EG&G ROCKY FLATS

INTEROFFICE CORRESPONDENCE

FEB - 1

DATE: January 20, 1994

TO: S. R. Keith, Solar Pond Program, Bldg 080, X8541

FROM: D. R. Swanson, Safety Analysis Engineering, Bldg. T886B, X7009

SUBJECT: 750 PAD ACCELERATED SOLAR POND SLUDGE REMOVAL SAFETY ANALYSIS FOR 207C POND AND CLARIFIER - DRS-006-94

PURPOSE

This letter is to transmit the results of the Safety Analysis for the 207C Pond and Clarifier portion of the Accelerated Solar Pond Sludge Removal Project (ASPSRP) and a copy of the calculations that support the safety analysis.

DISCUSSION

The Department of Energy (DOE) Order 5480.23, "Nuclear Safety Analysis Reports", requires, in part, that nuclear facilities perform or upgrade their Safety Analysis Reports (SARs) to comply with the DOE Order. The DOE Order requires that a Basis for Interim Operations (BIO) be prepared for the interim period until the SAR is approved

There currently exists a draft SAR for the 750/904 Pad that assumes that the waste form to be stored on the 750 Pad will be pondcrete, produced from the solar pond sludge, or saltcrete produced from the Building 374 evaporator concentrate. On the other hand, the ASPSRP will remove and store solar pond sludge and brine/sludge mixtures in 10,000 gallon tanks on the 750 Pad.

Since the draft SAR did not consider the storage of sludge or brine/sludge mixtures, the attached Safety Analysis (Attachment 1) evaluates the hazards associated with these operations for the 207C Pond and Clarifier and concludes that these operations will be within the safety envelope of the draft SAR. A draft revised BIO that reflects the ASPSRP was prepared for the evaluation of the 207A/B Pond sludge removal This BIO, with minor modifications, is still appropriate for the 207C and Clarifier brine/sludge removal and storage task. The calculations that support the Safety Analysis are documented in calculation number 94-SAE-001 A copy of the approved calculation is attached (Attachment 2)

The BIO will ultimately be submitted to DOE as part of the revised Safety Analysis Program Implementation Plan for DOE Order 5480.23 The BIO and supporting safety analysis will superseded upon DOE approval of the draft SAR The current estimated date for submittal of the SAR to DOE is July 1, 1994.

DOCUMENT CLASSIFICATION REVIEW WAIVER PER CLASSIFICATION OFFICE

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ADMIN RECORD

RESPONSE
If you have any questions or comments, please contact A. C Stalker at X8484/DP7565.

ACS:la

Attachments:
As Stated (2)

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750 PAD ACCELERATED SOLAR POND SLUDGE REMOVAL SAFETY ANALYSIS

207C Pond and Clarifier Solution Removal and Storage

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Date: January 19, 1994

750 PAD ACCELERATED SOLAR POND SLUDGE REMOVAL SAFETY ANALYSIS
207C Pond and Clarifier Solution Removal and Storage

1.0 INTRODUCTION

The accelerated solar pond sludge removal program will remove sludge from the solar ponds and store the sludge on the 750 Pad in 10000 gallon double walled polyethylene tanks A minimum of 45 tanks will be required for the storage of the 207C Pond sludge and solution, and 3 for the clarifier sludge and solution Water will be added to the 207C Pond to reach a total volume of 450000 gallons The pond will be circulated to dissolve as much salt as possible and suspend the insoluble sludge This salt brine with suspended sludge will be sucked into a 13 cubic meter (17 yd^3) truck, driving the loaded truck to the storage tank, and pumping the brine/sludge solution into the tank This operation will be repeated until the pond is empty The clarifier will be stirred until the brine solution and sludge is thoroughly mixed and then the mixture will be sucked into the truck, driven to the storage tank, and pumped into the tank This operation will continue until the clarifier is empty. Twenty-three tanks will have already been filled with the sludge from the 207A/B Ponds

2.0 DESCRIPTION OF EQUIPMENT

The vacuum truck is called the "Guzzler" and operates with a Dresser or Hargreaves Positive Displacement Vacuum Pump rated at 380 mm (15") of Hg and 5141 CFM at full vacuum The truck has a 13 cubic meter (17 yd^3) Cleanbore Body, designed for maximum separation of heavier materials from the air stream The payload capacity is rated at 12 2 m^3 (16 yd^3) It has four removable 16" top mounted centrifugal separators with easy access clean-out ports to insure maximum separation of material and dust from air stream prior to the baghouse stage filtration The baghouse has 60 acrylic coated filter bags with an automatic bag pulsing feature It has a stainless screen fitted in the vacuum tube make-break connection as a fail-safe barrier to any pump damaging material

The truck will be driven to the solar pond The truck mounted suction hose will be attached to a boom mounted extension hose and collection wand at the solar pond. The truck will be loaded with 12 2 m^3 of sludge. When the truck is full the hose will be sucked empty The boom extension will be disconnected and a cap will be installed for the trip to the 750 Pad The truck will then be driven to the 750 Pad

Each storage tank set will consist of a closed primary tank 13'6" in diameter inside of a 14' secondary open top containment tank, with a maximum capacity of 11500 gallons The working volume is 10000 gallons Both tanks are constructed of high density crosslinked polyethylene The wall thickness is calculated for the appropriate hoop stress for sludge up to a specific gravity of 1 9 A leak detection system is provided to detect leaks from the primary tank into the secondary

containment tank Twenty of these tank sets will be in Tent 3, 22 tanks in Tent 4, and 29 tanks in Tent 6 The tanks will be located on both sides of the tent with sufficient aisle space between the tanks to drive the transfer truck

The vacuum truck will be backed into the tent to the tank to be filled A sludge pump, rated at 200 gpm maximum, will be connected to the polyethylene tank with a three inch line It will take from 16 to 30 minutes to empty the truck into a tank Each tank will be filled with approximately 10000 gallons of sludge or brine solution The truck will then be driven back to the solar pond for the next load

3.0 ACCIDENTS

3.1 DRAFT SAFETY ANALYSIS REPORT FOR THE 750 AND 904 PADS

A Draft Safety Analysis Report (SAR) for the 750 and 904 Pads Temporary Pondcrete and Saltcrete Storage Facilities was written with the expected waste form as pondcrete or saltcrete in half triple-wall body package (triwall box), half flush-panel plywood box (half box), full flush-panel plywood box (full box), and corrugated metal waste container (metal crate) The Hazard Classification for the facility was calculated based on a small airplane crash into the facility with the resultant release due to impact, fire, and entrainment release of hazardous chemicals and radionuclides The facility was designated as Category 3 The total quantity of material involved was 1 71x10^7 kilograms, with a total 80 kg of pondcrete released into the atmosphere The chemical composition of the pondcrete was based on the 95th percentile of 19 samples analyzed for a variety of hazardous constituents for pondcrete produced from the 207A Pond

Three bounding accidents were evaluated in the 750/904 Pads SAR for assessing the consequences of these accidents They were

1) A spill of 5 12x10^3 kg of pondcrete over a five minute period releasing 0 034 kg of material to the atmosphere.

2) A 30 minute fire involving 2 15x10^5 kg of pondcrete releasing 0 9 kg of material to the atmosphere, and

3) A 2 hour fire involving 1 89x10^6 kg of pondcrete releasing 7 6 kg of material to the atmosphere

Table 1 presents a summary of the results for the radiological and chemical hazard analysis calculations from the draft SAR

3 2 EARLY REMEDIATION OF SOLAR PONDS ACCIDENT ANALYSIS

Early remediation of the solar ponds will move the contents of the ponds to tanks installed inside of tents on the 750 Pad The

total quantity of A/B/C Pond and Clarifier sludge/brine water mixture that will be placed in storage on the 750 Pad is approximately 3.5×10^6 kg The sludge or brine/sludge mixtures will occupy a minimum of 71 of the 10000 gallon storage containers
The aircraft scenario used in the bounding SAR analysis was not repeated for the tanks of sludge The estimated $3\ 5 \times 10^6$ kg of total material in the tanks represents approximately 21 percent of the total material inventory (i e , $1\ 7 \times 10^7$ kg) assumed to be involved in the aircraft crash and ensuing fire In addition, unlike pondcrete, the water content of the sludge and brine solution would act to inhibit fire propagation As a result of the placement of the tanks on the 750 Pad, the actual pondcrete capacity is diminished from that assumed in the SAR analysis, making the SAR analysis more conservative Therefore, the plane crash into the pondcrete is judged to bound a crash into the tanks

Two accidents are evaluated in detail for each of three brine/sludge solution types that may be transported to determine if the consequences are within those determined for the bounding accidents presented in the Draft SAR They are

1) The spill of the entire contents of one 10000 gallon container inside of the tent structure This would involve up to $5\ 9 \times 10^4$ kg of pond sludge releasing 0 11 kg to the atmosphere and

2) The spill of the entire contents of the vacuum truck onto the ground outside of the tent structure This would involve up to 2×10^4 kg of pond sludge releasing up to 0 04 kg to the atmosphere

The three solutions types, for which calculations are made, are pure liquid solution from the 207C Pond, concentrated brine with 5% suspended solids from the 207C Pond, and the brine/sludge mixture from the clarifier

The results of the hazard analysis calculations are given in Table 1 for comparison with the Draft SAR calculations

3.2.1 WASTE CHARACTERIZATION

Waste characterization for the Accelerated Sludge Removal Program is based on several reports as follows

1) Pond Sludge Waste Characterization Report and Clarifier Sludge Waste Characterization Report for EG&G Rocky Flats Prepared by Halliburton NUS Environmental Corporation March 1992

2) Weston Report

3) Options Analysis Report for the Accelerated Sludge Removal Project, Final Report, 234353GG Under MTS 225456RR, Prepared by ICF Kaiser Engineers, Inc July 26, 1993

The Weston and Halliburton/NUS chemical characterization data for the 207C Pond was treated together and a single conservative composition was calculated for the brine solution concentration and a single average composition for the sludge. There were no Weston data for the clarifier so the Halliburton/NUS data were used

