. Remove the inspection port from the cask lid and remove the barrel top from the disposable liner. Inspect the cask and liner for damage and foreign material.

NOTE: IF A CASK IS NOT USED, STEP 1.4.1.2.1 MAY BE OMITTED

_____ 2. Place the air sparge header assembly inside the disposab liner and adjust the level heads to the setpoints define by the current test specimen.

_____ 3. Position the solidification filling head over the dispos liner opening. Leave enough clearance so that the sparg header and level leads can be installed in their connect on the filling head assembly.

_____ 4. Following proper radiological precautions, insert the ai sparging header into the connection on the filling head assembly.

_____ 5. Following proper radiological precautions, insert the le leads into the lead connector points as follows:

1. Green - Ground
2. Yellow - Dewater
3. Black - Waste
4. White - UF

_____ 6. Place the control power switch in the on position.

_____ 7. Position the filling head on the disposable liner. Veri proper position by checking that the filling head positi light on the electrical control panel is energized.

_____ 8. Actuate main air selector switch on the control console and check available air pressure. Air pressure should be 100 $\pm$ 20 psig.

_____ 9. Check for proper operation of valve WS-1 by taking it fr fully open to the fully shut position from the control co sole and locally at the valve station.

_____ 10. Energize TV camera, TV monitor, and container light.

_____ 11. Check for proper operation of alarms and alarm lights at the control panel.

_____ 12. Obtain from the plant's radwaste system operator the approximate amount of waste to be transferred.

_____ 13. Perform the following valve lineup:

1. Shut or check shut valves WS-1, WS-3, WS-4, CT-5, DW-2, DW-5, UF-2, UF-5, and CT-2.

2. Open or check open valves WS-2, DW-7, UF-7, CT-3, DW-1, DW-6, UF-6, and UF-1.

3. Check the metering position of CT-1 (valve CT-1 shou be set to allow a transfer rate of 5.0 gpm. A trans rate of 5.0 gpm corresponds to a valve setting of 2. If valve CT-1 is not in the proper position, adjust valve CT-1 to the proper position.

4. Place valve SA-1 in the UF pump position.

_____14. Open valve WS-1 from the electrical control console and start the off-gas vent blower. Inform the radioactive waste system operator that the solidification system is ready to receive waste.

1.4.1.3 Radioactive Liquid Waste Transfer and Disposable Liner Filling

1. Before receiving radioactive waste, verify the preopera- tional checks are complete.

2. Verify that the transfer of radioactive waste has begun b viewing the TV monitor and inform the client's Radioactiv Waste System Operator that you are receiving waste. Reco date and time you began receiving waste in the radwaste l

3. Record fixed monitor radiation readings on an hourly bas and record in the radwaste log.

4. When the waste reaches the waste level setpoint, shut valve WS-1 and inform the plant radwaste system operator to secure transfer.

5. When the transferring operation is complete, inform the plant radioactive waste system operator to perform the necessary valve lineup to flush the waste transfer line.

6. When the radioactive waste system operator reports that he is ready to flush, open valve WS-1.

7. Continuously monitor liner level during flushing operati

8. Monitor the waste transfer header for radiation levels. adequate flushing has taken place, the radiation levels the waste transfer header should approximate background. If radiation levels are significantly greater than back- ground, further flushing is required.

9. After adequate flushing has taken place, shut valve WS-1

10. Obtain the volume of waste received and record in the lo and on Data Sheet PCP-1.

11. Actuate air sparge selector switch on the pneumatic cont console and increase pressure by adjusting the regulati valve until a gentle rolling motion is noticed on the surface of the liquid by viewing the remote monitor.

12. Start UF transfer pump by increasing the air pressure t the speed control regulator from the electrical control console.

13. Monitor the liner for UF flow and continue adding UF until the proper polymer to waste mixture has been achieved.

14. Continue sparging for a total sparging time of at least 1 hour and at least 15 minutes of sparging after all UF has been added. This ensures good mixing of the polymer and waste.

15. After sparging for the necessary time, commence catalyst addition using the following procedure:

    1. Start the catalyst transfer pump and add catalyst unt a noticeable increase in the mixture's viscosity is visible in the remote TV monitor.

    2. Verify that solidification has occurred and the rolli motion of the liquid has stopped by viewing the remot TV monitor.

    3. Secure the catalyst transfer pump and open valve CT-2 to drain any residual catalyst from the catalyst line

    4. After all residual catalyst has been returned to the stowage container, shut valve CT-2.

    5. Determine the volume of catalyst added for solidifica tion. Record on Data Sheet PCP-1.

16. Connect catalyst transfer line to dewater pump flush conne tion and operate dewater pump until all free liquid is removed from container and pumped back to plant.

17. Secure air sparging and secure the off-gas vent blower.

18. Secure main air selector switch.

19. Secure TV camera and monitor.

20. Following proper radiological precautions, raise the filling head away from the disposable liner and place in its stowage location.

21. Check the quality of the matrix by visual inspection and by checking for hardness.

22. Install the lid on the disposable liner.

1.4.2 Resin, Sludge, and Miscellaneous Media

1. Preoperational Checks

    1. Perform Steps 1.4.1.1.1 through 1.4.1.2.2.

    2. Place a CNSI-approved dewatering header inside the disposable liner.

    3. Position solidification filling head over the disposa liner opening. Leave enough clearance so that the sparging header, dewatering header, and level leads c be adapted to their fill head connections.

4. Following proper precautions insert the sparging header, dewatering header, and level leads into their fill head connections.

5. Place SA-1 in the dewater position.

6. Perform Steps 1.4.1.2.3 through 1.4.1.2.13.

NOTE: AT THIS POINT, THE PORTABLE SOLIDIFICATION UNIT IS READY TO RECEIVE AND DEWATER RESIN SLUDGE OR MISCELLANEOUS MEDIA.

2. Waste Transfer and Disposable Liner Filling

1. Perform Steps 1.4.1.3.1 and 1.4.1.3.2.

2. Actuate the air sparge selector switch on the pneumatic control panel and increase pressure by adjusting the regulating valve until a gentle rolling motion is noticed on the surface of the slurry by viewing the remote monitor

3. When waste reaches the 2-foot level, start the dewatering pump from the control console. This is performed by slowly increasing the air pressure to the speed control regulator

NOTE: IF SOLIDIFICATION IS NOT REQUIRED BY THE TECHNICAL SPECIFICATIONS THE LINER MAY BE FILLED TO WITHIN 3 INCHES OF THE TOP OF THE LINER.

4. Continue pumping until the pump loses suction and suction cannot be regained.

NOTE: IF AT ANY TIME RESIN SHOWS UP IN THE SUCTION OR DISCHARGE OF THE DEWATERING PUMP, SECURE THE PUMP AND ISOLATE THE SYSTEM. DO NOT CONTINUE OPERATING THE SYSTEM UNDER ANY CONDITIONS. INFORM THE PLANT CHEMICAL ENGINEER OF THE CONDITION.

5. Monitor radiation of the solidification unit operating space and waste header during operation.

3. Solidification of Resins, Sludges, and Miscellaneous Media

1. When the dewatered media reaches the setpoint defined by the most recent test solidification, shut valve WS-1 and secure the dewatering pump. Inform the radwaste system operator to secure pumping and line up to flush.

2. When the radwaste system operator reports that he is ready to flush, open valve WS-1.

3. When the radiation levels on the waste transfer hose approach background, shut valve WS-1 and inform the radwaste system operator to secure flushing operations.

NOTE: IF SOLIDIFICATION IS NOT TO BE PERFORMED, PROCEED TO STEP 1.4.2.3.9.

4. Place valve SA-1 in the UF pump position.

5. Start the UF transfer pump from the control panel by slowly increasing air pressure to the speed regulator.

6. Monitor the UF flow and continue adding UF until the waste to polymer ratio defined by the most recent test solidification has been achieved. Secure UF transfer pump.

NOTE: DURING UF ADDITION, MONITOR CONTENTS OF THE LINER FOR FOAMING. IF FOAMING EXISTS, SECURE UF ADDITION AND INFO THE PLANT CHEMICAL ENGINEER OF THE PROBLEM.

7. Continue sparging for a total time of at least 1 hour and at least 15 minutes after securing UF addition.

8. After sparging the necessary time, commence catalyst addition using the following procedure.

   1. Start the catalyst transfer pump and add catalyst until a noticeable increase in the mixture's viscosit is visible in the remote TV monitor.

   2. Verify that solidification has occurred and the rolling motion of the liquid has stopped by viewing the remote TV monitor.

   3. Secure the catalyst transfer pump and open valve CT-2. After all residual catalyst has been drained to the catalyst stowage container, shut valve CT-2.

9. Secure air sparge system and secure the off-gas vent blower.

10. Secure main air selector switch.

11. Secure TV camera and monitor.

12. Following proper radiological precautions, raise the filling head away from the disposable liner and place the filling head in its stowage location.

13. Check the quality of the matrix by visual inspection and by checking for hardness.

14. Install the lid on the disposable container.

1.5 Reference Drawings (Furnished by Chem-Nuclear Systems, Inc.)

387-101 (P&ID Portable Solidification)
1-184-121 (Sparging Assembly Disposal Container)
2-387-300 Rev. B (Control Panel Layout & Interconnect Diagram Portable Solid Unit)
387-300 Rev. B (Control Panel Layout & Interconnect Diagram Portable Solid Unit)

ATTACHMENT 1

DATA SHEET PCP-1

Shipment # _____

Batch # _____

1.0 Solidification chemical test and acceptance criteria. Complete and sign below as applicable.

1.1 Urea Formaldehyde
Hydrometer test results: Specific Gravity. _____.
The acceptance criteria -- between 1.280 and 1.310.

1.2 Urea formaldehyde pH_____.
The acceptance criteria -- between 7.4 and 7.7 pH units.

1.3 Acid catalyst (sulfuric acid)
Hydrometer test results: Specific gravity _____.
acceptance criteria -- sulfuric acid $\geq$ 1.83

1.4 Acid catalyst color _____
acceptance criteria -- clear

Operator _____ Date _____

NOTE: If any acceptance criteria is out of specification, contact the plant chemical engineer for assistance.

2.0 Verify the solidification of at least one representative test sample from at least every tenth batch of each type of wet radioactive waste. Indicate below the type of waste.

Waste Type _____

3.0 Sample Collection - Refer to PCP Appendix A, Section 3.2.3, "Waste Sample Collection and Analysis"

3.1 Obtain sample (1 liter) from valve W-4 for a continous single transfer or from TI-16 sample point.

3.2 Obtain a sample (1 liter) of each transfer from valve W-4 during multi-transfers of resins.

3.3 Prepare a composite sample from multi-transfer effluents.
Refer to PCP Appendix A, Section 3.2.4, "Sample Multiple Transfers of Was

4.0 Sample Test Results and Pretreatment

4.1 Ph of Waste _____: if $<$ 3, refer to PCP Appendix A, Section 4.1.2. Then complete step 4.2 below. Otherwise, skip step 4.2.

4.2 Sample volume_____ml
Type/volume of caustic added _____ml
Resulting pH _____

4.3 Waste oil content _____%: if ≥ 1% refer to PCP Appendix A, Section 4.1.4.

4.4 Waste boron content _____ppm

4.5 Type/Volume of antifoaming agent _____ml
(refer to Appendix A, Section 3.3.7 and 4.1.3)

5.0 Test Solidification (if applicable)
Prerequisite: Steps 1.0, 2.0, 3.0, and 4.0 must be completed and proper signatures affixed to this form.

