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18. K. S. Witwer <i>[Signature]</i> 5/20/93 Signature of EDT Originator		19. W. W. Rutherford <i>[Signature]</i> Authorized Representative Date for Receiving Organization		20. M. J. Schliebe <i>[Signature]</i> 5/24/93 Design Authority/ Cognizant Manager		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	
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ORGANIC ION EXCHANGE RESIN SEPARATION METHODS EVALUATION

Keith S. Witwer

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Abstract: This document describes testing to find effective methods to separate Organic Ion Exchange Resin (OIER) from a sludge simulant. This task supports a comprehensive strategy for treatment and processing of K-Basin sludge. The simulant to be used resembles sludge that has accumulated in the 105KE and 105KW Basins in the 100K area of the Hanford Site. The sludge is an accumulation of fuel element corrosion products, organic and inorganic ion exchange materials, canister gasket materials, iron and aluminum corrosion products, sand, dirt, and other minor amounts of organic matter.

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ORGANIC ION EXCHANGE RESIN SEPARATION METHODS EVALUATION

HNF-2729

Rev. 0

May 19, 1998

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TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	4
2.0 OBJECTIVE	4
3.0 SCOPE	4
4.0 TEST DESCRIPTION	5
4.1 Stage 1 Testing	5
4.1.1 Solids Flotation	5
4.1.2 Hydro Cyclone	6
4.2 Stage 2 Testing	8
4.3 Test Parameters	8
4.4 Acceptance Criteria	9
4.4.1 Qualitative Analysis	9
4.4.2 Quantitative Analysis	9
4.5 Sludge Simulant	9
4.6 Test Environment	10
4.7 Test Equipment	10
4.8 Data	10
5.0 EXPECTED RESULTS	10
6.0 SAFETY	10
7.0 QUALITY ASSURANCE	11
8.0 ORGANIZATIONAL RESPONSIBILITIES	11
9.0 SCHEDULE	11
10.0 REFERENCES	12
APPENDIX A: SLUDGE SIMULANT SELECTION BASIS	13
APPENDIX B: TESTING SCHEDULE	22

LIST OF FIGURES

Figure 1:	Sketches of Solids Flotation Methods	6
Figure 2:	Hydro Cyclone with main flow pattern	7

ORGANIC ION EXCHANGE RESIN SEPARATION METHODS EVALUATION

1.0 INTRODUCTION

This document describes testing to find effective methods to separate Organic Ion Exchange Resin (OIER) from a sludge simulant. This task supports a comprehensive strategy (Flament 1998) for treatment and processing of K Basin sludge. The simulant to be used, described in Appendix A, resembles sludge that has accumulated in the 105KE and 105KW Basins in the 100K area of the Hanford Site. The sludge is an accumulation of fuel element corrosion products, organic and inorganic ion exchange materials, canister gasket materials, iron and aluminum corrosion products, sand, dirt and other minor amounts of organic matter.

Final process treatment will involve separation of the sludge from any solid material by passing through a ¼ inch mesh screen. This will be followed by chemical treatment before being stored in tank AW-105 at the Hanford Tank Farms. Undesirable chemical reactions occur with the OIER when the sludge is chemically processed (with nitric acid) however. Thus, the majority of the OIER needs to be removed from the sludge prior to chemical processing while also minimizing the amount of sludge entrained with the separated OIER. The resin can then be separately treated and disposed of as appropriate.

2.0 OBJECTIVE

The objective is two-staged. The first stage is to separate OIER from a standard sludge simulant via bench testing of several separation technologies. Separating the OIER from the sludge could be difficult due to the size/density distribution of particles in the sludge. The OIER is relatively large but low in density compared to the other smaller but heavy particles such as the sand.

The second stage will involve more detailed proof-of-principle testing using variations on the standard sludge simulant. Results from this testing will feed later validation "hot testing" using actual K-Basin sludge mixtures.

3.0 SCOPE

This testing is directed by Numatec Hanford Corporation (NHC) Sludge Treatment Project (STP) per NHC Internal Memo (Rutherford 1998) and will be done by the NHC Engineering Testing Laboratory (ETL) under Task Package Control Number LD453. It follows the testing strategy outlined in HNF-2574, "Testing Strategy to Support the Development of K Basins

Sludge Treatment Process," - specifically section 4.1. The testing is primarily of a bench scale nature and will use only non-radioactive components.