3.2.2 RELEASE FRACTIONS

Release fractions for the spilling of the material were taken from NUREG/CR-4658, "Aerosols Generated By Spills of Viscous Solutions and Slurries", Prepared by M Y Ballinger and W H Hodgson, December 1986 A least squares fit of the release fraction as a function of viscosity was performed and the data interpolated at 19 centipoise, the estimated viscosity for 207C Pond solution, and extrapolated to 50 and 400 centipoise, the estimated viscosities of the sludge/brine solution for the 207C Pond and Clarifier respectively. The value used is the calculated value plus two standard deviations, to account for the uncertainty in the calculated fit function, calculated at the appropriate viscosity

3.2.3 ATMOSPHERIC DISPERSION

Local worker exposure assumes that the released material is uniformly contained in 1000 cubic meters of atmosphere for the clarifier brine/sludge mixture This is about one-third of the free air space in Tent 3 or 4 The draft SAR used 206 m^3 for the immediate worker dilution volume for the spill of 4 2 yd^3 (850 gallons) of pondcrete, a much smaller volume of material For the 207C Pond material, the brine solution will be much less viscous and will spread through out the entire tent, therefore the smallest tent free space volume of 3360 m^3 will be used

A collocated worker is assumed to be 100 meters downwind under the most conservative meteorology conditions, F Stability Class with a wind speed of 1 meter/second. The maximum exposed individual off-site is assumed to be 1900 meters with the same meteorology.

In comparison, the draft SAR used 100-200 meter range for the on-site worker and 2000-2100 meter range for the off-site public dose calculations using the MACCS computer code For the three accident conditions analyzed the draft SAR used D stability class and 4 meters/second wind speed, which is less conservative However, the draft SAR used F stability class and one meter/second wind speed for the Hazard Classification Calculations

3.2.4 EXPOSURE CALCULATIONS

The aerosolized released fraction of material is assumed to occur instantaneously and persist for 15 minutes, allowing a peak 15 minute average concentration to be calculated The concentration of each hazardous chemical is then compared to the threshold limit value - time weighted average (TLV-TWA) provided by the American Conference of Governmental Industrial Hygienists (ACGIH) The use of TLV-TWA is conservative for accident analysis purposes and is consistent with the methodology used in the Building 910 hazard classification and SAR, which was approved by DOE The TLV-TWA limits does not create any limitations for the 750 Pad operations and provides an additional margin of safety

A safety fraction is calculated as the sum of the ratios of chemical concentration to the TLV-TWA For public exposure one-tenth of the TLV-TWA was used in the calculation of the safety factor These values are more conservative than those used in the draft SAR The on-site worker and the public are assumed to be exposed to the hazardous material at the maximum concentration during the entire plume passage

Radiological exposure is assumed to occur through inhalation of the radioactive material The breathing rate for the exposed population from the draft SAR was used Dose conversion factors were taken for specific radionuclides from the Federal Guidance Report No 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation Submersion and Ingestion Gross alpha was assumed to be composed of plutonium-239 and gross beta plutonium-241 Exposure was calculated as the committed effective dose equivalent (CEDE)

The results of these exposure calculations are shown in Table 1, Table 2, and Table 3 for the three scenarios evaluated Table 1 is for the 207C Pond Brine/Sludge mixture Table 2 is for the Clarifier Brine/Sludge mixture, and Table 3 is for the 207C Pond Solution only In all cases, the safety fraction or radiation exposure calculated is smaller than the largest value from the Hazard classification or analyzed accident in the Draft SAR Thus, the storage of the brine/sludge mixtures is within the bounding envelope calculated in the Draft SAR

4 0 CONCLUSIONS

The storage of brine/sludge mixtures from the 207C pond and clarifier in tanks on the 750 Pad is within the safety envelope calculated for the storage of Pondcrete on the 750/904 Pads as presented in the Draft SAR

TABLE 1

COMPARISON OF DRAFT SAR ACCIDENT ANALYSIS WITH EARLY REMEDIATION OF SOLAR POND HAZARD ANALYSIS
207C Pond Brine/Sludge

	SAR Hazard Classification	SAR Accidents Evaluated			Early Remediation 207C Pond & Clarifier - 750 Pad	
Exposed Individual Hazardous Chemical Radiological	Small Airplane Crash	Fork Lift Spill	30 Minute Fire	2 Hour Fire	10000 Gallon Tank Spill Inside Tent	Truck Spill Outside Tent
Worker Toxic Exposure Safety Fraction [1]	N/A	[1] 25 7 [2] 0 445	N/A	N/A	[3] 0.91	[3] 0.99
Worker Radiation Exposure Rem (CEDE)	N/A	0 106	N/A	N/A	$1\ 2\times10^{3}$	$4\ 3\times10^{-4}$
On-site Worker Toxic Exposure Safety Fraction [1]	0 63	0 069	0 0014	$2\ 9\times10^{12}$		[3] 0 057
On-site Worker Radiation Exposure Rem (CEDE)	0 0016	6×10^{6}	$3\ 6\times10^{7}$	1×10^{13}		8.2×10^{5}
Off-site Person Toxic Exposure Safety Fraction [1]	0 23	0 00048	8×10^{-5}	$4\ 4\times10^{17}$		[4] $2\ 6\times10^{3}$
Off-site Person Radiation Exposure Rem (CEDE)	00026	$1\ 3\times10^{7}$	$1\ 5\times10^{7}$	$2\ 8\times10^{16}$		$3\ 8\times10^{7}$

Note 1 - Fraction against ERPG2
Note 2 - Fraction against ERPG3
Note 3 - Fraction against ERPG1 (TLV-TWA)
Note 4 - Fraction against 0 1*TLV-TWA

TABLE 2

COMPARISON OF DRAFT SAR ACCIDENT ANALYSIS WITH EARLY REMEDIATION OF SOLAR POND HAZARD ANALYSIS
Clarifier Brine/Sludge

	SAR Hazard Classification	SAR Accidents Evaluated			Early Remediation 207C Pond & Clarifier - 750 Pad	
Exposed Individual Hazardous Chemical Radiological	Small Airplane Crash	Fork Lift Spill	30 Minute Fire	2 Hour Fire	10000 Gallon Tank Spill Inside Tent	Truck Spill Outside Tent
Worker Toxic Exposure Safety Fraction [1]	N/A	[1] 25 7 [2] 0 445	N/A	N/A	[3] 0.55	
Worker Radiation Exposure Rem (CEDE)	N/A	0 106	N/A	N/A	$1\ 4 \times 10^{3}$	
On-site Worker Toxic Exposure Safety Fraction [1]	0 63	0 069	0 0014	$2\ 9 \times 10^{12}$		[3] $1\ 8 \times 10^{3}$
On-site Worker Radiation Exposure Rem (CEDE)	0 0016	6×10^{6}	$3\ 6 \times 10^{7}$	1×10^{-13}		$2\ 5 \times 10^{5}$
Off-site Person Toxic Exposure Safety Fraction [3]	0 23	0 00048	8×10^{5}	$4\ 4 \times 10^{17}$		[4] $4\ 7 \times 10^{-4}$
Off-site Person Radiation Exposure Rem (CEDE)	00026	$1\ 3 \times 10^{7}$	$1\ 5 \times 10^{-7}$	$2\ 8 \times 10^{16}$		$1\ 2 \times 10^{7}$

Note 1 - Fraction against ERPG2
Note 2 - Fraction against ERPG3
Note 3 - Fraction against ERPG1 (TLV-TWA)
Note 4 - Fraction against 0 1*TLV-TWA

TABLE 3

COMPARISON OF DRAFT SAR ACCIDENT ANALYSIS WITH EARLY REMEDIATION OF SOLAR POND HAZARD ANALYSIS
207C Pond Solution Only

	SAR Hazard Classification	SAR Accidents Evaluated			Early Remediation 207C Pond & Clarifier - 750 Pad	
Exposed Individual Hazardous Chemical Radiological	Small Airplane Crash	Fork Lift Spill	30 Minute Fire	2 Hour Fire	10000 Gallon Tank Spill Inside Tent	Truck Spill Outside Tent
Worker Toxic Exposure Safety Fraction [1]	N/A	[1] 25 7 [2] 0 445	N/A	N/A	[3] 1.22	
Worker Radiation Exposure Rem (CEDE)	N/A	0 106	N/A	N/A	$5\ 5\times10^{-4}$	
On-site Worker Toxic Exposure Safety Fraction [1]	0 63	0 069	0 0014	$2\ 9\times10^{-12}$		[3] 0 076
On-site Worker Radiation Exposure Rem (CEDE)	0 0016	6×10^{6}	$3\ 6\times10^{7}$	1×10^{13}		$3\ 4\times10^{5}$
Off-site Person Toxic Exposure Safety Fraction [3]	0 23	0 00048	8×10^{5}	$4\ 4\times10^{17}$		[4] $4\ 9\times10^{3}$
Off-site Person Radiation Exposure Rem (CEDE)	00026	$1\ 3\times10^{7}$	$1\ 5\times10^{7}$	$2\ 8\times10^{16}$		$1\ 6\times10^{7}$

Note 1 - Fraction against ERPG2
Note 2 - Fraction against ERPG3
Note 3 - Fraction against ERPG1 (TLV-TWA)
Note 4 - Fraction against 0 1*TLV-TWA

NUCLEAR SAFETY ENGINEERING CALCULATION COVER SHEET

Sheet 1 of 23 Sheets

Title Hazard Calculation for Remediation of 207C Pond and Clarifier

Building 207C Solar Pond / 750 Pad

Project Work Package 12188 Calculation No 94-S.E-00.