1. Volume of waste (≈ 400 ml) _____ ml
2. Volume of Urea-formaldehyde _____ml
3. Volume of Acid Catalyst _____ml
4. Total Volume _____ml
5. Waste/Urea formaldehyde ratio _____
6. Urea formaldehyde/acid catalyst ratio _____

6.0 Free-Standing Water
Refer to PCP Appendix B, Section 4.2.7

6.1 Volume of decanted water_____ml

6.2 Total Volume of sample (taken from Step 5.0.4)_____ml

6.3 Free-standing water_____%

7.0 Test Solidification Acceptability
Steps 5.0 and 6.0 must be completed.

7.1 Step 6.3 above must be less than 1%. If 6.3 is greater than 1%, refer to PCP Appendix A, Section 4.3

7.2 Visual physical appearance: Verify that the solidified waste will maintain its shape when removed from the container. If it will not, refer to PCP Appendix A, Section 4.3

Operator_____Date_____

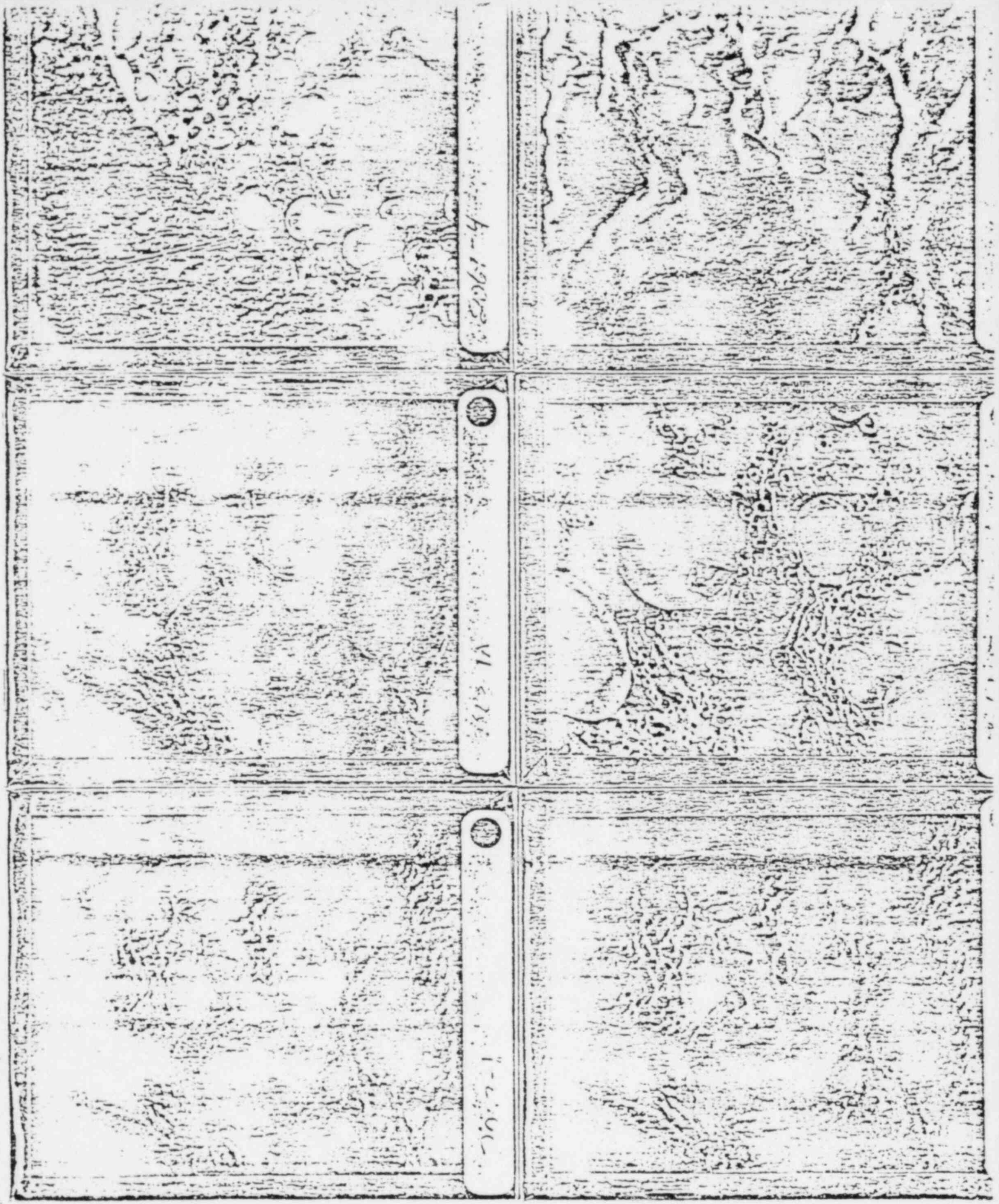
8.0 Batch Solidification

1. Waste type _____
2. Estimated volume(s) of waste transfer --------_____gal.
3. Volume of urea formaldehyde added ------_____gal.
4. Volume of acid catalyst added ----------_____gal.
5. Volume of caustic added ----------_____gal.
6. Volume of antifoaming agent added ------_____gal.
7. Level probe setpoint(s)----------_____
8. Sparging - air pressure ----------_____psi
   flowrate ----------_____scfm
   time ----------_____minutes

9.0 Verify solidification has gone to completion and there is ≤ 1 gallon of water on the surface.

_____/_____
Chemical Engineer Date


35



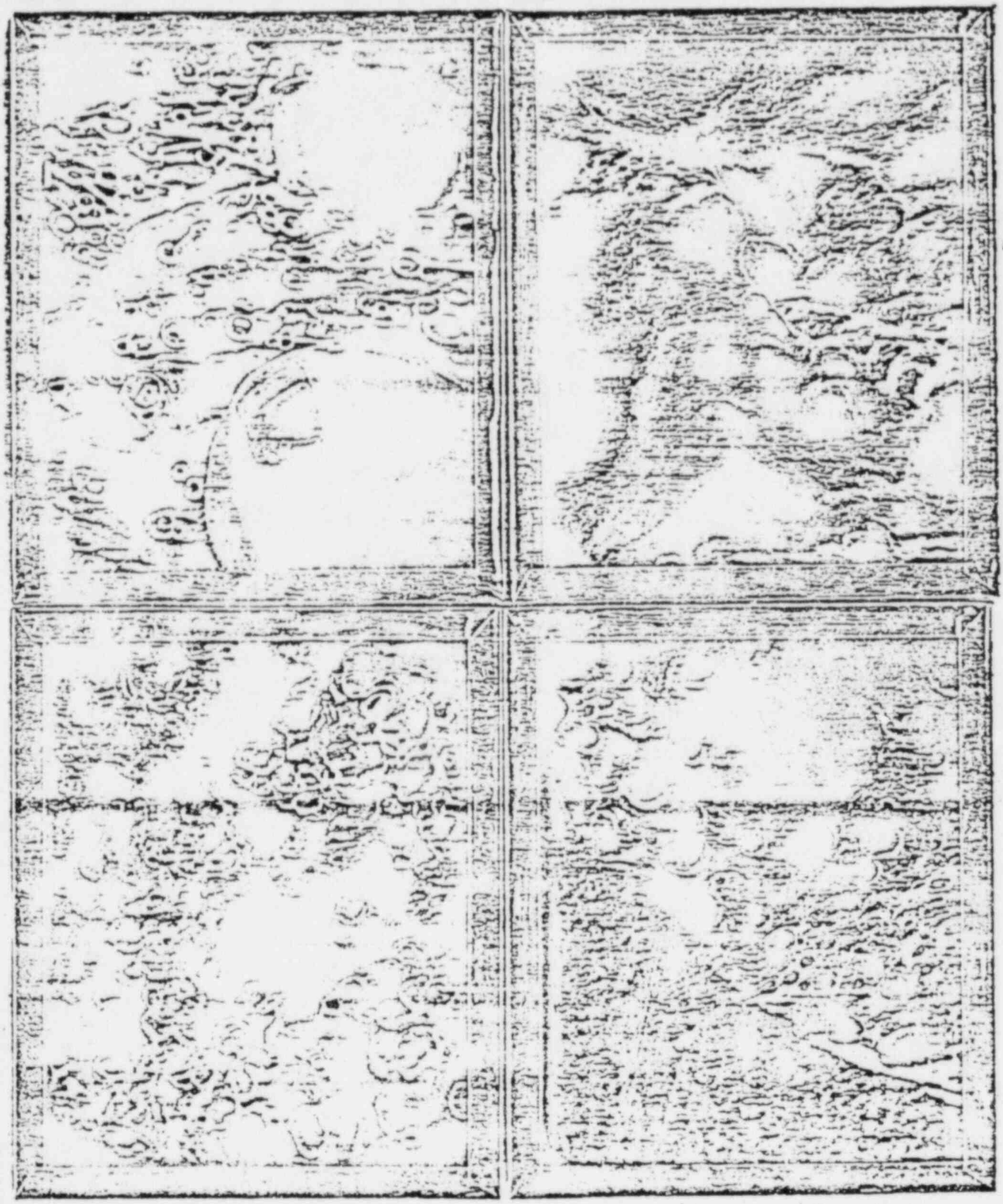


Table 1: pH Measurements by mls. of Catalyst for 200 ml. Slurries of Water/A-SET

X Ml. of 25% wt. Sodium Bisulfate	Y pH of Slurry @ 70°F.	Estimated pH
2	2.4	2.4
4	1.7	1.7
6	1.5	1.5
8	1.4	1.4
10	1.3	1.3

Equation for curvilinear fit of raw data. Shown in Figure 1.

$Y = 1.02522 + (.0415589X)$ Index of Determination = .99724

X Ml. of 3N H_2SO_4	Y pH of Slurry @ 70°F.	Estimated pH
1	2.7	2.7
2	1.9	1.9
3	1.6	1.6
4	1.4	1.5
6	1.4	1.3
10	1.2	1.2

Equation for curvilinear fit of raw data. Shown in Figure 1.

$Y = 1.05443 + (1.64827/X)$ Index of Determination = .99304

Table 2. 70° and 90°F. Gel Times by pH of Water/ A-SET Slurries Catalyzed with 25% Sodium Bisulfate

X Slurry pH @ 70°F. Using 25% wt. Sodium Bisulfate Solution	Y Gel Time @ 70°F. (mins.)	Estimated Gel Time @ 70°F.
2.4	19	19.4
1.7	11	9.3
1.5	5	5.7
1.4	4	5.0
1.3	4	3.5

Equation for curvilinear fit of raw data. Shown in Figure 2.

$Y = -15.2101 + (14.4304X)$ Index of Determination = .97226

X Slurry pH @ 70°F. Using 25% wt. Sodium Bisulfate Solution	Y Gel Time @ 90°F. (mins.)	Estimated Gel Time @ 90°F.
2.4	16	15.3
1.7	5	6.8
1.5	3	3.8
1.4	4	3.2
1.3	3	1.9

Equation for curvilinear fit of raw data. Shown in Figure 2.