4.0 TEST DESCRIPTION

As mentioned previously, the testing will be broken into two parts or stages. Stage 1 will involve general scoping tests of several separation methods. This will involve using a baseline simulant recipe that will be used for each separation method. Results from each method will be compared against the acceptance criteria (described in section 4.4) with follow-on Stage 2 testing focusing on refinement of operating parameters. This will involve more extensive testing with the chosen separation methods, possibly altering parameters such as the sand/OIER ratio, simulant flow rates through the device, etc.

4.1 Stage 1 Testing

Many methods for solid separation are commercially available. Of these, only a few are considered appropriate and/or are readily available for this testing given the cost and schedule constraints. These selected methods are:

- Solids Flotation
- Hydro Cyclone

Other methods, such as Lamella tube settling and screen filtration may be investigated if time permits and should be included in an engineering study for further consideration.

Brief functional descriptions of the selected methods are given below:

4.1.1 Solids Flotation

Flotation techniques take advantage of the variation in solids settling characteristics to achieve separation of particles and result in classification of particles fundamentally based on their physical properties. Three different flotation approaches will be evaluated:

- 1) Air Lift
- 2) Elutriation
- 3) Agitated Slurry

Each technique uses a different mechanism to achieve solids separation. Refer to Figure 1 for a sketch of each process. The airlift separator (ALS) uses finely distributed air/gas affectively to alter the liquid density and promote upward entrainment of solids. Adjusting air flow and bubble size are key parameters affecting solids separation characteristics. The

Figure 1: Sketches of Solids Flotation Methods

rising air causes the resin to float and be skimmed off over a weir into a catch basin. Water going over the weir can be filtered out and recycled into the original container. Elutriation uses upward liquid flows to entrain solids with lower settling velocities (fine sludge) while allowing those with higher settling velocities (OIER) to settle. The agitated slurry method also uses an injected liquid flow to suspend and separate fine sludge particles from resin beads. A coarse screen would be sized to retain the larger resin beads and allow fine particles to pass.

4.1.2 Hydro Cyclone

The hydro cyclone is closely related both to the gravity settling tank and the sedimenting centrifuge. The function of the hydro cyclone is shown in Figure 2. A feed stream enters through the tangential inlet, generating a scroll-like flow along the inner surface of the cyclone body; this is the primary vortex flow. The apex, or underflow nozzle, prevents the discharge of the total flow, and causes the upwards secondary vortex flow into the overflow outlet nozzle. The primary vortex, with its relatively low centrifugal forces causes the coarser particles to settle toward the wall. Both the circumferential speed and the angular velocity are much higher in the secondary vortex than in the primary vortex, thus generating high centrifugal forces that induce settlement of the fine particles in a radial direction. These fine particles join the primary settled coarse ones and move with them along the wall toward the apex, then to be discharged as a concentrated but fluid stream. Part of the secondary settled finer particles are recycled internally, thus giving a good washing effect that results in a relatively sharp separation.

Figure 2 Hydro Cyclone with main flow pattern

Each of the stated methods may be used as a first stage filtration process with devices added downstream for final particle separation.

4.2 Stage 2 Testing

Stage 2 will involve assessment of results from Stage 1 testing; refinement of equipment as test results indicate; additional proof-of-principle tests to confirm assumptions; and development of procurement specs for commercially available equipment. As mentioned, test parameters will be altered to verify the technology under varying conditions.

4.3 Test Parameters

Some key test parameters for each separation method are listed in Table 1. Modification of independent variables for each separation method which will affect the efficiency of the device in terms of the most important variable - OIER capture. This, along with any residual sludge captured are the two common dependant variables common to all of the separation methods. Other dependant variables, such as particle terminal velocity for the ALS or underflow velocity for the hydro cyclone are unique to each method. The significance in knowing and measuring these values is that later conceptual design will need the information for design purposes.