Analyzed System _____ Supersedes Calculation No _____

References _____

If Superseded, Give Superseding Calculation Number _____

Calculation Objective/Summary Description

Provide a Safety Analysis for the Accelerated Solar Pond Sludge and Liquor Removal and Storage in Tanks for the 207C Pond and Clarifier

Computer Code

Dated Program Version _____

Operating System _____

Hardware Configuration _____

Rev No	Revision	Originator	Date	Checked By	Date	Approved By	Date
0	Original	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1/20/94

NUCLEAR SAFETY ENGINEERING CALCULATION
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By A. C. Stalker Date 1/7/94 Sheet 2 of 23 Sheets

Calculation No 94-SAE-001

Checked By [illegible] Date 1/13-94 Revision No 0

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Additional Comments

Subject Hazard Calculation for Remediation of 207C Pond and Clarifier
By A C Stulke Date 1/7/04 Chk By B S Ryfel Date 1-13-94 Orig ☒ Rev ☐

1 Object of Calculation

The object of the calculation is to combine the Hallburton/NUS and Weston analytical data for the solar pond 207C sludge and liquid analyses and for the clairifyer data, (NUS only) Calculate the hazard for storing the sludge and liquid material in 10000 gallon tanks on the 750 Pond These results will be compared to the 750 draft SAR accident calculation.

2 Methodology.

a. Combine the Weston and Hallburton/NUS analytical data for both the sludge and liquid in the 207C Pond The data are as follows

1. ~~Sludge~~ Liquid

Weston 1 composite sample from 4 quadrants
NUS 5 quadrants sample (1 duplicate from NE)

NUS Calculate an average from the 5 samples
((NE + NE dup)/2 + NW + SE + SW)/4

Calculate an average value from (NUS - weston)/2 for each analyte when one value is missing will use the other at its value

A conservative concentration value is based on the largest single measurement in any of the six samples

These calculations are found in EXCELL Spreadsheet 207CF20 XLS Hard copy is page 5 through 7 of this calculation

2. Sludge

Weston 4 quadrant sample - 1 composite of 4 quadrants

Subject Hazard Calculation for Remediation of 207C Pond and Clarifier
By A C Stalker Date 1/7/94 Chk By G S Raphael Date 1-15-94 Orig ☒ Rev ☐

2 a 2 cont'

NUS 1 four quadrant composite, 1 berm sample, 3 quadrant samples (NW, NW dup & SW)

Averages calculated for each company.

Weston ((NW + SW + NE + SE)/4 + composite)/2

NUS (((NW − NWD)/2 + SW)/2 + composite)/2

NUS data found in EXCEL SPREADSHEET NUSCSLG XLS
Hard copy is pages 8 − 10 of this calculation

Weston data found in EXCEL SPREADSHEET 207CSLG.XLS
Hard copy is pages 11 − 15 of this calculation.

A best estimate average value was calculated as (Weston + NUS)/2 for those cases where both vendors reported a value. For those ~~cases~~ analytes where only one vendor reported, that concentration was used EXCEL FILE 207CSLG XLS

b. The only analytical data for the clarifier was done by Halliburton/NUS

1. Liquid - Three sample locations with one duplicate were analyzed. An average value was calculated as ((001 + 001 dup)/2 + 002 + 003)/3. A conservative value estimate used the highest value for an analyte EXCEL FILE 207CSLG XLS

2 Sludge - Three sample locations with one duplicate were analyzed. An average value was calculated as ((001 + 001 dup)/2 + 002 + 003)/3 EXCEL FILE NUSCSLG XLS

NEXT TEXT ON PAGE 16

207 C Solar Pond Water Sample Analytical Data

Detection Limit Values are BOLD numbers

Less than multiplier = 1

Analyte	Mole wt	Halliburton NUS Samples PW207C NE mg/L	PW207C NED mg/L	PW207C NW mg/l	PW207C SE mg/L	PW207C SW mg/L	Halliburton NUS Average mg/L	Weston 207 C mg/L	207C Pond Average mg/L
2 Butanone	72 12	0 11	0 077	0 11	**0 01**	0 079	7 31E 02		7 31E 02
Ag	107 87								
A	74 92	4 11	3 37	3 55	3 35	4 07	3 68E+00	1	2 34E+00
B as B(OH)4	78 84	3 35E+03	3 60E+03	3 19E+03	3 19E+03	3 53E+03	3 35E+03	2 62E+03	2 99E+03
Ba	137 33	0 13	0 11	0 13	0 13	0 15	1 33E 01		1 33E 01
Cd	112 41	0 49	0 43	0 45	0 5	0 56	4 93E 01	0 312	4 02E 01
Cr	52	3 58	3 4	3 37	3 32	3 94	3 53E+00	2 36	2 95E+00
Cu	63 546							6 79	6 79E+00
Hg	200 59								
Pb	207 2	0 3	0 3	0 3	0 3	0 3	3 00E 01	0 3	3 0E 01
Mg	24 305	2 97	1 3	2 95	2 85	3 87	2 95E+00		2 95E+00
Ni	58 71	2 61	2,92	2 56	2 54	2 79	2 66E+00	5 09	3 88E+00
K	39 0983	55200	59200	55200	54700	54500	5 54E+04	78700	6 71E+04
Se	78 96	0 6	6	3	3	0 6	2 48E+00	0 5	1 49E+00
Si	28 0855							30 1	3 01E+01
Na	22 99	138000	142000	137000	136000	136000	1 37E+05	102000	1 20E+05
Zn	65 39							2	2 00E+00
NH3	17	5	6 4	1 9	1 8	3 6	3 25E+00		3 25E+00
Cl	35 4527	21000	24000	25000	22000	23000	2 31E+04	18300	2 07E+04
F	18 998							1470	1 47E+03
NO2	46							8225	8 23E+03
NO3	62	65000	66000	57000	62000	62000	6 16E+01	11518	3 66E+04
CN	26	3 3	20	1	7 1	4 1	6 71E+00	9 65	8 18E+00
SO4	96	17000	17000	18000	16000	17000	1 70E+04	12200	1 46E+04
CO3	60							25000	2 50E+04
HCO3	61							4000	4 00E+03
TOC		1300	1600	1300	1200	1400	1 34E+03	54 9	6 96E+02
P	30 97	570	610	520	560	570	5 60E+02	431	4 96E+02
Total		3 01E+05	3 14E+05	2 97E+05	2 96E+05	2 98E+05	3 00E+05	2 65E+05	3 01E+05
Sum of Fraction									
pH		10	10 1	10 1	10 1	10 1	10 09	10 2	10 14
TDS		510000	500000	470000	500000	300000	4 44E+05	400000	4 22E+05
S Gravity		1 348	1 348	1 318	1 33	1 316	1 328	1 328	1 328
		pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L
G Alpha		63000	84000	98000	130000	120000	1 05E+05	7 20E+04	8 87E+04
G Beta		170000	190000	180000	200000	230000	1 98E+05	1 70E+05	1 84E+05
U 234								2 60E+03	2 60E+03
U 235								1 20E+02	1 20E+02
U 238								3 90E+03	3 90E+03
Am 241								8 6	8 60E+00
Pu 239								6 70E+02	6 70E+02

Hazard Calculation For Remediation 207C Pond Land Clinker By [illegible] Date 1/12/94 CHK By [illegible] Date 1/12/94 Calc No 94 SAF 001 Sheet 6 of 23 Sheets