$Y = -13.8506 + (12.1519X)$ Index of Determination = .94999

Table 3.
Table 3. 70° and 90°F. Gel Times by pH of Water/ A-SET Slurries Catalyzed with 3N Sulfuric Acid

X Slurry pH @ 70°F. Using 3N H_2SO_4	Y Gel Time @ 70°F. (mins.)	Estimated Gel Time @ 70°F. (mins.)
2.7	118	133.7
1.9	24	21.1
1.6	9	8.5
1.4	6	4.2
1.4	3.5	4.2
1.2	1.5	1.9

Equation for curvilinear fit of raw data. Shown in Figure 3.

$Y = .719384 (X^{5.26018})$ Index of Determination = .97931

X Slurry pH @ 90°F. Using 3N H_2SO_4	Y Gel Time @ 90°F. (mins.)	Estimated Gel Time @ 90°F. (mins.)
1.9	13	12.9
1.6	8	7.9
1.4	5	4.5
1.4	3.5	4.5
1.2	1.5	1.2

Equation for curvilinear fit of raw data. Shown in Figure 3.

$Y = -18.9786 + (16.7857X)$ Index of Determination = .98248

FIGURE 1. ML. OF SODIUM BISULPHITE SOLUTION VS. SLURRY pH

ML. OF 25% WT. SOLUTION OF SODIUM BISULPHITE PER 200 ML. SLURRY*

* SLURRY = 2 PARTS TAP WATER / 1 PART CR-2

Figure 2:
pH vs. ml. of 3% H_2SO_4
* Slurry = 2 parts tap water/part CR-2
2 ml. of 3% H_2SO_4 per 200 ml. Slurry

Figure 3. Gel Time of Slurry vs. Slurry pH
Gel Time (Hrs.)
Slurry pH
70°F Gel Temp. 25% wt. Sodium Chloride
70° Gel Temp. 3% KCl
90°F Gel 25% wt. Sodium Chloride
3% KCl
*Slurry = 2 parts water/1 part cement

ANEFCO INC. ECOPAC SYSTEM PROCEDURE FOR ON-SITE SOLIDIFICATION OF LOW-LEVEL RADIOACTIVE WASTE AT SEQUOYAH NUCLEAR PLANT

CONTRACT 80P68-161957

ANEFCO CODE B-123

This Procedure describes general operation of the ECOPAC system and the necessary interfacing with Sequoyah Nuclear Plant systems.

SCOPE:

1.0 The purpose of this procedure is to describe the general operations, precautions, and interfacing for the removal and packaging of resin and liquid radwaste from the Sequoyah Nuclear Plant (SNP).

PREREQUISITES:

2.0 All radiation protection standards will be in accordance with the Radiological Safety Policy and Program of Sequoyah Nuclear Plant, and Code of Federal Regulations, Title 10, ENERGY; Part 20, Standards for Protection Against Radiation.

2.1 All ECOPAC equipment will be checked prior to this operation by the ANEFCO field supervisor.

2.2 Radiation work permit must be completed.

PRECAUTIONS:

3.0 Traumatic safety is of primary concern throughout the entire operation.

3.1 Radiation limits established by Health Physics section and 10 CFR 20, will be monitored.

3.2 The limiting radiation factors, as applied to this procedure, are the readings on the side of the transfer vehicle. Dose rates on shielded container will be limited to DOT regulations for sole use vehicle, 200 mr/hr. contact and 10 mr/hr at six feet from truck body.

3.3 Area barriers (i.e. radiation signs) will be posted per 10 CFR

3.4 Wipe tests (i.e. smearable loose contamination) will be performed prior to work and at the finish of the job to establish that this area is within the limits as prescribed by the applicable regulation.

3.5 Waste transfer piping and hose will be blown free when transfer is completed to prevent subsequent plugging, contamination buildup within the lines, and to reduce area background radiation levels.

3.6 All ECOPAC connecting hoses will be disconnected and stored when operations are completed.

OPERATIONAL PROCEDURE (Utilize 4.0 thru 4.8 for both Resin and Boric Acid solidification)

4.0 Position cask with empty disposable liner inside auxiliary building access bay alongside the ANEFCO ECOPAC solidification system.

4.1 Attach ECOPAC loading arm to the liner 2" male dry-break connector. Verify that the ultra-sonic level detector fits properly into liner port and seal OPW quick disconnect.

4.2 Connect the loading arm acid line to the liner 1/2" male dry-break connector.

4.3 Connect the dewatering system hose to the ECOPAC system air compressor outlet.

4.4 Connect two air hoses from plant service air to the ECOPAC system.

4.5 Connect both electrical supplies to ECOPAC system. (110 VAC 60 hz; 220 VAC 3 phase, 60 hz).

4.6 Couple U-F tank to the 1 1/2" Sandpiper pump using 1" double OPW female quick-disconnect hose.

4.7 Couple U-F Sandpiper pump to ECOPAC system using 25' double OPW female quick-disconnect hose.

4.8 Attach air supply from ECOPAC system outlet to the U-F Sandpiper pump.

RESIN SOLIDIFICATION

5.0 Slide hose containment over resin-t[illegible]se prior to attaching hose to SNP discharge fi[illegible] FCV-77-400.

5.0.1 Tape hose containment to hos[illegible] three absorbant pads into the containment, then t[illegible] seal the containment to SNP pipe (refer to drawing SNP-1).

5.1 Connect the SNP resin outlet hose to the catch tank top inlet quick-disconnect and contain per drawing SNP-1.

5.2 Connect the resin catch tank discharge pump outlet (Moyno) to the ECOPAC system utilizing the 25' female quick disconnect flanged hose and contain per drawing SNP-1.

5.3 Connect the resin catch tank well point to the dewatering pump and contain per drawing SNP-1.

5.4 Attach dewatering pump discharge hose to SNP valve number FCV-77-

5.5 ANEFCO will indicate when one complete ~~gallon~~ batch of resin can be pumped by SNP to the catch tank.

5.6 SNP should flush/clear resin hose prior to step 5,7 to lower the dose rate as low as reasonably achievable.

5.7 Supply 110 vac to the dewatering pump and dewater resin through SNP valve #FCV-77-401 Water recovered by dewatering system from catch tank will be pumped to SNP receiving line.

5.8 Supply 220 vac, 3 phase 60 hz. to resin forwarding Moyno pump from ECOPAC system.

5.9 Connect air sparge hose from ECOPAC system to resin catch tank and sparge for a minimum of 30 minutes prior to transfer for solidification.

5.10 ANEFCO personnel to solidify the dewatered resin according to the ANEFCO ECOPAC process control plan. When resin solidification is completed, disconnect the SNP resin outlet hose to the catch tank top inlet and contain per drawing SNP-1. Store hose in assigned location.

5.11 Disconnect the catch tank discharge pump (Moyno) outlet hose to the ECOPAC system and contain per drawing SNP-1. Store hose in proper location.

5.12 Disconnect loading arm waste dry-break connector, acid dry-break connector, and ultra-sonic level detector. Contain opening with safety drip bags.

5.13 Health Physics Technician will monitor radiation levels and condition of solidified waste in the liners.

5.14 Seal full liners. Paint one liner cap with temporary sealed cap for indentification at burial site for subsequent inspection. Seal other liner caps with lock-cement (permanent).

5.15 Seal cask cover.

BORIC ACID/EVAPORATOR BOTTOMS (Liquid Wastes)

6.0 Slide hose containment over boric acid-transfer hose prior to attaching hose to SNP discharge line number

6.1 Tape hose containment to hose, add (3) three absorbant pads into the containment then tape and seal the containment to SNP pipe (refer to drawing SNP-1).

6.2 Connect the boric acid transfer hose to the ECOPAC system waste inlet and contain per drawing SNP-1.

6.3 ANEFCO will notify SNP when ECOPAC system is ready to receive liquid wastes.

6.4 SNP to open valve number FCV-77-402 for transfer of waste to ECOPAC system.

6.5 ANEFCO personnel will solidify the liquid wastes according to the ANEFCO ECOPAC Process Control ~~Plan~~. Program.

6.6 ANEFCO will verbally notify SNP upon receipt of one complete batch of boric acid so that SNP can terminate pumping waste by closing valve number FCV-77-402.

6.7 After notifying SNP operator, ANEFCO will flush ECOPAC system using SNP demin water ~~to~~ through SNP valve number FCV-77-402.

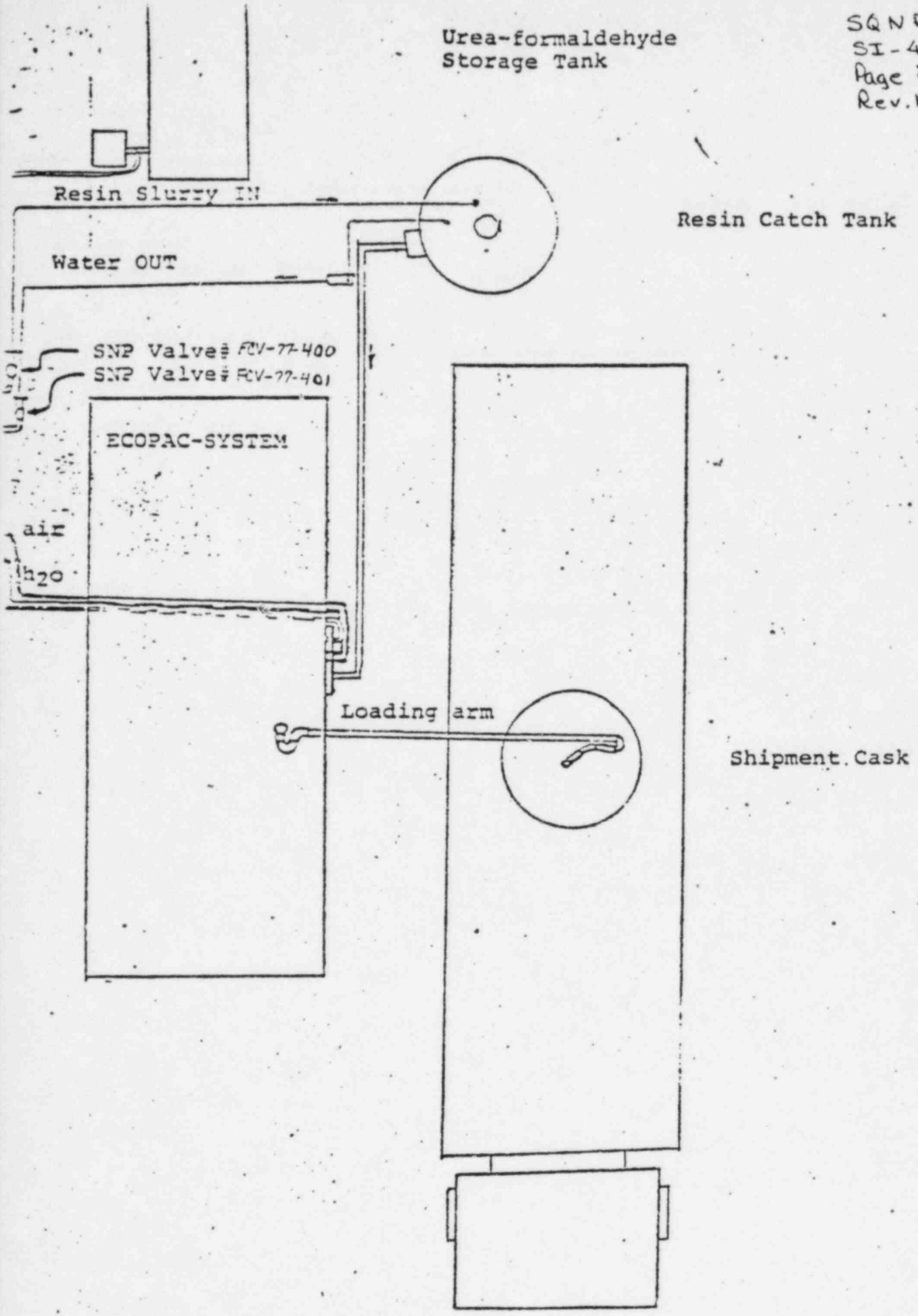
6.8 Disconnect the boric acid transfer hose from both the ECOPAC waste inlet and the SNP discharge line valve number FCV-77-402 using the containment method illustrated in drawing SNP-1. Store hoses in proper location.