Table 1 - Test Parameters

Separation Method	Independent Variables	Dependant Variables
Solids Flotation	volumetric air flow rate; gas bubble size; water flow rate; mixing configuration; vessel dimensions; resin concentration; blow sand concentration;	flow or linear fluid velocity; particle terminal velocity; resin/sludge separation time; off-gas treatment; % resin capture; %residual sludge: -% Copper -% Fe Oxide -%Al Oxide
Hydro Cyclone	vessel dimensions (inlet & outlet port diameters, cone angle, cylinder length); tangential inlet pressure; resin concentration; blow sand concentration;	Underflow and overflow volumetric rates; resin/sludge separation time; % resin capture %residual sludge: -% Copper -% Fe Oxide -%Al Oxide

The percent resin and percent residual sludge are the dependant variables of interest. Other dependent variables are related to or feed this variable.

4.4 Acceptance Criteria

The acceptance criteria for the chosen method is the ability of the selected method to separate at least 95% of the OIER from the sludge simulant. In addition, criteria for carryover of the sludge fines with the resin shall be no more than 5% of the total sludge fines. The acceptance criteria may be modified later by STP based on information (such as equipment limitations) discovered during testing.

4.4.1 Qualitative Analysis

Success of a given method would initially be qualitative in nature. Visual inspection of the separated slurry for total percentage of OIER should provide adequate information to rank one method over another.

4.4.2 Quantitative Analysis

Quantitative inspection of the separated mixture would involve such methods as mass balance analysis. The mass of a unit volume of the dry OIER before mixing with other simulant components will be determined as a reference point. The resin will then be mixed with the sludge simulant to allow fine particulate to adhere to the resin bead surface. The resin will be separated from the sludge quantitatively and washed to remove loosely adhered sludge particulate from the resin bead surface. The unit mass of the resin will again be measured to determine the nominal mass offset due to residue adhesion to the resin surface. Sufficient replicates will be performed to determine if there is constant positive mass increase. This data will be used to adjust the mass percent residual sludge carry-over.

4.5 Sludge Simulant

The simulant to be used for testing has been defined (Duncan 1998) and a copy of the selection basis is included in Appendix A. The particle size distribution for the simulant is also defined in Appendix A and is in accordance with particle size distribution of the samples taken from the K East main floor basin and the "Weasel Pit." The sludge simulant components (by weight percentages) are defined as:

- Copper 2.5%
- Iron Oxide 10.8%
- Aluminum Oxide 1.8%
- Water 56.8%
- Blow Sand & Purolite OIER 28.1%

Note that except for the copper, these components closely mimic those found in K Basin sludge. Copper will be used in place of uranium oxide because it is readily available, has a specific gravity (8.9) relatively close to uranium oxide (10.96), and will eliminate the radiation hazard. Initially a 50/50 mixture (14.05 % each) of the blow sand and OIER will be used. This will provide a baseline recipe for use in each of the separation methods. The blow sand/OIER ratio will be altered in the second phase of testing (somewhere between a 10/90 to 90/10 ratio) once a final separation method has been identified.

4.6 Test Environment

Testing of any of the above proposed methods will be done at the Engineering Testing Laboratory located in the 305 Building, 300 Area, Richland, WA.

4.7 Test Equipment

Test equipment that will be needed may include flow meters, pressure gages, mass balances, temperature indicators, data acquisition systems, etc. Each item used for measurement will be verified for accuracy. When available, either currently calibrated equipment or accepted primary standard will provide verification.

4.8 Data

Pertinent test data to be measured will include items such as sludge solids concentrations, separated OIER weight percentages, flow rate, temperature, etc. These will be recorded in controlled laboratory logbook number HNF-N-132-1. Data will also be collected electronically using a data acquisition system where appropriate. Data measuring equipment information will also be recorded which will include information such as equipment type and specification, test results and observations, sketches and photos, etc.

5.0 EXPECTED RESULTS

These tests are expected to identify one or more methods for adequate separation of OIER from a K-Basin sludge simulant. This selected method(s) will be presented as candidates for additional proof testing using variations of the simulant.