Analyte	Conservative Estimate 207C Pond mg/L	Release Fraction = 10000 gal Tank Conservative Estimate 207C Pond KG	4 10E 06 Worker Conservative Release 207C Pond mg/m3	Worker Safety Factor exp/TLV TWA	3232 Gallon Spill Truck release 207C Pond mg	X/Q (s/m3) 5 1[illegible]E 02 Co located Worker Exposure mg/m3	Co located Worker Safety Factor exp/TLV TWA	X/Q (s/m3) 2 36E 04 Maximum Off site Individual mg/m3	MOI Safety Factor exp/(0 1*TWA)
2 Butanone	1 10E 01	4 16E 03	5 08E 06	8 61E 09	5 52E 03	3 1[illegible]E 07	5 35E 10	1 45E 09	2 45E 11
Ag		0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00
A	4 11E+00	1 56E 01	1 90E 04	9 49E 01	2 06E 01	1 1[illegible]E 05	5 90E 05	5 41E 08	2 70E 06
Ba(PO)4	3 60E+03	1 36E+02	1 66E 01	1 66E 01	1 81E+02	1 0[illegible]E 02	1 03E 02	4 71E 05	4 74E 01
Be	1 50E 01	5 68E 03	6 93E 06	1 39E 05	7 52E 03	4 31E 07	8 61E 07	1 97E 09	3 95E 08
Cd	5 60E 01	2 12E 02	2 59E 05	5 17E 01	2 81E 02	1 6[illegible]E 06	3 21E 05	7 3[illegible]E 09	1 47E 06
Cr	3 91E+00	1 19E 01	1 82E 04	3 61E 03	1 98E 01	1 1[illegible]E 05	2 26E 04	5 19E 08	1 04E 05
Cu	6 79E+00	2 57E 01	3 11E 04	3 14E 01	3 41E 01	1 9[illegible]E 05	1 95E 05	8 9[illegible]E 08	8 93E 07
Hg		0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00	0 00E+00
Pb	3 00E 01	1 14E 02	1 39E 05	9 28E 01	1 50E 02	8 6[illegible]E 07	5 74E 06	3 95E 09	2 63E 07
Mg	3 87E+00	1 16E 01	1 79E 01	1 79E 01	1 94E 01	1 11E 05	1 11E 06	5 09E 08	5 09E 08
Hg	5 09E+00	1 93E 01	2 35E 04	2 35E 01	2 55E 01	1 4[illegible]E 05	1 46E 05	6 70E 08	6 70E 07
K	7 87E+01	2 98E+03	3 61E+00	3 64E 01	3 95E+03	2 2[illegible]E 01	2 26E 02	1 04E 03	1 04E 03
Se	6 00E+00	2 27E 01	2 77E 04	1 39E 03	3 01E 01	1 7[illegible]E 05	8 61E 05	7 89E 08	3 95E 06
Si	3 01E+01	1 14E+00	1 39E 03	1 39E 01	1 51E+00	8 6[illegible]E 05	8 64E 06	3 96E 07	3 96E 07
Na	1 12E+05	5 38E+03	6 56E+00	6 56E 01	7 12E+03	4 0[illegible]E 01	4 08E 02	1 87E 03	1 87E 03
Zn	2 00E+00	7 57E 02	9 24E 05	9 24E 06	1 00E 01	5 7[illegible]E 06	5 74E 07	2 63E 08	2 63E 08
NH3	6 40E+00	2 42E 01	2 96E 04	1 7[illegible]E 05	3 21E 01	1 8[illegible]E 05	1 08E 06	8 4[illegible]E 08	4 95E 08
Cl	2 50E+01	9 46E+02	1 15E+00	0 00E+00	1 25E+03	7 1[illegible]E 02	0 00E+00	3 29E 04	0 00E+00
F	1 47E+03	5 56E+01	6 79E 02	2 7[illegible]E 02	7 37E+01	4 2[illegible]E 03	1 69E 03	1 93E 05	7 73E 05
NO2	8 23E+03	3 11E+02	3 80E 01	0 00E+00	4 13E+02	2 3[illegible]E 02	0 00E+00	1 08E 04	0 00E+00
NO3	6 60E+01	2 50E+03	3 05E+00	0 00E+00	3 31E+03	1 8[illegible]E 01	0 00E+00	8 68E 04	0 00E+00
CN	2 00E+01	7 57E 01	9 24E 04	1 85E 01	1 00E+00	5 7[illegible]E 05	1 15E 05	2 63E 07	5 26E 07
SO4	1 80E+01	6 81E+02	8 31E 01	0 00E+00	9 03E+02	5 1[illegible]E 02	0 00E+00	2 3[illegible] 04	0 00E+00
CO3	2 50E+01	9 46E+02	1 15E+00	0 00E+00	1 25E+03	7 1[illegible]E 02	0 00E+00	3 29E 04	0 00E+00
HCO3	4 00E+03	1 51E+02	1 85E 01	0 00E+00	2 01E+02	1 1[illegible]E 02	0 00E+00	5 26E 05	0 00E+00
TOC	1 60E+03	6 06E+01	7 39E 02	0 00E+00	8 03E+01	4 5[illegible]E 03	0 00E+00	2 10E 05	0 00E+00
P	6 10E+02	2 31E+01	2 82E 02	0 00E+00	3 06E+01	1 7[illegible]E 03	0 00E+00	8 02E 06	0 00E+00
Total	3 71E+05	1 42E+01	1 73E+01	1 73E+00	1 88E+04	1 07E+00	1 07E 01	4 9[illegible]E 03	4 92E 03
Sum of Fraction				1 22E+00			7 58E 02		3 48E 03
pH	10 20								
TD	5 10E+05								
S Gravity	1 348								
	Gallon	1 00E+04	3360	m3 volum					
	pCi/l	Curies	uCi/cc	Rem (CEDE)	Curies	uCi/cc	Rem (CEDE)	uCi/cc	Rem (CEDE)
G Alpha	1 30E+05	4 92E 03	6 00E 12	5 37E 01	6 52E 09	3 7[illegible]E 13	3 34E 05	1 71E 15	1 53E 07
G Beta	2 30E+05	8 71E 03	1 06E 11	1 82E 05	1 15E 08	6 60E 13	1 13E 06	3 03E 15	5 19E 09
U 234	2 60E+03	9 84E 05	1 20E 13	1 97E 07	1 30E 10	7 46E 15	1 22E 08	3 42E 17	5 61E 11
U 235	1 20E+02	1 51E 06	5 54E 15	8 11E 09	6 02E 12	3 4[illegible]E 16	5 23E 10	1 58E 18	2 10E 12
U 238	3 90E+03	1 48E 01	1 80E 13	2 63E 07	1 96E 10	1 1[illegible]E 14	1 63E 08	5 13E 17	7 48E 11
Am 241	8 60E+00	3 26E 07	3 97E 16	3 66E 09	4 31E 13	2 4[illegible]E 17	2 27E 09	1 13E 19	1 04E 11
Pu 239	6 70E+02	2 53E 05	3 09E 14	2 77E 06	3 36E 11	1 9[illegible]E 15	1 72E 07	8 81E 18	7 88E 10

Hazard Calculation For Remediation of 207C Pond and Clarifier By [signature] Date 1/13/94 CHK By [signature] Date 1-13-94 Calc No 94 SAF 001 Sheet 7 of 23 Sheets

Detection Limit Values are BOLD numbers

Halliburton - NUS Clarifier Analytical Data

Analyte	CW 001 mg/L	CW 001D mg/L	CW 002 mg/L	CW 003 mg/L	Clarifier Average mg/L	Conservative Estimate Clarifier mg/L	56781 Liters Clarifier Liquid KG	TLV TWA mg/m3	
2 Butanone								590	
Ag	0 066	0 11	0 072	0 091	8 37E 02	1 10E 01	6 25E 03	0 01	as Ag
As	0 342	0 272	0 334	0 302	3 14E 01	3 42E 01	1 94E 02	0 2	as As
B as P(OH)4	1 74E+02	1 70E+02	2 20E+02	2 53E+02	2 15E+02	2 53E+02	1 44E+01	1	as borate
Ba	0 044	0 091	0 03	0 032	4 32E 02	9 10E 02	5 17E 03	0 5	as Ba
Cd	0 231	0 57	0 038	0 043	1 61E 01	5 70E 01	3 24E 02	0 05	as Cd
Cr	0 283	0 825	0 138	0 175	2 89E-01	8 25E 01	4 68E 02	0 05	as Cr(VI)
Cu								1	as Cu dust & mist
Hg	0 0022	0 0038	0 0035	0 0046	3 70E 03	4 60E 03	2 61E 04	0 01	as Hg skin & alkyl cmpds
Pb	0 034	0 046	0 03	0 03	3 33E 02	4 60E 02	2 61E 03	0 15	as Pb inorg dust & fume
Mg	3 27	6 73	2 58	3 02	3 53E+00	6 73E+00	3 82E 01	10	MgO fume
Ni	0 258	0 393	0 293	0 335	3 18E 01	3 93E 01	2 23E 02	1	as Ni insoluble cmpds
K	4930	4860	6090	7000	6 00E+03	7 00E+03	3 97E+02	10	PNOC
Se								0 2	as Se
Si								10	precipitated silica
Na	10200	9940	12800	14800	1 26E+04	1 48E+04	8 40E+02	10	PNOC
Zn								10	as ZnO dust
NH3	8 5	5	9 8	14	1 02E+01	1 40E+01	7 95E 01	17	as NH3
Cl	1600	1700	3200	1850	2 23E+03	3 20E+03	1 82E+02		
F								2 5	as F fluorides
NO2									
NO3	10000	5700	6900	6100	7 05E+03	1 00E+04	5 68E+02		
CN	2 4	2 7	2 8	3	2 78E+00	3 00E+00	1 70E 01	5	as CN
SO4	3200	2600	2800	2600	2 77E+03	3 20E+03	1 82E+02		
CO3									
HCO3									
TOC	190	140	160	170	1 65E+02	1 90E+02	1 08E+01		
P	84	80	78	81	8 03E+01	8 40E+01	4 77E+00		
Total	3 04E+01	2 52E+01	3 23E+04	3 32E+01	3 11E+04	3 88E+01	2 20E+03	10	PNOC
Sum of Fraction									
pH	10	10	10	9 9	9 97	10 00			
TDS	46000	61000	60000	68000	6 05E+04	6 80E+04			
S Gravity	1 038		1 040	1 011	1 041	1 044			
	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	pCi/L	Curies	CEDE Rem/Ci	
G Alpha	16000	19000	18000	16000	1 72E+04	1 90E+04	1 08E 03	4 30E+08	Assumes all Pu 239
G Beta	23000	22000	26000	30000	2 62E+04	3 00E+01	1 70E 03	8 25E+06	Assumes all Pu 241
U 234								7 89E+06	Inhalation Class W
U 235								7 30E+06	Inhalation Class W
U 238								7 01E+06	Inhalation Class W
Am 241								4 43E+08	Inhalation Class W
Pu 239								4 30E+08	Inhalation Class W

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Hazard Calculation For Remediation of 207C Pond and Clarifier By [illegible] Date 1/13/94 CHK By [illegible] Date [illegible] Calc No 94 SAE 001 Sheet 8 of 23 Sheets