6.9 Disconnect loading arm waste dry-break connector, acid dry-break connector, and ultra-sonic level detector. Contain openings with safety drip bags.

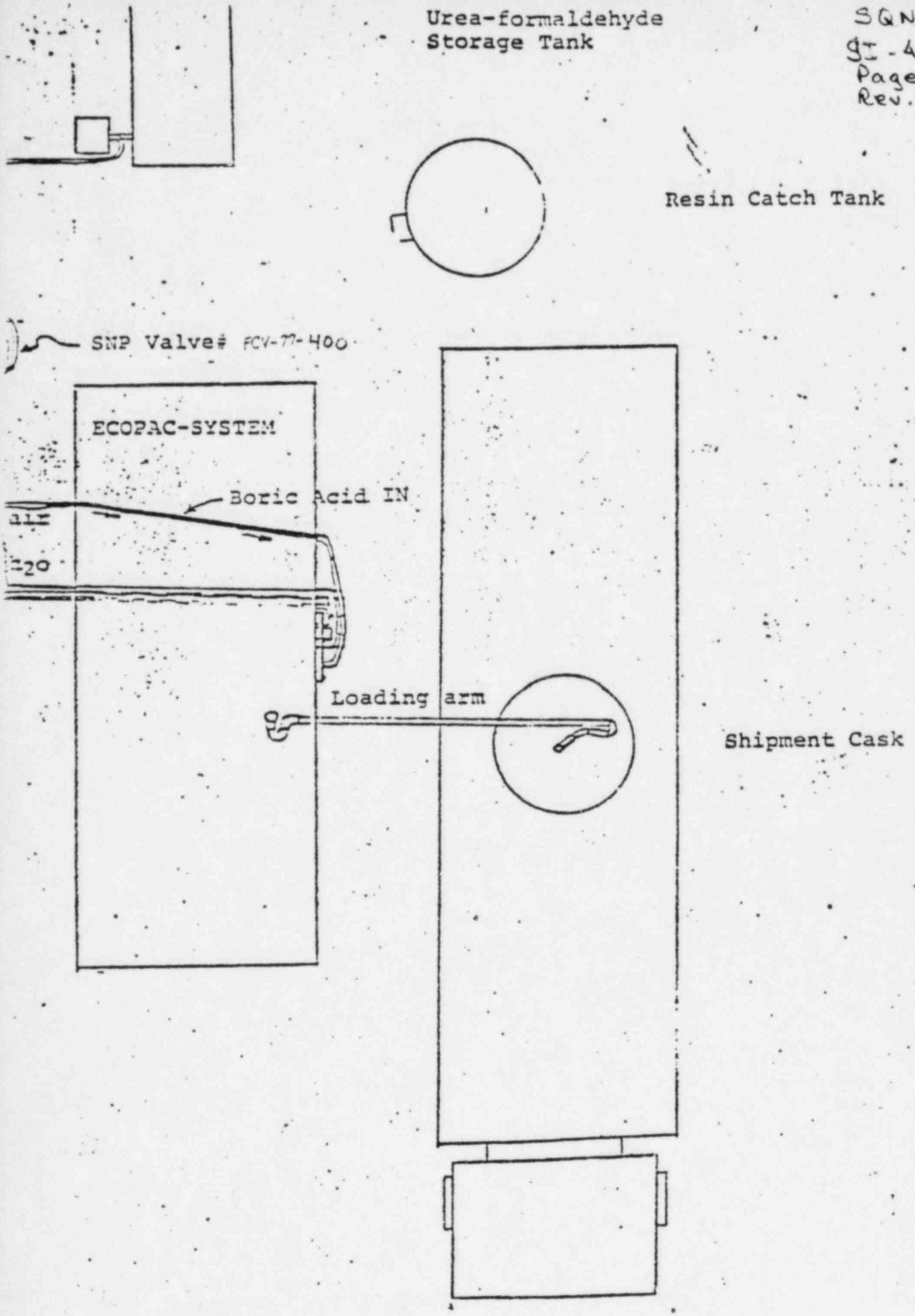
6.10 Health Physics technicians will monitor radiation levels.

6.11 Seal full liners. Paint one liner cap with temporary seal for identification at the burial site for subsequent inspection. Seal other liner caps with lock-cement (permanent).

6.12 Seal cask cover.

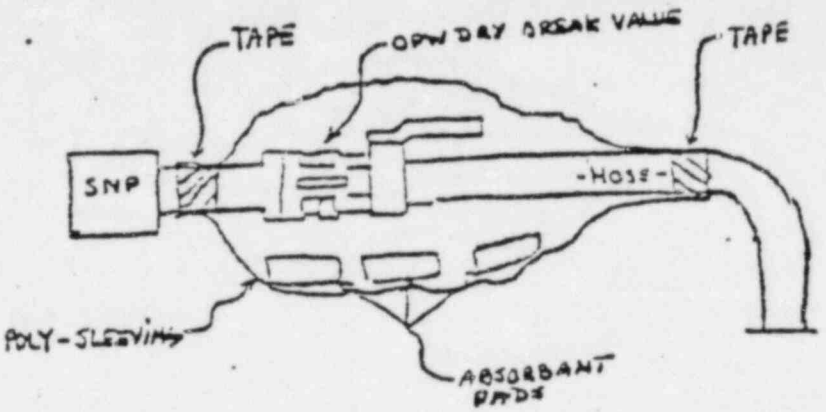


RESIN SOLIDIFICATION SCHEMATIC



BORIC ACID SOLIDIFICATION SCHEMATIC

(1)



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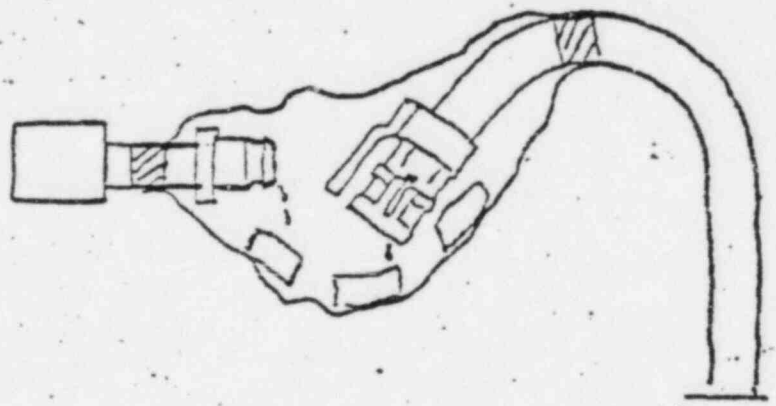

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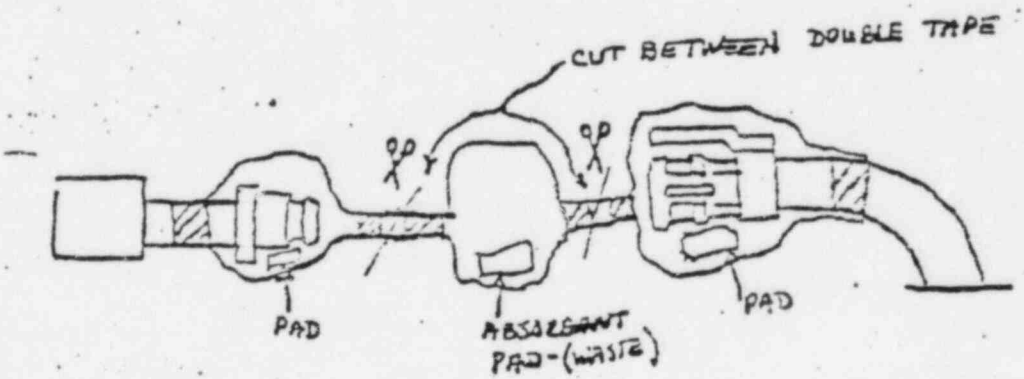

DRAWING SNP-1

(Hose Coupling Containment)

EXPERIMENTAL SIMULATIONS OF RADIOACTIVE WASTE AND A-SET RESIN* FORMULATIONS

Experimental formulations for the solidification of selected simulated wastes with A-Set Resin has been determined. These formulations, [redacted], attempt to incorporate a relatively maximum quantity of waste while consistently producing a solidified product. Solidified products were obtained for all waste types tested although some difficulties were encountered at high waste to solidification agent ratios for sulfate wastes to UF. The addition of sufficient acid catalyst[1] to waste-UF mixtures to achieve a pH of 1.5± 0.5 was found to produce a more rapid and consistent polymerization and also permit a higher waste to UF ratio for most wastes. Care should be exercised to assume that a thorough homogeneous blend is achieved. Mixing equipment must be kept free from foreign matter and cured adhesive build-up.

The free standing water in simulated wastes solidified with UF was measured and found to vary from zero to 25.4 wt.%. Adjustment of the waste to UF mixture pH to 1.5± 0.5 by the addition of sufficient acid catalyst resulted in a significant reduction in the quantity of free standing water. The free standing water was found to have a pH approximating that of the water to UF mixture after addition of the catalyst.

The polymerization reaction is acid catalyzed and is both temperature and pH dependent. Low waste to UF mixture pH and high ambient temperature decrease the time required for solidification. A pH of 1.5± 0.5 in the waste-UF mixture is desirable; however, the amount of catalyst needed must be determined for each type of waste. Such mixtures will begin to gel in several minutes and are generally well solidified within thirty minutes. Dilute solutions of strong acids maybe used to adjust the pH of highly buffered waste-UF mixtures. The use of strong acid solutions must be done with care to avoid premature gelling of the mixture.

Concentrated soduim sulfate wastes may cause erratic setting in UF. Additions of less than ten weight percent sodium sulfate or small amounts of calcium chloride are reported to eliminate this problem. The addition of 2 wt.% calcium chloride to UF containing sodium

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[1] Heacock, H.W. and Riches, J.W., Waste Solidification-Cement or Ureaformaldehyde, American Society of Mechanical Engineers, 74-WA/NE-9, 1974.

*Registered Trademark

sulfate wastes was found to increase the permissible waste/A-set Resin ratio.. The addition of sufficient catalyst to produce a pH of 1.5± 0.5 in the waste-UF mixture allows an increase in the waste/UF ratio for most wastes.