6.0 SAFETY

Standard ETL safety practices will be enforced. This includes the proper use of pertinent personal protection equipment, such as safety glasses and face shield, steel toed shoes,

protective lab coat or apron, etc. A Job Hazard Analysis (JHA) will be produced identifying any specific hazards and will be reviewed by all test personnel before any testing may commence. The test director will conduct a pre-job meeting and is responsible for ensuring that all personnel involved are properly trained and aware of any hazards present. An Industrial Safety representative will review the JHA and associated testing apparatus prior to testing.

7.0 QUALITY ASSURANCE

Since these tests are of scoping nature, standard QA oversight and review of procedures is not applicable. Standard laboratory controls such as measuring equipment verification, calibration (where possible), etc., will be in place to assure quality control. Later verification testing will incorporate QA oversight as needed.

8.0 ORGANIZATIONAL RESPONSIBILITIES

Engineering Testing Laboratory - NHC

The ETL is responsible for providing test personnel, equipment, OIER separation equipment, test direction, and final test report writing and release. The Cognizant Manager is Michael Schliebe and the Test Engineer/Technical Lead is Keith Witwer.

Sludge Treatment Project - NHC

The Sludge Treatment Project is providing funding and direction for this testing. The Project Manager is Wallace W. Rutherford and the Technical Lead is Thierry A. Flament.

Chemical Engineering - COGEMA Engineering Corporation

Jim Duncan will provide chemical engineering and particle separation research support as needed. Don Gana, a COGEMA Engineering technician, will provide simulant preparation support as well as any equipment setup support as needed.

9.0 SCHEDULE

Scoping tests will begin as soon as simulant is made and OIER separation devices are setup. An interim report is scheduled for June 5, 1998 followed by a final supporting document test report due on June 28, 1998. A Sludge Treatment Projects schedule, which lists this testing, is included in Appendix B.

10.0 REFERENCES

FLAMENT 1998, *Testing Strategy to Support the Development of K Basins Sludge Treatment Process*, HNF-2574, April 1998.

RUTHERFORD 1998, *Letter of Instruction #STP-002 For Organic Ion Exchange Resin Separation Cold Testing*, 8C720-98-WWR-002, May 1998.

DUNCAN 1998, *Internal Memo - Sludge Simulant for Organic Ion Exchange Resin Separation*, 8C720-98-JBD-001, April 1998.

APPENDIX A: SLUDGE SIMULANT SELECTION BASIS

NHC
Numatec
Hanford Corporation

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CC: KSW
HNF-2729
Rev. 0
Page 14 of 28

Internal
Memo

From: J. B. Duncan JBD
Phone: 372-0896 H7-20
Date: April 23, 1998
Subject: SLUDGE SIMULANT FOR ORGANIC ION EXCHANGE RESIN
SEPARATION

8C720-98-JBD:001

To: T. A. Flament H7-20

cc: K. L. Pearce H7-20
M. J. Schliebe L6-13

- References:
- (1) Article, "Analysis of Sludge from Hanford K East Basin Floor and Weasel Pit," WHC-SP-1182, dated April 1996.
 - (2) Article, K. Willeke and K.T. Whitby, J. Air Pollution Control Assoc., Vol. 25 p. 529, dated 1975.
 - (3) Book, Kirk-Othmer, Encyclopedia of Chemical Technology, Vol. 1 (4th Ed.), 1991.
 - (4) Book, edited by R. C. Weast, CRC Handbook of Chemistry and Physics, 53rd Ed., 1972-1973
 - (5) Technical Data Sheet, Purolite NRW-37 Nuclear Grade Resin.

Purpose

The purpose of this memorandum is to put forth a selection basis for the K East Basin floor and Weasel Pit simulant for the organic ion exchange resin (OIER) separation unit operation.

K East Sludge and Weasel Pit

Using Table 4.3 Sludge Characterization Data -- Per Gram As-Settled Sludge (WHC-SP-1182), the following mean values were extracted:

Table 1^A Sludge Characterization Data

Component	Per Cent Mean Concentration
Inorganic Elements	13.4
Water	56.8 ^B
Uranium	2.5 ^C
Acid Insoluble Residue	8.25

Component	Per Cent Mean Concentration
Total	80.95
Major Inorganic Elements (> 1%)	Fe 10.8 Al 1.8

^A The values are "as settled sludge", the expected water content of the retrieved sludge is expected to be at a much higher concentration.