Halliburton/NUS Sludge Data

Less than multiplyer = 1 0

Analyte	Composite PS207C mg/kg	Composite Berm 207C mg/kg	PS207C NW mg/kg	PS207C NWD mg/kg	PS207C SW mg/kg	Average PS207C mg/kg	Average PS207C KG	CS 001 mg/kg	CS 001D mg/kg
1 1,1 Trichloroethane								0 026	0 009
2 Butanone	0 015	0 074	0 16	0 16	0 14	8 30E 02	2 22E 02	0 18	0 092
Benzene	0 007				0 031	7 00E 03	1 87E 03		
Trichlorotrifluoroethane								0 1	0 073
Tetrachloroethylene	0 011	0 073	0 009	0 008	0 01	1 01E 02	2 71E 03	1	0 28
Trichloroethylene				0 007	0 005	6 00E 03	1 60E 03		0 007
Pyrene	0 19	0 32				1 90E 01	5 08E 02		
Arsenic	23 9	35	37	18	26 2	2 54E +01	4 08E +00	21 9	13 5
Barium	23	61 5	13 2	32 2	25 2	2 35E +01	3 77E +00	217	94 8
Boron as P(OH)4	3 32E +03	5 05E +03	4 33E +03	5 [illegible]E +03	3 91E +03	3 89E +03	6 25E +02	5 01E +03	3 06E +03
Cadmium	67 3	665	28 9	31 8	27 3	4 81E +01	7 72E +00	4660	2010
Calcium									
Chromium	572	960	252	718	586	5 54E +02	8 90E +01	2640	1180
Lead	12 9	38 5	7 9	19 1	18 4	1 44E +01	2 32E +00	182	83
Magnesium	2410	6250	1340	3690	3160	2 62E +03	4 22E +02	24200	10400
Mercury	1	1	0 8	0 8	0 7	8 75E 01	1 41E 01	5	5 3
Nickel	33 6	146	17 4	30 5	34 2	3 13E +01	5 04E +00	738	339
Potassium	87200	64500	82000	81200	75700	8 29E +04	1 33E +04	62300	28700
Silver	58 6	73 6	35 1	51 1	49 2	5 28E +01	8 48E +00	156	64 6
Sodium	114000	150000	19300	162000	139000	1 29E +05	2 08E +04	84000	39200
Ammonia	0 01	0 01	0 01	0 01	0 01	1 00E 02	1 61E 03	84	64
CN	13	14	170	150	14	5 00E +01	8 03E +00	25	21
Cl	14800	14600	13200	13800	15000	1 53E +04	2 45E +03	3200	3200
NO3	220000	178000	200000	200000	200000	2 10E +05	3 37E +04	8200	9000
SO4	26000	17600	18800	16200	18000	2 19E +04	3 51E +03	4200	4400
Total Organic Carbon	9000	8900	6400	7300	7200	8 01E +03	1 29E +03	3500	6200
Total	5 08E +05	4 17E +05	3 46E +05	4 97E +05	4 63E +05	4 75E +05	7 63E +04	2 03E +05	1 08E +05
Sum of Fraction									
TDS									
Moisture Gravimetric %	33 8	16 5	48 4	18 8	41 3	31 9	1 07E +05	69	33 1
Moisture Karl Fisher %									
Specific Gravity						1 82E +00			
	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	Curies	pCi/g	pCi/g
Gross Alpha pCi/g	1500	5900	2700	3100	8700	5 15E +03	8 27E 01	6600	6300
Gross Beta pCi/g	660	810	170	120	1200	7 41E +02	1 19E 01	780	860
Volume in Liters						1 47E +05			
Sludge Dry Weight KG						1 61E +05			
Sludge Weight KG						2 67E +05	1 83E +05		
Sludge Volume gallons						38789			
# of 10000 gallon tank						4			

Excel File NUSCSLG XLS

1/12/94

Hazard Calculation For Remediation of 2070 Tank Land Clarifier By [illegible] Date 1/13/91 CHK By [illegible] Date [illegible] Calc No 94 AL 001 Sheet 9 of 23 Sheets

Analyte	CS 002 mg/kg	CS 003 mg/kg	Average Clarifier Sludge mg/kg	Average Clarifier Sludge KG	Clarifier Liquid mg/L	Clarifier Liquid KG	Clarifier Total KG	Release Fraction = 3 85E 07 Clarifier 10 000 Gallon Release mg	Clarifier Release Worker mg/m3
1 1 1 Trichloroethane	0 018	0 029	2 15E 02	1 30E 03			1 30E 03	1 86E 04	1 86E 07
2 Butanone	0 037	0 13	1 18E 01	7 10E 03			7 10E 03	1 02E 03	1 02E 06
Benzene							0 00E+00	0 00E+00	0 00E+00
Trichlorotrifluoroethane	0 015	0 15	9 38E 02	5 66E 03			5 66E 03	8 11E 04	8 11E 07
Tetrachloroethylene	0 32	0 83	5 97E 01	3 60E 02			3 60E 02	5 15E 03	5 15E 06
Trichloroethylene			7 00E 03	4 23E 04			4 23E 04	6 05E 05	6 05E 08
Pyrene							0 00E+00	0 00E+00	0 00E+00
Arsenic	11 5	12 5	1 49E+01	3 25E 01	0 342	1 91E 02	3 45E 01	4 94E 05	4 94E 05
Barium	215	207	1 93E+02	4 21E+00	0 091	5 17E 03	4 21E+00	6 03E 01	6 03E 04
Potassium P(OH)4	8 97E+03	1 01E+04	7 69E+03	1 68E+02	253	1 41E+01	1 82E+02	2 61E+01	2 61E 02
Cadmium	1030	1280	3 77E+03	8 [illegible]E+01	0 57	3 [illegible]4E 02	8 23E+01	1 18E+01	1 18E 02
Calcium							0 00E+00	0 00E+00	0 00E+00
Chromium	3130	2900	2 67E+03	[illegible]	0 825	4 [illegible]9E 02	5 83E+01	8 34E+00	8 34E 03
Lead	191	187	1 70E+02	3 [illegible]E+00	4 60E 02	2 [illegible]1E 03	3 72E+00	5 32E 01	5 32E 04
Magnesium	23300	24100	2 16E+01	4 71E+02	6 73	3 [illegible]2E 01	4 71E+02	6 75E+01	6 75E 02
Mercury	12	14	1 04E+01	2 27E 01	4 60E 03	2 [illegible]1E 04	2 27E 01	3 25E 02	3 25E 05
Nickel	902	822	7 51E+02	1 [illegible]E+01	0 393	2 [illegible]3E 02	1 65E+01	2 36E+00	2 36E 03
Potassium	[illegible]	57100	6 02E+01	1 31E+03	7000	3 97E+02	1 71E+03	2 45E+02	2 45E 01
Silver	153	166	1 13E+02	[illegible]	0 11	6 [illegible]E 03	3 13E+00	4 48E 01	4 48E 04
Sodium	95300	26300	3 46E+01	1 [illegible]E+03	1 18E+01	[illegible]	2 69E+03	3 85E+02	3 85E 01
Ammonia	9	71	5 77E+01	[illegible]	14	7 [illegible]5E 01	2 05E+00	2 93E 01	2 94E 04
CN	130	110	1 [illegible]E+02	[illegible]	3	1 [illegible]0E 01	2 52E+00	3 61E 01	3 61E 04
Cl	3600	3100	3 10E+02	[illegible]	3200	1 [illegible]E+02	2 56E+02	3 66E+01	3 66E 02
NO3	8600	8100	8 60E+02	1 [illegible]E+02	1 00E+04	5 [illegible]E+02	7 56E+02	1 08E+02	1 08E 01
SO4	[illegible]	[illegible]	[illegible]	1 [illegible]E+02	3 20E+03	1 8[illegible]E+02	2 92E+02	4 17E+01	4 17E 02
Total Organic Carbon	1[illegible]0	6100	5 [illegible]	1 [illegible]E+02	190	1 0[illegible]E+01	1 26E+02	1 81E+01	1 81E 02
Total Concentration	[illegible]	[illegible]	2 04E+01	1 [illegible]E+03	3 37E+04	2 [illegible]E+03	6 66E+03	9 53E+02	9 53E 01
TDS					0 90E+04				
Moisture Gravimetric	[illegible]	[illegible]	6 35	[illegible]E+01					
Moisture Karl Fischer									
Specific Gravity			1 21		1 044				
	[illegible]	pCi/g	pCi/g	Curies	pCi/L	Curies	Curies	Curies	uCi/cc
Gross Alpha	[illegible]	1 00	4 85E+03	1 05E 01	1 90E+01	1 [illegible]9E 03	1 07E 01	1 53E 08	1 53E 11
Gross Beta	[illegible]	600	6 53E+02	1 13E 02	3 00E+04	1 70E 03	1 60E 02	2 29E 09	2 29E 12
Volume in Liters			1 50E+01		5 68E+04		1 02E+05	Volume (m3) =	1000
Sludge Dry Weight KG			2 18E+01						
Sludge Wet Weight KG			6 01E+01	1 30E+01					
Sludge Volume gallons			11900		15000				
# of 10000 gallon tanks			2		2		3		

Hazard Calculation For Remediation of 207C Fuel and Clarifier By [illegible] Date 1/13/94 CHK By [illegible] Date [illegible] Calc No 94 SAF 001 Sheet 10 of 23 Sheet