TABLE 1

Simulated Waste Types Included in the Experimental Program

1. Bead Resin Waste

2. BWR Precoat Filter Cake

    a. Powdered Resin
    b. Diatomaceous Earth

3. Forced Recirculation Evaporator Concentrates

    a. BWR Chemical Regenerative Waste
    b. PWR Chemical Regenerative Waste
    c. Boric Acid Waste
    d. Decontamination Waste

4. Thin Film Evaporator Concentrates

    a. BWR Chemical Regenerative Waste
    b. PWR Chemical Regenerative Waste
    c. Boric Acid Waste
    d. Decontamination Waste

TABLE 2

Simulated Waste Formulations

1. BEAD RESIN WASTE

Material	Weight Percent, %
Water	50.
Bead Resin (IRN-150)[a]	50.
Temperature	70°F
pH	7

2a. BWR PRECOAT FILTER CAKE (WITH POWDERED RESIN)

Material	Weight Percent in Filter Cake, %
Water	50.
Anion Powdered Resin (PAO)[b]	20.
Cation Powdered Resin (PCH)[b]	20.
Crud[c]	5.
Sodium Chloride	5.
Temperature	70°F
pH	7

2b. BWR PRECOAT FILTER CAKE (WITH DIATOMACEOUS EARTH)

Material	Weight Percent in Filter Cake, %
Water	50.
Diatomaceous Earth	40.
Crud[c]	10.
Temperature	70°F
pH	7

3a. BWR CHEMICAL REGENERATIVE WASTE OF A FORCED RECIRCULATION EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	75.
Sodium Sulfate	22.9
Sodium Chloride	2.0
Crud[c]	0.1
Temperature	170°F
pH	6

3b. PWR CHEMICAL REGENERATIVE WASTE OF A FORCED RECIRCULATION EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	73.4
Sodium Sulfate	14.9
Ammonium Sulfate	9.6
Sodium Chloride	2.0
Crud[c]	0.1
Temperature	170°F
pH	2.5 to 4.0

3c. BORIC ACID WASTE OF A FORCED RECIRCULATION EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	87.9
Boric Acid	12.0
Crud[c]	0.1
Temperature	170°F
pH	3.5

3d. DECONTAMINATION WASTE OF A FORCED RECIRCULATION EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	80.
NUTEK-700[d]	9.4
EDTA	5.
Citric Acid	5.
Crud[c]	0.2
Hydraulic Oil No. 2	0.2
Lubricating Oil No. 20	0.2
Temperature	170°F
pH	5

4a. BWR CHEMICAL REGENERATIVE WASTE OF A THIN FILM EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	50.
Sodium Sulfate	45.8
Sodium Chloride	4.0
Crud[c]	0.2
Temperature	150 to 250°F
pH	6

4b. PWR CHEMICAL REGENERATIVE WASTE OF A THIN FILM EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	50.
Sodium Sulfate	29.
Ammonium Sulfate	16.8
Sodium Chloride	4.0
Crud[c]	0.2
Temperature	150 to 250°F
pH	1.8 to 4.0

4c. BORIC ACID WASTE OF A THIN FILM EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	50.
Boric Acid	49.8
Crud[c]	0.2
Temperature	150 to 250°F
pH	2.5 to 3.5

4d. DECONTAMINATION WASTE OF A THIN FILM EVAPORATOR

Material	Weight Percent in Evaporator Bottoms, %
Water	50.
NUTEK-700[d]	20.
EDTA	9.8
Citric Acid	19.
Crud[c]	0.2
Hydraulic Oil No. 2	0.5
Lubricating Oil No. 20	0.5
Temperature	150 to 250°F
pH	5

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[a] Rohm and Haas Co., Philadelphia, Pa. 19105
[b] Ecodyne Corp., Union, N.J. 07083
[c] fine air cleaner test dust no. 1543094, AC Spark Plug Division, General Motors Corp., Flint, Michigan 48556
[d] compound for the dissolution of calcium sulfate scale, Nuclear Technology Corp., Anston, Conn. 06231

TABLE 4

Formulations for the Solidification of BWR and PWR Wastes Using A-Set Resin. 25 Wt.% Sodium Bisulfate (Anhydrous) Aqueous Catalyst Solution Added to 2.0 Volume % of the Waste-UF Mixture

Waste Type	Weight Ratio Waste to A-Set	Approximate Solidification Time	Comments
1. Bead Resin	2.2	15 minutes	
2. BWR Precoat Filter Cake			
a. Powdered Resin	2.0	15 minutes	
b. Diatomaceous Earth	2.0	30 minutes	
3. Forced Recirculation Evaporator Concentrates			
a. BWR Chemical Regenerative Waste	1.2	25 minutes	
b. PWR Chemical Regenerative Waste	1.2	20 minutes	
c. Boric Acid Waste	1.0	15 minutes	
d. Decontamination Waste	1.1	6 hours	
4. Thin Film Evaporator Concentrates			
a. BWR Chemical	1.0	30 minutes	
Regenerative Waste	1.2	30 minutes	2 wt.% $CaCl_2$ added
b. PWR Chemical	0.7	30 minutes	
Regenerative Waste	1.5	30 minutes	2 wt.% $CaCl_2$ added
c. Boric Acid Waste	1.0	30 minutes	
d. Decontamination Waste	1.5	4 hours	

TABLE 5

Formulations for the Solidification of BWR and PWR Wastes Using A-Set Resin. Sufficient 25 Wt.% Sodium Bisulfate (Anhydrous) Aqueous Catalyst Solution Added to Achieve pH = 1.5±0.5 in the Waste-UF Mixture

Waste Type	Weight Ratio Waste to UF	Approximate Solidification Time	Volume % $NaHSO_4$ Solution Added
1. Bead Resin	2.2	15 minutes	1.8
2. BWR Precoat Filter Cake			
a. Powdered Resin	2.0	15 minutes	1.9
b. Diatomaceous Earth	2.0	15 minutes	3.0
3. Forced Recirculation Evaporator Concentrates			
a. BWR Chemical Regenerative Waste	1.3	15 minutes	3.1
b. PWR Chemical Regenerative Waste	1.3	15 minutes	2.9
c. Boric Acid Waste	1.2	10 minutes	0.8
d. Decontamination Waste	1.2	30 minutes	10.5
4. Thin Film Evaporator Concentrates			
a. BWR Chemical Regenerative Waste	1.5	20 minutes	1.5
b. PWR Chemical Regenerative Waste	1.0	20 minutes	1.7
c. Boric Acid Waste	1.2	20 minutes	1.4
d. Decontamination Waste	1.5	30 minutes	13.3

Data and Discussion: Tables 1 through 3 as described below show the raw data obtained in these catalyst studies of A-Set Resin 2 as well as their conversion to a curvilinear fit in graphing.

Table 1: pH Measurements by mls. of Catalyst for 200 ml. Slurries of Water/CASCO-RESIN 2

Table 2: 70° and 90°F. Gel Times by pH of Water/A-Set Resin 2 Slurries Catalyzed with 25% Sodium Bisulfate

Table 3: 70° and 90°F. Gel Times by pH of Water/A-Set Resin 2 Slurries Catalyzed with 3N Sulfuric Acid

Figures 1 through 3 attached are graphical portrayals of Tables 1 through 3 and need no further description.

Table 1: pH Measurements by mls. of Catalyst for 200 ml. Slurries of Water/A-Set Resin 2

X Ml. of 25% wt. Sodium Bisulfate	Y pH of Slurry @ 70°F.	Estimated pH
2	2.4	2.4
4	1.7	1.7
6	1.5	1.5
8	1.4	1.4
10	1.3	1.3

Equation for curvilinear fit of raw data. Shown in Figure 1.

$Y = 1.02522 + (.0415589X)$ Index of Determination = .99724

X Ml. of 3N H_2SO_4	Y pH of Slurry @ 70°F.	Estimated pH
1	2.7	2.7
2	1.9	1.9
3	1.6	1.6
4	1.4	1.5
6	1.4	1.3
10	1.2	1.2

Equation for curvilinear fit of raw data. Shown in Figure 1.

$Y = 1.05443 + (1.64827/X)$ Index of Determination = .99304

Table 2. 70° and 90°F. Gel Times by pH of Water/A-Set Resin 2 Slurries Catalyzed with 25% Sodium Bisulfate

X Slurry pH @ 70°F. Using 25% wt. Sodium Bisulfate Solution	Y Gel Time @ 70°F. (mins.)	Estimated Gel Time @ 70°F.
2.4	19	19.4
1.7	11	9.3
1.5	5	5.7
1.4	4	5.0
1.3	4	3.5

Equation for curvilinear fit of raw data. Shown in Figure 2.

$Y = -15.2101 + (14.4304X)$ Index of Determination = .97226

X Slurry pH @ 70°F. Using 25% wt. Sodium Bisulfate Solution	Y Gel Time @ 90°F. (mins.)	Estimated Gel Time @ 90°F.
2.4	16	15.3
1.7	5	6.8
1.5	3	3.8
1.4	4	3.2
1.3	3	1.9

Equation for curvilinear fit of raw data. Shown in Figure 2.

$Y = -13.8506 + (12.1519X)$ Index of Determination = .94999

Mil. of Sodium Bicarbonate Solution of 25% wt. per 2000 Sq. Ft. Surface
Mil. of Sodium Bicarbonate Solution per 2000 Sq. Ft. Surface
+ Slurry = 2 parts TAP Water/1 part CO2
0
2
4
6
8
10
15
20