^B Averaged values from 222S Lab and PNNL.

^C ICP for total U, 222S Lab

The total analysis does not sum to 100%. This is due to some elements not being analyzed, such as Si. Silicon did appear in compounds detected by XRD analysis. For example, some of the compounds reported were: SiO_2 , $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$, Si, $\text{CaAl}_2\text{Si}_2\text{O}_8 \cdot 4\text{H}_2\text{O}$. Also, the analysis ignored the mass contribution of bound water (water of hydration).

In Appendix I (WHC-SP-1182), the particle size analysis indicated that the samples were measured "as received", after sonication at 25W (120 sec.), and after sonication at 40W (300 sec.). The data taken into consideration for this report will be the "as received" data for simulant formulation. The use of "as received" data is due to the fact that the sludge retrieval mechanism is not yet known. Appendix A of this memorandum is an analysis of the graphical data presented in Appendix I of WHC-SP-1182, for the "as received" and sonicated samples.

Assumptions

1. The separations will be based on physical parameters of the floor and weasel pit sludge.
2. The analyses as reported in WHC-SP-1182 are correct.
3. The fully loaded resin beads have a negligible increase in density (phone conversation with a Purolite Tech Representative, (800) 343-1500).
4. The mean mass balance difference of 19.05% (100% minus 80.95% from Table 1) is due to the mass contribution of compounds that were not considered for analyses (silicon for example), bound water, and ion exchange resin.
5. The resin is Purolite NRW-37 Nuclear Grade, mixed bed. The density of the hydrogen form (cation exchange resin) is 1.24. The density of the Cl form (anion exchange resin) is 1.10. The mesh size is 16 to 40, US standard screen (1.19 to 0.42 mm, respectively).
6. Blow sand in the range of 2.5 to 10 microns (See Appendix B).
7. The only radionuclide of mass consequence is Uranium.
8. The simulant will be derived from the mean values as reported in Table 4.2 (WHC-SP-1182). Adjustments will be made to mimic various conditions.

Selection of the Simulant for OIER separation

Table 2 Major Analytes and Simulants

Analyte (Assumed Species)	Simulant	Per Cent of Simulant	Density of Simulant (Density of Assumed Species)
Uranium (UO ₂)	Copper or Chromium	2.5	Cu = 8.9 Cr = 7.2 (10.96)
Iron (Fe ₂ O ₃)	Iron Oxide	10.8	5.24 (5.24)
Aluminum (Al ₂ O ₃)	Aluminum oxide	1.8	3.97 (3.97)
Water	Water	56.8	1.00 (1.00)
Total		71.9	
Silicon (SiO ₂)	Blow Sand from K Area, quartz	Sand and the combination of ion exchange resin will make up the balance of 28.1 per cent as delineated in the OIER test plan.	2.64 (2.64)
Organic Ion Exchange Resin	Purolite, NRW-37, mixed bed (Volume Ratio 1.5 anion to 1.0 cation)		Cation Resin = 1.24 Anion Resin = 1.10

Laboratory Protocol for Simulant Make-up

Materials:

- Resin: Resin beads will be obtained from either the vendor or from K Basin operations.
- Aluminum oxide, chromium (or copper) will be obtained from a vendor in varying particle dimensions.
- Iron oxide will be obtained by physically scraping "rusty material" found in storage yards around Bldg. 305, 306E, etc.
- Blow sand will be obtained by retrieving the top 2 to 3 mm of sand around the K East basin.
- Water will be de-ionized, conductivity and pH will approximate that of K East basin.

Preparation:

- Grinding:

Individually, the iron oxide, aluminum oxide, and the blow sand will be subjected to a grinding phase such as a ball mill or similar apparatus.

All material will individually be classified using a Rotap, with screen sizes from 25 US Standard mesh (710 μm) to 400 US Standard mesh (37 μm). Material passing the 400 mesh will be collected as 400 minus and subjected to particle analysis.

- Simulant Make-up

Example:

The resin and sand are dependent variables and will vary according to the test protocol. However, the concentrations for iron oxide, aluminum oxide, water, and chromium will be fixed (assumption -- normally and independently distributed, (0,1)).