Analyte	Worker Safety Factor exp/TLV TWA	X/Q (s/m3) = Clarifier Truck, 3232 Gallon release mg	Co located Worker Exposure mg/m3	Co located Worker Safety Factor exp/TLV TWA	Maximum Off site Individual mg/m3	MOI Safety Factor exp/(0.1*TWA)	TLV TWA mg/m3	
1,1,1 Trichloroethane	9.72E-11	6.00E-05	3.44E-09	1.80E-12	1.57E-11	8.24E-14	1910	
2 Butanone	1.72E-09	3.29E-04	1.88E-08	3.19E-11	8.62E-11	1.46E-12	590	
Benzene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	32	
Trichlorotrifluoroethane	1.00E-10	2.62E-04	1.50E-08	1.95E-12	6.87E-11	8.96E-14	7670	
Tetrachloroethylene	1.52E-08	1.67E-03	9.53E-08	2.81E-10	4.37E-10	1.29E-11	339	
Trichloroethylene	2.25E-10	1.95E-05	1.12E-09	4.16E-12	5.13E-12	1.91E-13	269	
Pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		
Arsenic	2.17E-04	1.60E-02	9.13E-07	1.56E-06	4.18E-09	2.09E-07	0.2	as As
Barium	1.21E-03	1.95E-01	1.12E-05	2.23E-05	5.11E-08	1.02E-06	0.5	as Ba
Boron as P(OH)4	2.61E-02	8.13E+00	4.82E-04	4.82E-04	2.21E-06	2.21E-05	1	as borate
Cadmium	2.36E-01	3.81E+00	2.18E-04	4.36E-03	9.99E-07	2.00E-04	0.05	as Cd
Calcium	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	10	as carbonate or silicate
Chromium	1.67E-01	2.70E+00	1.54E-04	3.09E-03	7.07E-07	1.41E-04	0.05	as Cr (VI)
Lead	3.55E-03	1.72E-01	9.84E-06	6.56E-05	4.51E-08	3.01E-06	0.15	as Pb inorg dust & fumes
Magnesium	6.75E-03	2.18E+01	1.25E-03	1.25E-04	5.72E-06	5.72E-06	10	as MgO fume
Mercury	3.25E-03	1.05E-02	6.01E-07	6.01E-05	2.75E-09	2.75E-06	0.01	as Hg skin & alkyl compds
Nickel	2.30E-03	7.63E-01	4.37E-05	4.37E-05	2.00E-07	2.00E-06	1	as ni insoluble compounds
Potassium	2.15E-02	7.92E+01	4.53E-03	4.53E-04	2.08E-05	2.08E-05	10	PNOC
Silver	1.49E-02	1.45E-01	8.29E-06	8.29E-04	3.80E-08	3.80E-05	0.01	as Ag
Sodium	3.85E-02	1.24E+02	7.12E-03	7.12E-04	3.26E-05	3.26E-05	10	PNOC
Ammonia	1.73E-05	9.50E-02	5.14E-06	3.20E-07	2.49E-08	1.47E-08	17	as NH3
CN	7.22E-05	1.17E-01	6.68E-06	1.34E-06	3.06E-08	6.12E-08	5	as CN
Cl	0.00E+00	1.18E+01	6.78E-01	0.00E+00	3.10E-06	0.00E+00		
NO3	0.00E+00	3.50E+01	2.00E-03	0.00E+00	9.17E-06	0.00E+00		
SO4-	0.00E+00	1.35E+01	7.72E-04	0.00E+00	3.54E-06	0.00E+00		
Total Organic Carbon	0.00E+00	5.84E+00	3.34E-04	0.00E+00	1.53E-06	0.00E+00		
Total	9.53E-02	3.08E+02	1.76E-02	1.76E-03	8.07E-05	8.07E-05	10	PNOC
Sum of Fraction - TDS	5.54E-01			1.02E-02		4.69E-04		
Moisture Gravimetric %								
Moisture Karl Fischer %								
Specific Gravity								
	Rem CEDE	Curies	uCi/cc	Rem CEDE	uCi/cc	Rem CEDE	Rem/Ci	Inhalation
Gross Alpha pCi/g	1.37E-03	4.95E-09	2.83E-13	2.53E-05	1.30E-15	1.16E-07	4.30E+08	Assumes all Pu 239
Gross Beta pCi/g	3.92E-06	7.39E-10	4.23E-11	7.25E-08	1.94E-16	3.32E-10	8.25E+06	Assumes all Pu 241
Volume in Liters								
Sludge Dry Weight KG								
Sludge Weight KG								
Sludge Volume gallons								
# of 10000 gallon tanks								

Ex [illegible] NUSCSLG XLS

1/12/94

Enclosure 1
SRK-022-94
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By [illegible] Date 11/3/94 Chk By [illegible] Date [illegible]

	Less than multiplier =	1		Weston Solar Pond Sludge Data		
Analyte	Molecular Weight	207C-NW-SL mg/kg	207C NE SL mg/kg	207C SW SL mg/kg	207C-SE SL mg/kg	207C CP SL mg/kg
2-Butanone	72 12					
Benzene	78 12					
Tetrachloroethylene	165 8					
Trichloroethylene	13 4					
Pyrene	202 26					
Aluminum	26 98	69 5	132	1330	82 4	97 2
Antimony	121 75	10 1	12 1	13 8	12 1	13
Arsenic	74 92	2 2	2	2 7	2	2
Barium	137 33					
Beryllium	9 012	0 85	1 1	17 6	1	1 1
Boron as B(OH)4	78 84	5 75E+02	8 68E+02	1 01E+04	7 51E+02	8 53E+02
Cadmium	112 41	3 2	5 8	116	4 5	5 6
Calcium	40 08	845	1010	1550	1010	1080
Chromium	51 996	16	21 6	365	19 2	17 6
Copper	63 546	4 3	5 3	78	5 1	6 3
Iron	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lead	207 2	0 66	0 51	2	0 61	0 59
Lithium	6 941	24	36 9	108	32 7	42 8
Magnesium	24 305					
Manganese	54 938	2 5	3	8 7	3	3 3
Mercury	200 59	0 17	0 17	0 27	0 11	0 11
Nickel	58 71	6 8	8 1	20 1	8 1	8 7
Potassium	39 098	224000	365000	16900	327000	273000
Silicon	28 086	506	862	6990	607	422
Silver	107 87	1 7	2	4 4	2	2 2
Sodium	22 99	36900	49200	378000	45800	50900
Selenium	78 96					
Zinc	65 39	5 3	[illegible]	9 9	[illegible]	5 5
Chloride	35 45	2860	[illegible]	9890	2630	[illegible]
Fluoride	18 998	6020	1 700	29000	14800	22800
Cyanide	26	2 2	6	5 2	9 9	3 2
Sulfate	96	20800	53900	[illegible] 000	60000	10000
Nitrite	46	1579 2	3290	1710 8	1776 6	2632
Nitrate	62	443000	287950	575900	443000	429710
Carbonate	60					
Bicarbonate	61					
Phosphorus	30 97	1600	1300	3400	400	1700
Ammonia	17	3 28	3 28	5 46	3 40	[illegible] 3
TOC						
Total of Identified		7 47E+05	7 78E+05	1 7E+06	9 07E+05	8 99E+05
Water		9 00E+04	9 90E+04	[illegible] E+05	[illegible]1E+05	[illegible]E+04
Grand Total		8 37E+05	8 77E+05	1 40E+06	1 01E+06	9 76E+05
TDS (Liquids)						
% Solids		91	90	77 9	89 9	92 3
Volume Liters						
Specific grav						
Sludge Kg Wet						
		pCi/g (dry)	pCi/g (dry)	pCi/g (dry)	pCi/g (dry)	pCi/g (dry)
Gross alpha		29	0	1200	25	18
Gross beta		500	290	0	420	420
U 234		1 1	0 06	9 2	0 011	5 2
U 235		0 36	0 1	0 4	0 016	0 84
U 238		16	5 7	14	-	-
Am 241		0 73	0 5	0 0	0 -	-
Pu 239		16			2 8	5
Total Specific Isotopes						
Sum of Gross						

By [illegible] Date 11/13/94 CHK By [illegible] Date [illegible]

	Weston Average	Halliburton NUS Average	Best Est Average	Conservative Sludge conc	Best Est Sludge conc	Conservative Water Conc
Analyte	207C	207C	207C	207C	207C	207C
	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/L
2-Butanone		8 30E 02	8 30E 02	8 30E 02	1 51E 01	1 10E 01
Benzene		7 00E 03	7 00E 03	7 00E 03	1 27E 02	
Tetrachloroethylene		1 01E 02	1 01E 02	1 01E 02	1 84E 02	
Trichloroethylene		6 00E 03	6 00E 03	6 00E 03	1 09E 02	
Pyrene		1 90E 01	1 90E 01	1 90E 01	3 46E 01	
Aluminum	2 50E+02		2 50E+02	2 50E+02	4 56E+02	
Antimony	1 25E+01		1 25E+01	1 25E+01	2 28E+01	
Arsenic	2 23E-00	2 54E+01	1 38E-01	2 54E+01	2 51E+01	4 11E+00
Barium		2 35E+01	2 35E+01	2 35E+01	4 28E+01	1 50E 01
Beryllium	3 12E+00		3 12E+00	3 12E+00	5 68E+00	
Boron as B(OH)4-	1 97E+03	3 89E+03	2 93E+03	3 89E+03	5 03E+03	3 60E+03
Cadmium	1 90E+01	4 81E+01	3 35E+01	4 81E+01	6 10E-01	5 60E 01
Calcium	1 09E+03		1 09E+03	1 09E+03	1 99E+03	
Chromium	6 15E+01	5 54E+02	3 08E+02	5 54E+02	5 60E+02	3 94E-00
Copper	1 48E-01		1 48E-01	1 48E+01	2 69E+01	6 79E+00
Iron	5 87E-0		5 87E-0	5 87E-0	[illegible]	
Lead	7 68E 01	1 44E-01	7 58E-00	1 44E-01	1 38E+01	3 00E 01
Lithium	4 66E+01		4 66E-01	4 66E+01	8 48E-01	
Magnesium		2 62E+03	2 62E-03	2 62E+03	4 77E+00	3 87E-00
Manganese	3 80E+00		3 80E+00	3 80E+00	6 92E-00	
Mercury	1 45E-01	8 75E-01	5 10E 01	8 75E 01	9 28E 01	
Nickel	1 01E+01	3 13E+01	2 07E+01	3 13E-01	3 77E+01	5 09E-00
Potassium	2 53E+05	8 29E+04	1 68E+05	2 53E+05	3 06E+05	7 87E+04
Silicon	1 33E+03		1 33E-03	1 33E-03	2 42E+03	3 01E-01
Silver	2 53E+00	5 28E+01	2 77E-01	5 28E+01	5 03E+01	
Sodium	8 92E+04	1 29E+05	1 09E+05	1 29E+05	1 99E-05	1 42E+05
Selenium			0 00E-00	0 00E-00	0 00E+00	6 00E-00
Zinc	7 2 E-00		7 21E-00	7 21E-00	1 3 E-01	2 00E-00
Chloride	4 56E-00	1 53E-04	9 90E-00	50E-04	1 81E-04	2 50E-04
Fluoride	1 92E+04		1 92E-04	92E-04	3 50E+04	1 47E-00
Cyanide	3 96E-00	5 00E-0	2 70E-0	5 00E-01	4 91E-0	2 00E-01
Sulfate	9 15E-04	2 19E+04	5 67E-04	9 5E-04	00E-05	80E-04
Nitrite	2 36E+03		2 36E-03	2 36E+03	4 30E+03	8 23E+03
Nitrate	4 34E-05	2 10E+05	3 22E-05	4 34E-05	5 86E-05	6 60E-04
Carbonate			0 00E-00	0 00E-00	0 00E-00	2 50E+04
Bicarbonate			0 00E-00	0 00E-00	0 00E-00	4 00E+03
Phosphorus	1 81E-03		1 81E-03	1 81E-03	3 30E+03	6 10E-02
Ammonia	3 99E-00		3 99E-00	3 99E-00	7 27E-00	6 40E-00
TOC		7 20E+03	7 20E-03	7 20E-03	1 3 E-04	3 49E-00
Total of Identified	9 00E-05	4 74E-05	7 05E-05	9 63E-05	20E-06	3 78E-05
Water	1 02E-05	3 99E-05	2 5 E-05		4 56E-05	9 26E-05
Grand Total	1 00E-06	8 73E-05	9 56E-05		1 82E-06	1 30E-06
TDS (Liquids)						4 22E-05
% Solids	89 8	60 1	74 9			
Volume Liters						
Specific gravity		1 82	82			3-3
Sludge Kg Wet						
	pCi/g (dry)	pCi/g (dry)	pCi/g (dry)	pCi/g (dry)	pCi/L	pCi/L
Gross alpha	1 66E-02	5 15E-03	2 66E-03	5 15E+03	9 37E+06	1 30E-05
Gross beta	3 74E+02	7 41E-02	5 57E-02	7 41E+02	1 35E+06	2 30E-05
U 234	5 13E-00		5 13E-00	5 3E-00	9 34E-03	1 60E-03
U 235	5 30E 01		5 30E 01	5 30E 0	9 64E-02	1 20E-02
U 238	2 01E-01		2 0 E-01	2 0 E-0	3 65E-04	3 90E-03
Pu 241	09E-0		1 09E-00	1 09E-00	99E-03	8 60E-00
Pu 239	1 22E-0		1 22E-01	1 22E-0	2 22E-04	6 70E-02
Total Specific Isotopes						
Sum of Gross						