FIGURE 1

Figure 2. ML. of 3 Normal H_2SO_4 vs. Slurry* pH

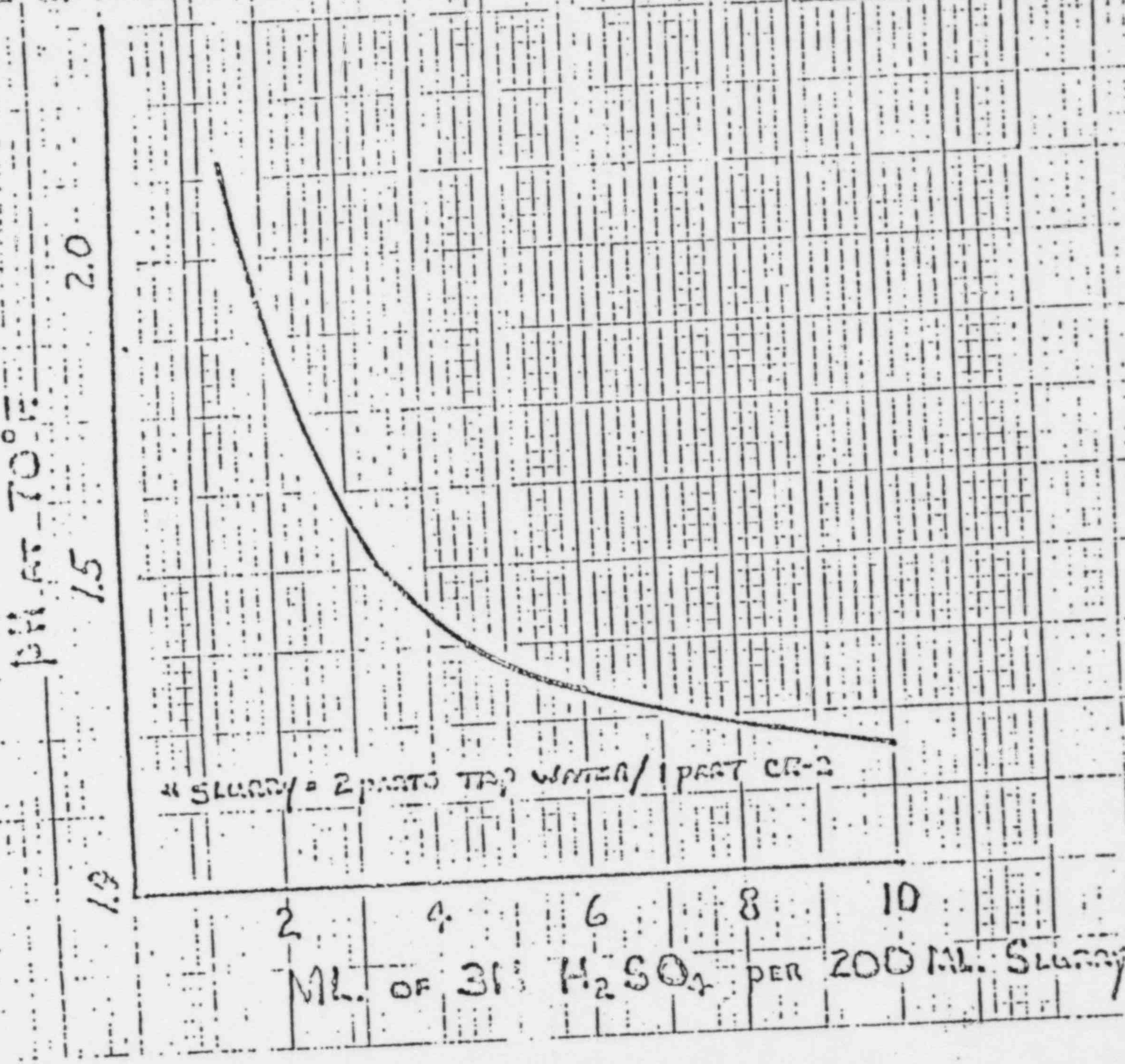
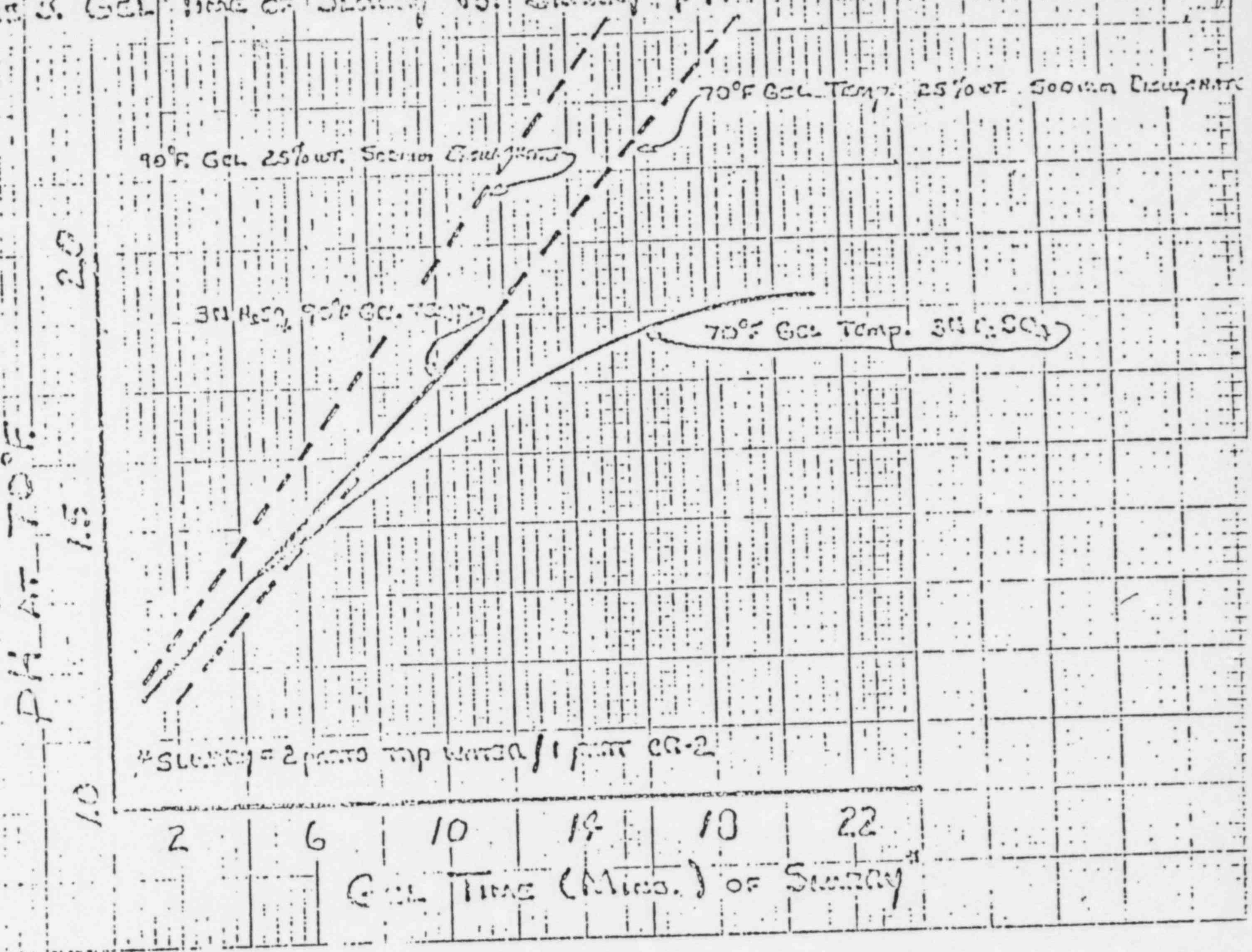


Figure 3. Gel Time of Slurry* vs. Slurry pH



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VII. APPENDIX

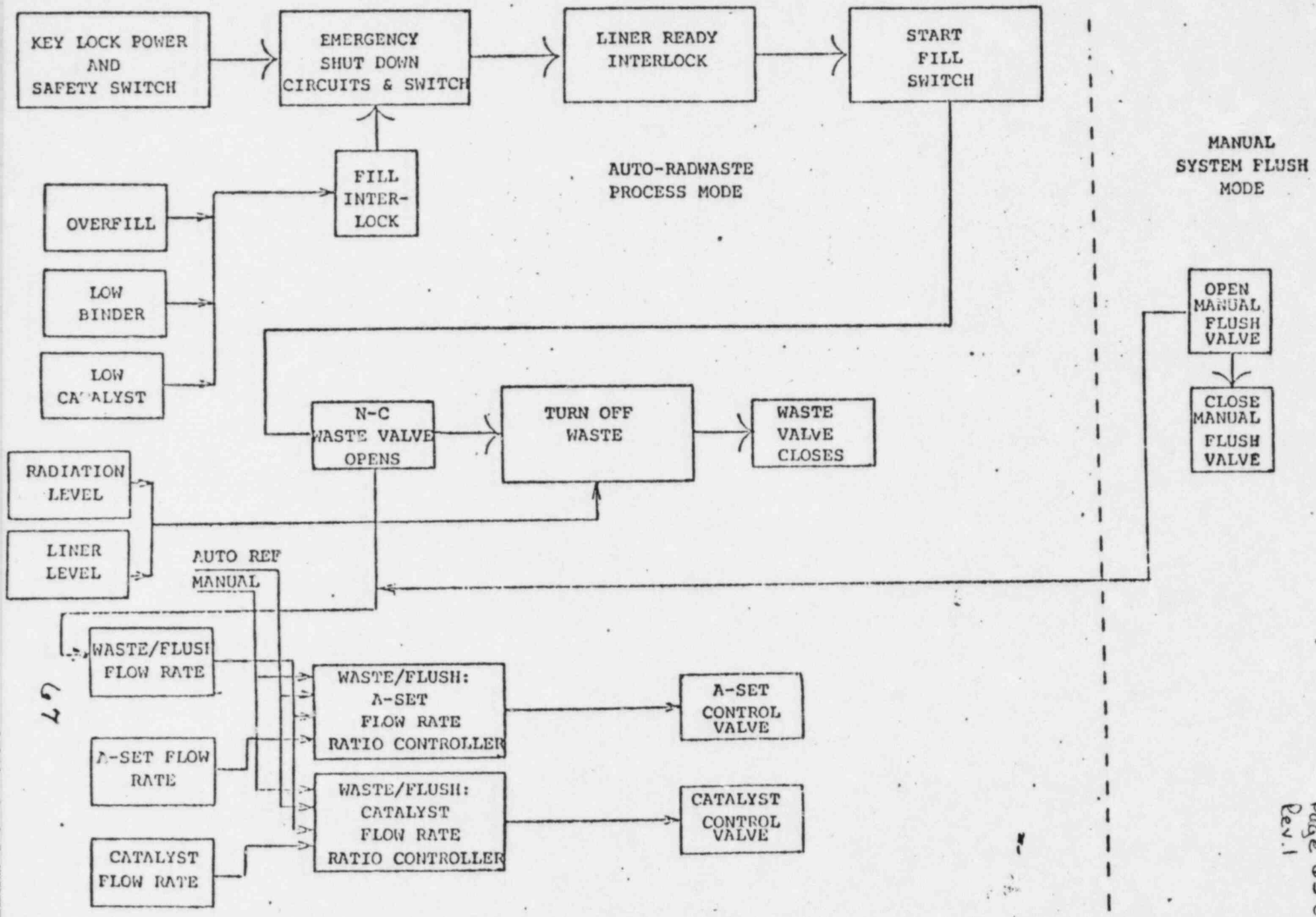
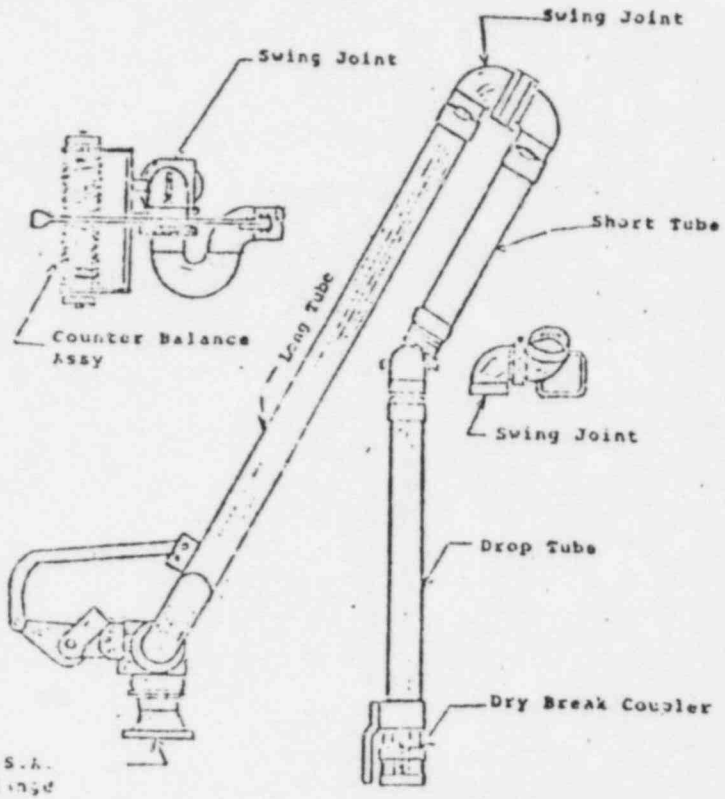