For a total of 1000 g of simulant, and using the particle volume distribution for M13B (Appendix A, Table A-2, as received), particle diameters from 31 μm to 352 μm (mesh size of 400 to 48 respectively). The following table can be derived. The weight of simulant should sum to the gram fraction of 1000 g as indicated. The difference between the independent variables and the total grams required for that particle range will be made from the dependent variables (resin and sand).

Table 3 Example of Simulant Make-up (1000 g)

Mesh Size	48 - 60	60 - 80	120 - 80	170 - 120	230 - 170	325 - 230	400 - 325	< 400
Particle Diameter (□m)	248 - 352	176 - 248	125 - 176	88 - 125	62 - 88	44 - 62	37 - 44	< 37
Per Cent Particles in Range	1.3 (13 g)	3.3 (33 g)	3.9 (39 g)	5.5 (55 g)	7.9 (79 g)	9.7 (97 g)	10.1 (101 g)	58.3 (583 g)
Al ₂ O ₃ @ 1.8 % (g)	0.23	0.60	0.70	0.99	1.4	1.7	1.8	
Fe ₂ O ₃ @ 10.8% (g)	1.4	3.6	4.2	5.9	8.5	10.5	10.9	
Cr @ 2.5% (g)	0.33	0.83	0.98	1.38	1.9	2.4	2.5	
Water @ 56.8% (g)	7.4	18.7	22.2	31.2	44.9	55.1	57.4	
Total	9.4	23.7	28	39.5	55.3	69.7	72.6	
Difference to be made up with Resin and Blow Sand (g)	3.6	9.3	11	15.5	23.7	27.3	28.4	

APPENDIX A

Analyses of Particle Number Distribution and Particle Volume Distribution Graphs from Appendix I, WHC-SP-1182

Table A-1 Particle Number Distribution (WHC-SP-1182, Appendix I)

Particle Dia. (μ m)	M13T			M13B			T20T			T20B(Duplicate)		
	Per Cent in Range			Per Cent in Range			Per Cent in Range			Per Cent in Range		
	40 W	25 W	As Received	40 W	25 W	As Received	40 W	25 W	As Received	40 W	25 W	As Received
0.172 to 0.243	35	--	--	--	--	--	60	64	--	48	37	--
0.243 to 0.344	38	60	--	60	57	--	25	23	--	34	41	33
0.344 to 0.486	13	21	--	23	23	--	8	6	--	11	14	42
0.486 to 0.688	7	9	47	9	10	51	4	2	55	5	6	14
0.688 to 0.972	3	5	27	6	8	25			23			7
0.972 to 1.375	1	3	13	1		12			7			3
1.375 to 1.946			7			5			4			1
1.946 to 2.750			3			3			3			
2.750 to 3.889			2			3			8			
3.889 to 5.500			1			1						
Total	98	98	100	99	98	100	97	95	100	98	98	100

Table A-2 Particle Volume Distribution (WHC-SP-1182, Appendix I)

	M13T			M13B			T20T			T20B(Duplicate)		
Particle Dia. (μ m)	Per Cent in Range			Per Cent in Range			Per Cent in Range			Per Cent in Range		
	40 W	25 W	As Received	40 W	25 W	As Received	40 W	25 W	As Received	40 W	25 W	As Received
0.172 to 0.243	0.75	--	--	--	--	--	1.8	1.7	1.2	0.9	0.8	--
0.243 to 0.344	1.80	0.8	--	1.0	0.4	--	2.1	1.8	1.3	2.0	1.8	1.0
0.344 to 0.486	1.90	1.0	0.3	1.0	1.0	0.8	2.0	1.6	1.2	2.0	1.8	1.0
0.486 to 0.688	1.60	1.1	0.8	1.3	1.1	0.9	2.1	1.5	1.3	1.9	1.8	1.0
0.688 to 0.972	2.6	1.6	1.1	2.0	1.7	1.2	2.7	1.9	1.5	2.7	2.1	1.4
0.972 to 1.375	3.4	2.0	1.6	2.7	2.1	1.6	3.7	2.4	2.1	3.6	2.8	1.9
1.375 to 1.946	4.0	3.2	1.9	3.2	2.5	2.1	3.8	2.8	2.3	3.9	3.2	2.1
1.946 to 2.750	5.0	4.2	2.3	3.8	3.5	2.6	3.9	3.7	2.2	4.2	3.6	2.4
2.750 to 3.889	6.3	5.5	4.1	4.8	4.5	3.8	5.1	4.6	4.0	4.9	4.2	3.2
3.889 to 5.500	7.4	7.7	5.9	6.3	6.0	5.1	6.5	6.1	5.4	5.5	4.7	4.0
5.500 to 7.778	10.8	10.6	8.7	8.1	7.7	6.3	8.1	7.8	6.5	7.4	6.5	5.0
7.778 to 11.000	11.5	11.6	10.3	8.6	8.2	7.1	8.6	8.3	7.5	7.8	6.9	5.2
11.000 to	11.	11.	11.0	8.8	8.7	8.0	9.3	9.4	8.5	7.9	7.4	5.8