By [illegible] Date 11/2/94 CHK By [illegible] Date [illegible]

Release Fraction = 1 93E 06

Analyte	Water Conc to 45 wt% TDS 207C mg/L	45% TDS Soln - 5% Sludge Conc mg/L	45% TDS Soln - 5% Sludge 450000 gal KG	45% TDS Soln - 5% Sludge 10000 gal Tk KG	10000 gallon Tank Spill Worker mg/m3	Worker Safety Fraction exp/TLV TWA
2 Butanone	1 64E 01	1 63E 01	2 78E 01	6 18E 03	3 55E 06	6 02E 09
Benzene		6 07E 04	1 03E 03	2 30E 05	1 32E 08	4 12E 10
Tetrachloroethylene		8 78E 04	1 49E 03	3 32E 05	1 91E 08	5 63E 11
Trichloroethylene		5 20E 04	8 86E 04	1 97E 05	1 13E 08	[illegible]
Pyrene		1 65E 02	2 80E 02	6 23E 04	3 58E 07	0 00E+00
Aluminum		2 17E+01	3 70E+01	8 21E 01	4 72E-04	2 36E 04
Antimony		1 08E+00	1 85E+00	4 10E 02	2 36E 05	4 72E 05
Arsenic	6 13E+00	7 03E+00	1 20E+01	2 66E 01	1 53E 04	7 65E 04
Barium	2 24E-01	2 25E+00	3 83E+00	8 52E 02	4 89E-05	9 78E 05
Beryllium		2 70E 01	4 60E 0	1 02E 02	5 88E 06	2 94E 03
Boron as B(OH)4-	5 37E+03	5 36E+03	9 14E+03	2 03E+02	1 17E 01	1 17E 01
Cadmium	8 35E 01	3 70E+00	6 31E+00	1 40E 01	8 05E 05	1 61E 03
Calcium		9 46E+01	1 61E+02	3 58E+00	2 06E 03	2 06E 04
Chromium	5 87E+00	3 23E+01	5 50E+01	1 22E+00	7 02E 04	1 40E 02
Copper	1 01E+01	1 09E+01	1 86E+01	4 13E 01	2 38E 04	2 38E 04
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lead	4 47E 01	08E+00	1 85E+00	4 10E 02	2 36E 05	1 57E 04
Lithium		4 04E+00	6 88E+00	1 53E 01	8 78E 05	8 78E 06
Magnesium	5 77E+00	2 33E+02	3 96E+02	8 80E+00	5 06E-03	5 06E 04
Manganese		3 29E 01	5 61E 01	1 25E 02	7 16E 06	1 43E 06
Mercury		4 42E 02	7 53E 02	1 67E 03	9 61E 07	9 61E 05
Nickel	7 59E-00	9 02E-00	1 54E+01	3 41E 01	1 96E 04	1 96E 04
Potassium	1 17E+05	1 26E+05	2 15E+05	4 78E+03	2 75E+00	2 75E 01
Silicon	4 49E+01	1 58E+02	2 69E+02	5 99E+00	3 44E 03	3 44E 04
Silver		2 40E+00	4 08E+00	9 08E 02	5 21E 05	5 21E 03
Sodium	2 12E+05	2 11E+05	3 60E+05	7 99E+03	4 59E+00	4 59E 01
Selenium	8 94E+00	9 52E+00	1 45E+01	3 22E 01	1 85E 04	9 26E 04
Zinc	2 98E+00	3 46E+00	5 90E+00	[illegible]	7 53E 05	7 53E 06
Chloride	3 73E+04	3 64E+04	6 11E+04	1 38E+00	7 90E 3	0 00E+00
Fluoride	2 19E+03	2 75E+03	6 39E+03	4 42E+02	3 16E 02	3 25E 02
Cyanide	2 98E+01	3 07E+01	5 24E+01	1 16E+00	6 68E 04	1 34E 04
Sulfate	2 68E+04	3 05E+04	5 19E+04	5E+03	8 00E 3	0 00E+00
Nitrite	1 23E+04	1 19E+04	2 03E+04	4 50E+02	2 59E 01	0 00E+00
Nitrate	9 84E+04	1 22E+05	2 07E+05	4 60E+03	2 64E+00	0 00E+00
Carbonate	3 73E+04	3 55E+04	6 05E+04	1 34E+00	7 72E 01	0 00E+00
Bicarbonate	5 96E+03	5 68E+03	9 67E+03	2 15E+02	23E 01	0 00E+00
Phosphorus	9 09E+02	1 02E+03	1 74E+03	3 87E+01	2 22E 02	0 00E+00
Ammonia	9 54E+00	9 43E+00	1 61E+01	3 57E 01	2 05E 04	1 2 E 05
TOC	8 18E+03	8 42E+03	1 43E+04	3 19E+02	1 83E 3	0 0 E+00
Total Unidentified	5 64E+05	5 98E+05	1 02E+06	2 26E+04	1 30E+01	30E+00
Water	7 64E+05	7 49E+05	20E+06	2 04E+04	Sum	
C and Total	1 39E+06	1 41E+06	2 40E+06	5 10E+04	of Fraction = 9 11E 01	
TDS (Liquids)	6 29E+05		1 08E+06			
% Solids		TSS =	1 20E+05			
Volume Liters			[illegible]			
Specific gravity	1 00	1 0	[illegible]	[illegible]		
Sludge Kg Wet						
		0 05				
	pCi/L	pCi/L	Curies	Curies	uCi/cc	Rem CEDE
Gross alpha	1 94E+05	6 31E+05	1 07E+00	2 39E 02	37E 11	1 23E 03
Gross beta	3 43E+05	3 91E+05	6 66E 01	1 48E 02	8 50E 12	1 46E 05
U 234	3 88E+03	4 14E+03	7 05E 03	57E 04	8 99E 14	4 80E 07
U 235	1 79E+02	2 16E+02	3 68E 04	3 19E 06	4 70E 15	1 14E 09
U 238	5 91E+03	7 28E+03	2 4E 02	2 75E 04	58E 3	[illegible]
Am 241	28E+01	07E+02	82E 14	4 05E 06	2 3 E 15	[illegible]
Pu 239	9 99E+02	2 01E+03	3 42E 03	7 60E 05	4 37E 14	3 90E 08
Total Specific Isotopes			2 34E 02			4 50E 06
Sum of Gross			1 74E+00			24E 0

By [illegible] Date 11/13/94 CHK By [illegible] Date [illegible]