Figure 2.1 System Control Schematic



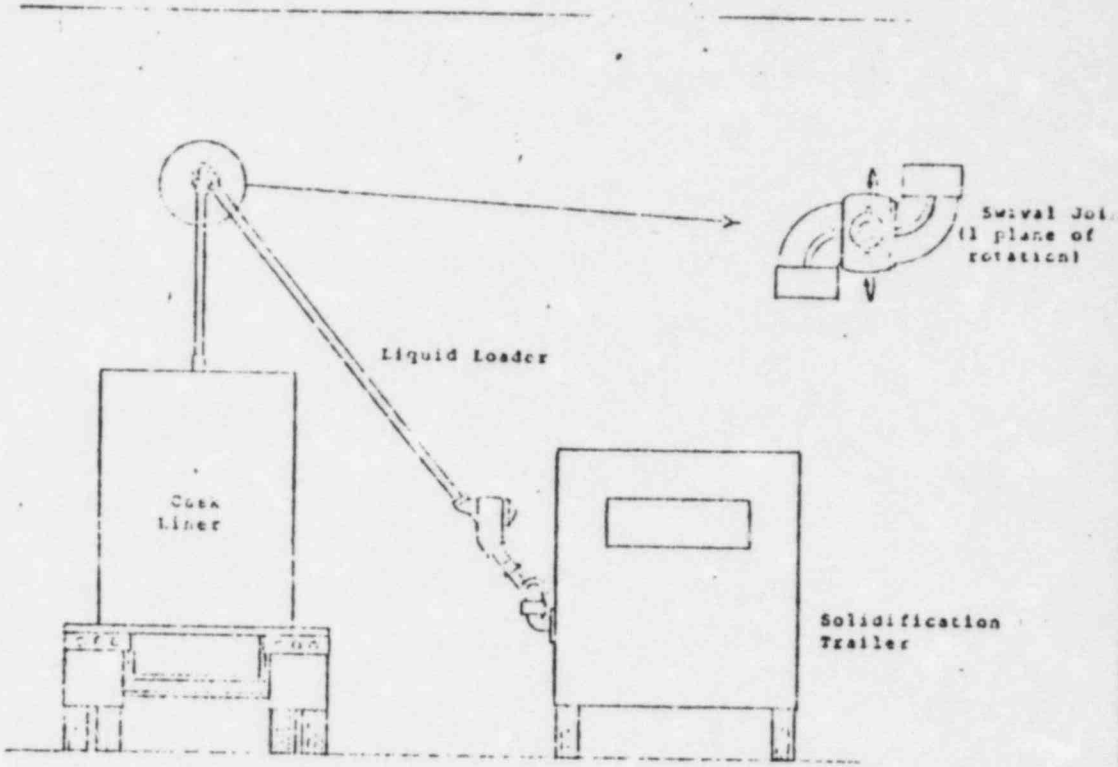


Figure 2.2 Waste Loader

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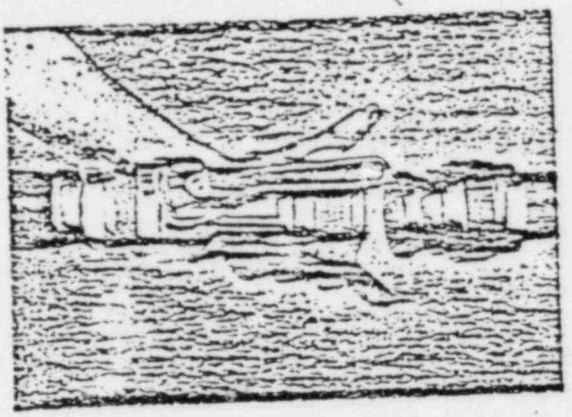
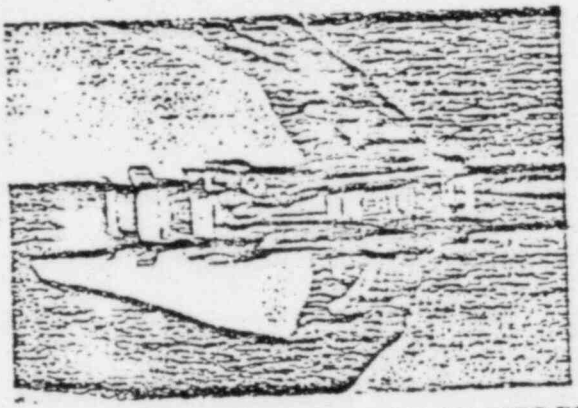
Figure 2.3 Dry Disconnect Coupler

operation:

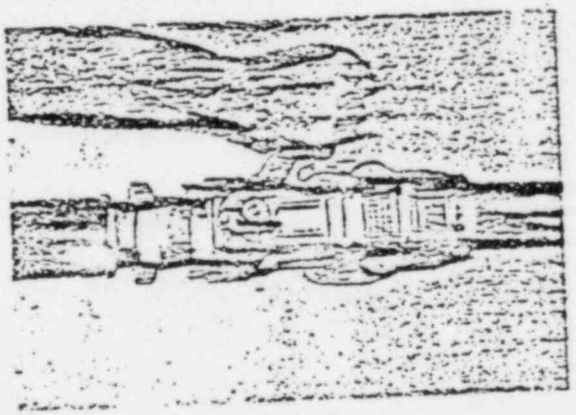
IT ONLY TAKES 4 SECONDS TO START FLOW.



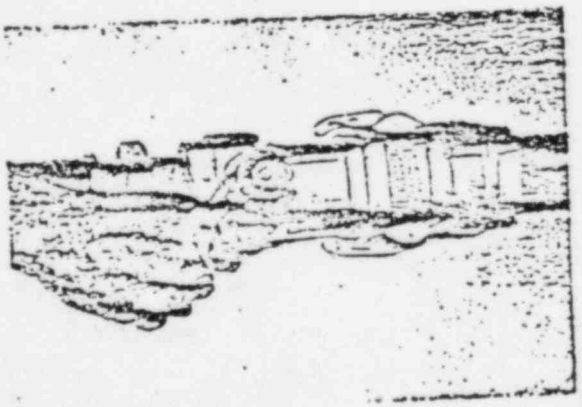
1. COUPLE IN ANY POSITION



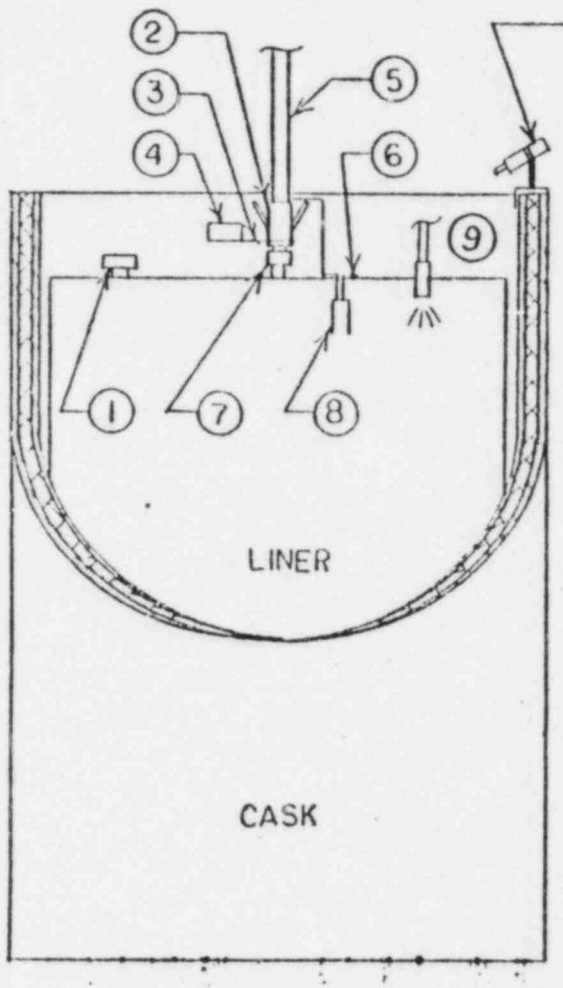
2. CAM ARMS LOCK COUPLER AND ADAPTOR TOGETHER



3. LEVER OPENS VALVE



4. FULL FLOW STARTS



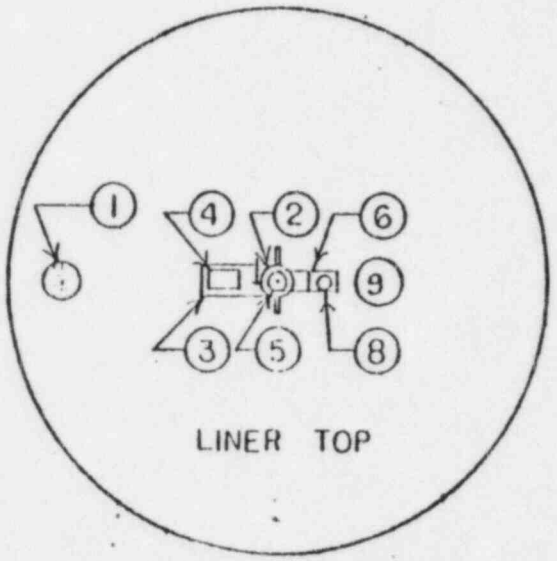


Figure 2.4

ECOPAC SOLIDIFICATION LINER DIAGRAM

(1) Exhaust Vent HEPA Filter
(2) Dry Break Manifold
(3) R.A.M. Support Bracket
(4) Remote Area Monitor
(5) Waste Loader Drop Tube
(6) Liquid Level Probe L Bracket Support
(7) Liner Dry Brake Coupling
(8) Liquid Level Probe and Limit Switch
(9) Acid Catalyst Coupling