15.560	8	8										
15.560 to 22.000	11. 9	13. 5	14.7	10. 1	10. 0	9.0	10. 5	11. 0	10.2	8.4	8.2	6.7
22.000 to 31.100	9.3	11. 4	14.7	10. 9	11. 1	10.1	9.6	10. 6	10.4	7.8	8.3	7.5
31.100 to 44.000	5.2	6.9	10.1	10. 3	11. 4	10.1	7.1	7.1	9.0	7.8	8.3	8.2
44.000 to 62.230	2.5	3.2	5.6	7.9	9.4	9.7	4.9	5.5	6.7	5.8	6.8	5.9
62.230 to 88.000	1.2	1.8	2.7	4.7	5.9	7.9	2.0	2.7	4.5	4.5	5.4	5.1
88.000 to 124.50	0.6	0.8	0.9	3.2	4.1	5.5	1.6	2.2	3.3	3.4	4.6	4.8
124.50 to 176.00			1.3	1.5	1.9	3.9	1.0	1.8	2.3	2.5	3.5	5.2
176.00 to 248.900				0.7	0.9	3.3	1.2	2.2	2.3	1.1	1.7	4.5
248.900 to 352.00						1.3	1.7	1.8	3.2	1.5	2.0	3.0
352.00 to 497.00									2.2	3.8	4.8	9.6
497.00 to 704.00												10.2
Total	99.6	98.7	98	100.9	102.1	100.3	99.3	98.5	99.1	101.3	101.2	104.7

APPENDIX B

Basis for Blow Sand Particle Size

- Reference: (1) Articke, K. Willeke and K.T. Whitby, J. Air Pollution Control Assoc., Vol. 25 p. 529, dated 1975.
(2) Book, Kirk-Othmer, Encyclopedia of Chemical Technology, Vol. 1 (4th Ed.), 1991.

Atmospheric aerosols may be classified into three size modes: nuclei, accumulation, and large or coarse-particle modes. The bulk of the aerosol mass usually occurs in the 0.1 to 10 μm size range which encompasses most of the accumulation mode and part of the large-particle mode. From approximately 0.09 μm to approximately 2.5 μm , particles are in the accumulation mode, while particles in the 2.5 μm to 10 μm range tend to have appreciable deposition velocities (Kirk-Othmer).

The characteristics of wind blown dust are (Willeke & Whitby):