11-7-79

KEW

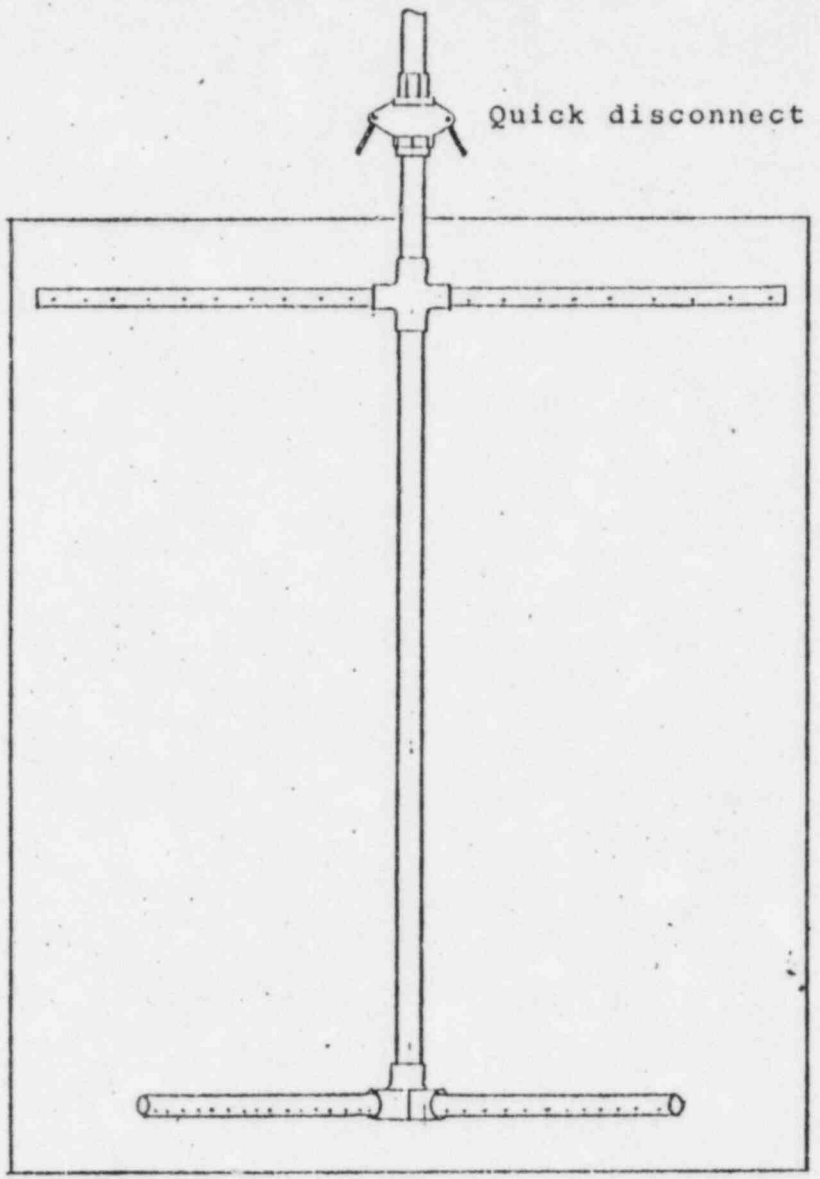


Figure 2.5 Dewatering System

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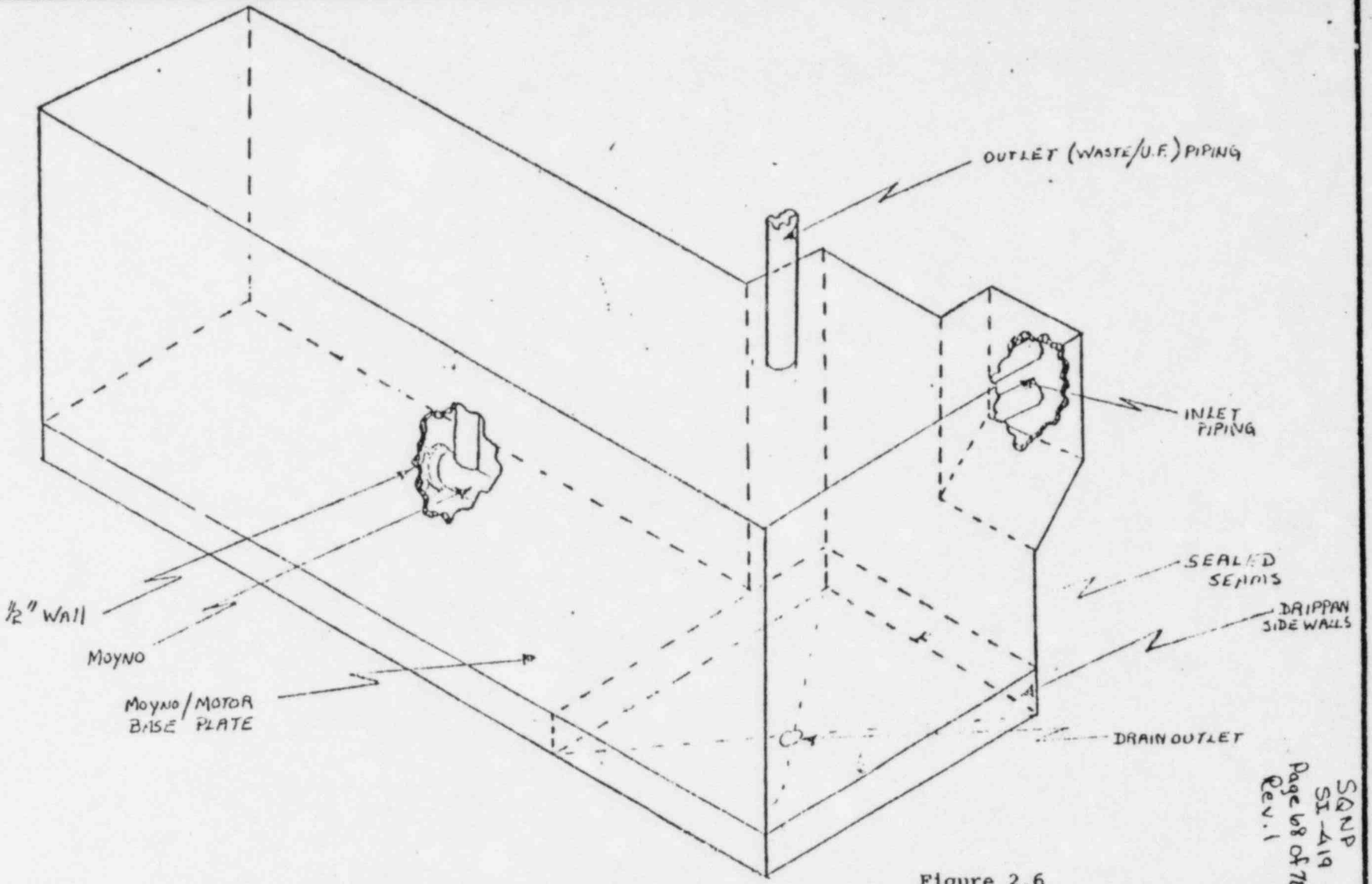

Figure 2.6

ANEFCO INC.
222 MAMARONECK AVE.
WHITE PLAINS, N.Y. 10605

DATE 4-9-80	DRAWN BY JDMJR	APPROVED BY
SCALE NONE DRAWING SIZE	REVISED	

RENDITION - CONTAINMENT AND SHIELDING
ENCLOSURE - PIPING & PUMP

ECOPAC II

DRAWING NUMBER 15169-02

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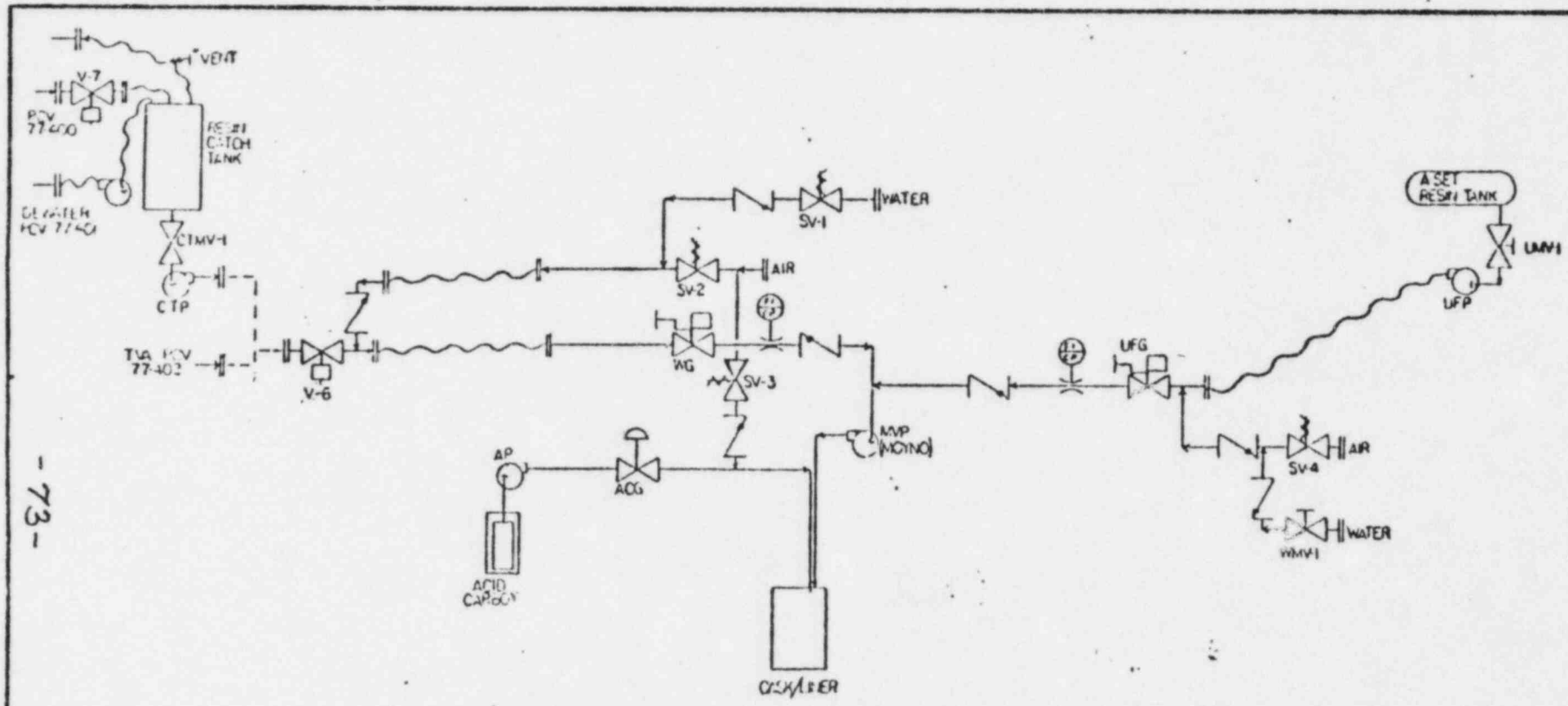

KEY

- SOLENOID VALVE
- GATE VALVE
- AIR OPERATED MANUAL ORIFICE
- DIAPHRAGM VALVE
- SAMPLE VALVE
- FLOW INDICATOR CONTROL PANEL
- PUMP
- CHECK VALVE

PROPRIETARY

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Figure 2.7

ECOPAC II FLOW DIAGRAM		
DATE 3-20-80	DRAWN BY DM	APPROVED BY
SCALE N/A	REVISED 5-10-80	
ANEFCO INC. 222 MAMARONECK AVE WHITE PLAINS, N.Y. 10605		
		DRAWING NUMBER B123-07

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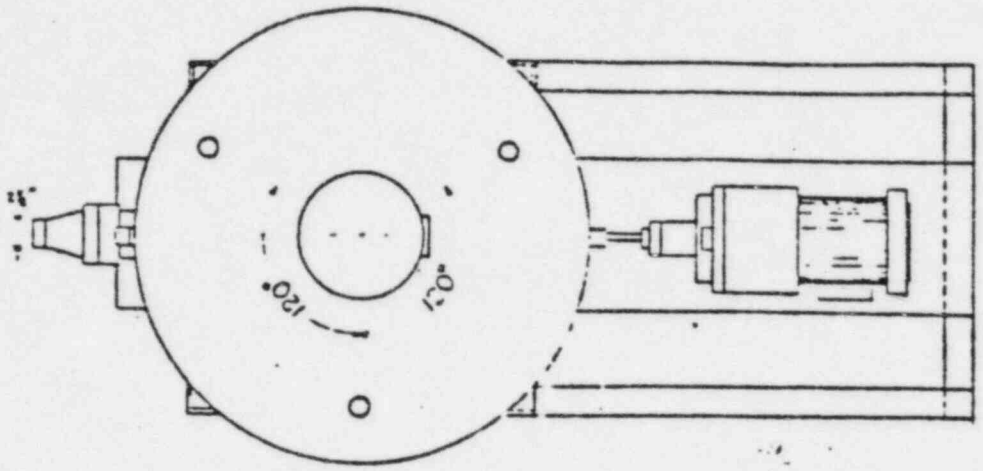

Figure 2.8 - Resin Catch Tank