Table B-1 Aerosol Characteristics of 2.5 μm to 10 μm Particles

Source	Wind Blown Dust
Fate	Deposit
Atmospheric Lifetime	Hours

APPENDIX B: TESTING SCHEDULE

Activity ID	Activity Description	Start	Finish	Pct Cmpl	RD	TF	FY98																											
							APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
Numatec Hanford Co.							Numatec Hanford Co.																											
Sludge Treatment System Development							Sludge Treatment System Development																											
Project Management							Project Management																											
SD102	Project Management	30MAR98A	30SEP98	26	94*	0																												
Project Basis - Rev A							Project Basis - Rev A																											
SD100	Milestone: Receive FDH Letter	30MAR98A		100	0																													
SD110	Sludge Data Base (rev. A)	30MAR98A	29MAY98	70	9*	-4																												
SD112	Process Description (rev. A)	30MAR98A	03JUN98	60	12*	-3																												
SD114	Process Flow Diagram (rev. A)	27APR98A	05JUN98	40	14*	-8																												
SD116	SGN Review	15JUN98*	15JUN98	0	1	-10																												
SD117	Milestone: Project Basis Rev. A Complete		15JUN98	0	0	-10																												
Process Studies							Process Studies																											
SD11	ENGINEERING / PROCESS STUDIES	30MAR98A	22JUL98	35	45*	-10																												
SD118	Dissolution U/UO2	27APR98A	22JUN98	30	25*	10																												
SD120	Solid/Liquid Separation	11MAY98A	22JUN98	10	16*	10																												
SD122	Removal PCB from Liquids	06APR98A	27MAY98	70	7*	28																												
SD126	Precipitation from U	16JUN98*	15JUL98	0	20	-5																												
SD130	Organic Ion Exchange Resins Separation	30MAR98A	29MAY98	70	9*	10																												
SD132	Safeguards	18MAY98A	30JUN98	5	31*	4																												
SD134	Removal of PCB from Solid	27APR98A	27MAY98	60	7*	28																												
SD136	Solids Processing	16JUN98	22JUL98	0	25	-10																												
SD138	Disolver OFF Gas	01MAY98A	30JUN98	30	31*	4																												
SD139	Milestone: Process Studies Complete		22JUL98	0	0	-10																												
Safety Studies							Safety Studies																											
SD152	Shielding Calculation Process	30MAR98A	24APR98A	100	0*																													

Project Start: 01/01/98
Project Finish: 15/01/02
Data Date: 15/01/98
Run Date: 15/01/98

SNF PROJECTS
SLUDGE TREATMENT PROJECTS
Status thru May 18, 1998

20 27 4 11 18 25 1 8 15 22 29 6 13 20 27 3 10 17 24 31 7 14 21 28

APR MAY JUN JUL AUG SEP

FY98

Sheet 1 of 1

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Checked: _____

Approved: _____

[illegible]

Activity ID	Activity Description	Start	Finish	Pct Cmpl	RD	TF	FY98																							
							APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
Project Basis Review							Project Basis Review																							
SD198	Review of Design (Rev. B)	06AUG98	19AUG98	0	10	-10																								
SD200	Milestone: Decision to Proceed		05AUG98*	0	0	0																								
Conceptual Design							Conceptual Design																							
SDW60	CONCEPTUAL DESIGN	06AUG98	02JUN99	0	207	16																								
SDW60140	Criticality Transport	06AUG98	19AUG98	0	10	133																								
SDW60142	Chemical Reaction Transport	06AUG98	19AUG98	0	10	133																								
SDW60144	Shielding Calculation Transport	06AUG98	19AUG98	0	10	133																								
SDW60146	Transport Analysis	06AUG98	17SEP98	0	30	113																								
SDW60148	Criticality Process	06AUG98	26AUG98	0	15	98																								
SDW60150	Chemical Reaction Process	27AUG98	08OCT98	0	30	98																								
SDW60156	Transport	06AUG98	10SEP98	0	25	61																								
SDW60160	Site Selection	11SEP98	02DEC98	0	57	61																								
SDW60170	Liquid Solid Transfer	06AUG98*	26AUG98	0	15	128																								
SDW60180	Transfer System Requirements	06AUG98	02SEP98	0	20	123																								
SDW60190	Acquisition Strategy	06AUG98	22OCT98	0	55	168																								
SDW60192	Regulatory Strategy	06AUG98	15OCT98	0	50	173																								
SDW60194	Preliminary Cost & Schedule	06AUG98	17SEP98	0	30	193																								
SDW61100	Prep & Approve CSER	06AUG98	20JAN99	0	114	202																								
SDW61110	Prep & Approve PHA	06AUG98	20JAN99	0	114	202																								

Project Start
Project Finish
Data Date
Run Date

01/01/98
15/01/98
15/01/98
15/01/98

Early Bar

Progress Bar

Critical Activity

FL17/CON0

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FY98

Sheet 5 of 8

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SNF PROJECTS
SLUDGE TREATMENT PROJECTS
Status thru May 18, 1998

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		EDT No. 618464			
		ECN No. N/A			

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