				χ/Q (s/m3)		χ/Q (s/m3)
				5 15E 02	Co located	2 36E 04
	3232 gal Truck	Truck Spill	Worker	On-site	Worker	Maximum
	45% TDS soln	Worker	Safety	Co located	Safety	Off site
Analyte	+ 5% sludge	Exposure	Fraction	Worker	Fraction	Individual
	KG	mg/m3	exp/TLV TWA	mg/m3	exp/TLV TWA	mg/m3
2 Butanone	2 00E 03	3 86E 06	6 54E 09	2 21E 07	3 74E 10	1 01E 09
Benzene	7 42E 06	1 43E-08	4 48E 10	8 20E 10	2 56E 11	3 76E 12
Tetrachloroethylene	1 07E 05	2 07E 08	6 [illegible]E [illegible]	1 19E 09	3 50E 12	5 43E 12
Trichloroethylene	6 36E 06	1 23E 08	[illegible] 56E 11	7 03E [illegible]	2 61E [illegible]	3 22E 12
Pyrene	2 01E 04	3 89E 07	0 00E - 00	2 22E 08	0 00E + 00	1 02E 10
Aluminum	2 65E 01	5 12E 04	2 56E 04	2 93E 05	1 47E 05	1 34E 07
Antimony	1 33E 02	2 56E 05	5 12E 05	1 47E 06	2 93E 06	6 71E 09
Arsenic	8 60E 02	1 66E 0[illegible]	8 30E 04	9 50E 06	4 75E 05	4 35E 08
Barium	2 75E 02	5 31E 05	1 06E 04	3 04E 06	6 08E 06	1 39E 08
Beryllium	3 31E 03	6 38E 06	3 19E 03	3 65E 07	1 83E 04	1 67E 09
Boron as B(OH)4-	6 56E + 01	1 27E 01	1 27E-01	7 25E 03	7 25E 03	3 32E 05
Cadmium	4 53E 02	8 74E 05	1 75E 03	5 00E 06	1 00E 04	2 29E 08
Calcium	1 16E + 00	2 23E 03	2 23E 04	1 28E 0[illegible]	1 28E 05	5 86E 07
Chromium	3 95E 01	7 62E 04	1 52E 02	4 36E 05	8 72E 04	2 00E 07
Copper	1 34E 0[illegible]	2 58E 04	2 58E 0[illegible]	1 48E 05	1 48E 05	6 76E 08
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lead	1 03E 02	2 56E 05	1 71E 0[illegible]	1 46E 06	9 76E 06	6 71E 09
Lithium	4 94E-02	9 54E 05	9 54E 06	5 46E 06	5 46E 07	2 50E 08
Magnesium	2 85E + 00	5 49E 03	5 49E 04	3 14E 04	3 [illegible]E 05	1 44E 06
Manganese	4 03E 03	7 78E 06	1 56E 06	4 45E 07	8 90E 08	2 04E 09
Mercury	5 41E-04	1 04E-06	1 04E 04	5 97E 08	5 97E 06	2 74E 10
Nickel	1 10E 01	2 13E 04	2 13E 04	1 22E 05	1 22E 05	5 59E 08
Potassium	1 55E + 03	2 98E + 00	2 98E 01	1 71E 01	1 71E 02	7 82E 04
Silicon	1 93E + 00	3 73E 03	3 73E 04	2 14E 04	2 14E 05	9 79E 07
Silver	2 93E-02	5 66E 05	5 66E 03	3 24E 06	3 24E 0[illegible]	1 48E 08
Sodium	2 58E + 03	4 98E - 00	4 98E 01	2 85E 01	2 85E 02	1 31E 03
Selenium	04E 01	2 01E 0[illegible]	1 01E 02	1 15E 05	5 75E 05	5 27E 08
Zinc	[illegible] 2[illegible]E 02	[illegible] 05E 05	[illegible] 80 0[illegible]	[illegible] 80E 06	[illegible] 80E 07	2 [illegible]5E 08
Chloride	4 45E - 02	8 58E 0[illegible]	0 [illegible]0E - 0[illegible]	[illegible] 9 E 02	0 00E - 00	2 20E 0[illegible]
Fluoride	4 59E + 01	8 86E 02	8 55E 0[illegible]	5 07E 03	2 03E 03	2 32E 02
Cyanide	3 76E 01	7 26E 04	1 45E 0[illegible]	[illegible] 15E 05	8 01E 06	90E 07
Sulfate	3 70E + 02	7 [illegible]9E 0[illegible]	0 00E - 00	[illegible] 2E 02	0 00E - 00	89E 0[illegible]
Nitrite	1 45E + 02	2 81E-01	0 00E - 00	1 61E 02	0 00E - 00	7 36E 05
Nitrate	1 49E + 03	2 87E + 00	0 00E - 00	1 64E 01	0 00E - 00	7 53E 04
Carbonate	[illegible] 34E - 02	8 38E 01	0 00E - 00	[illegible] 80E 02	0 00E - 00	2 20E 0[illegible]
Bicarbonate	6 95E + 01	1 34E 0[illegible]	0 00E + 00	7 67E 03	0 00E - 00	3 52E 05
Phosphorus	1 25E - 01	2 42E 02	0 00E - 00	1 38E 03	0 00E - 00	6 33E 06
Ammonia	1 [illegible]5E 0[illegible]	2 23E 04	1 31E 05	1 27E 05	7 50E 07	5 84E 08
TOC	1 03E + 02	1 99E 01	0 00E - 00	1 14E 02	0 00E - 00	5 21E 05
Total Unidentified	7 32E - 03	[illegible] E - 0	[illegible]E - 00	8 09E 0[illegible]	[illegible] 00E 0[illegible]	3 70E 0[illegible]
Water	9 70E - 00	Sum		Sum		Sum
Grand Total	1 70E + 04	of Fraction = 9 89E 01		of Fraction = 5 66E 02		of Fraction =
TDS (Liquids)						
% Solids						
Volume Liquids						
Sludge Volume						
Sludge Kg/Yr						

	Curies	uCi/cc	Rem CEDE	uCi/cc	Rem CEDE	uCi/cc
Gross alpha	8 [illegible]9E 03	4 71E 12	[illegible] 21E 04	9 05E 13	8 09E 05	[illegible] 15E 15
Gross beta	5 07E 03	2 91E 12	5 00E 06	5 60E 1[illegible]	9 61E 07	2 57E 15
U 234	5 07E 05	3 00E 14	5 08E 08	5 93E [illegible]	9 [illegible]E 09	2 72E 17
U-235	2 8[illegible]E 06	1 6[illegible] E 15	2 [illegible]5E 0[illegible]	3 1[illegible]E 16	[illegible] 7 E 10	[illegible]2E 18
U 238	9 [illegible]5E 05	5 [illegible]3E 1[illegible]	7 9[illegible] E 0[illegible]	0[illegible]E [illegible]	[illegible]	[illegible] 7E 17
Am 241	[illegible]9E 06	7 90E [illegible]	7 [illegible]50 0[illegible]	500 [illegible]	[illegible] E 0[illegible]	7 [illegible] E [illegible]
Pu 239	2 6[illegible] E 05	50E 1[illegible]	0[illegible]E 08	2 80E [illegible]	2 [illegible]7E 0[illegible]	1 02E 17
Total Specific Isotopes			54E 06		2 97E 07	
Sum of Gross			4 26E 0[illegible]		8 [illegible]E 05	

By [illegible] Date 11/17/94 CHK By [illegible] Date [illegible]

Analyte	MOI Safety Fraction exp/(0 1*TWA)	TLV-TWA mg/m3	TLV STEL mg/m3	
2 Butanone	1 71E-11	590	885	
Benzene	1 17E 12	32		
Tetrachloroethylene	1 60E 13	339	1357	
Trichloroethylene	1 20E 13	269	1070	
Pyrene	0 00E+00			
Aluminum	6 72E-07	2		as Al soulble salts
Antimony	1 34E-07	0 5		as Sb compounds
Arsenic	2 18E 06	0 2		as As
Barium	2 79E-07	0 5		as Ba
Beryllium	8 37E-06	0 002		as Be
Boron as B(OH)4-	3 32E 04	1		as borate
Cadmium	4 58E 06	0 05		as Cd
Calcium	5 86E 07	10		as carbonate or silicate
Chromium	4 00E-05	0 05		as Cr (VI)
Copper	6 76E 07	1		as Cu dust & mis
Iron	3 15E 07			as Fe soluble salts
Lead	4 47E 07	0 15		as Pb inorg dus & fumes
Lithium	2 50E-08	10		PNOC
Magnesium	1 44E 06	10		MgO fume
Manganese	4 08E-09	5		as Mn dust & compounds
Mercury	2 74E-07	0 01	0 03	as Hg skin & alkyl compounds
Nickel	5 59E-07	1		as Ni insoluble compounds
Potassium	7 82E-04	10		PNOC
Silicon	9 79E 07	10		precipitated silica
Silver	1 48E-05	0 01		as Ag
Sodium	1 31E 03	10		PNOC
Selenium	2 64E 06	0 2		as Se
Zinc	2 15E 08	0		ZnO dus
Chloride	0 00E-00			
Fluoride	9 30E 05	2 5		as F fluorides
Cyanide	3 81E 07	5		as CN
Sulfate	0 00E+00			
Nitrite	0 00E+00			
Nitrate	0 00E+00			
Carbonate	0 00E+00			
Bicarbonate	0 00E+00			
Phosphorus	0 00E+00			
Ammonia	3 44E 08	17	24	as NH3
TOC	0 00E+00			
Total of Identified	3 70E 03	10		PNOC (Particulate not otherwise classified
Water				
Grand Total	2 59E 03			
TDS (Liquids)				
% Solids				
Volume Liters				
Specific Grav				
Sludge kg Wet				

	Rem CEDE	Rem/Ci	Innalation
Gross alpha	3 71E 07	4 30E+08	Assumes all Pu 239
Gross beta	4 40E 09	9 25E+06	Assumes all Pu 239
U 234	4 46E 11	7 89E+06	Class W
U 235	4 16E 12	7 30E+06	Class
U 238	6 97E 11	7 01E+06	Class W
Am 241	5 49E 11	4 40E+09	Class
Pu 239	1 18E 09	4 30E+08	Class W
Total Specific Isotopes	1 36E 09		
Sum of Cross	3 75E 07		

Subject Hazard Calculation for Remediation of 207C Pond and Clarifier
By AE Stalker Date 1/7/94 Chk By E S Rayfel Date 1-13-94 Ong ☒ Rev ☐

2.C. Volumes of sludge and liquid

1 Pond 207C - The entire contents of the Pond will be stored in 10,000 gallon tanks. The plan, per Leon Collins is to circulate and dissolve as much salt as possible. Try to get ~45% TDS in the solution. 45% TDS solution will have a specific gravity of 1.398 as calculated on page 17 of this calculation. Preparing for a mixture of solution and solid sludge material (Total Suspended Solids [TSS]) up to 5% TSS. The total volume of solution + sludge is planned to be 450000 gallons, which includes washdown water.

Brown & Root Calculation from August 4, 1992 measurement data provides the following total solids evaluation

Sludge/Silt	348,125	lbs	dry solids
Crystal Mush	361,805	lbs	dry solids
Soln in sludge/silt	110,365	lbs	TDS
Soln in Xtal mush	231,748	lbs	TDS
Soln above Xtal layer	1,588,811	lbs	TDS
Total lbs of solids	2640834	lbs	Total solids in 207C Pond

450000 gallons * 3.7854 L/gal * 1.409 KG/L * (.45 TDS - .05 TSS) = 1.2×10^6 KG

1.2×10^6 kg * 2.2046 lb/kg = 2.646×10^6 lbs

2. Clarifier

Sludge 11,900 gallons * 3.7854 L/gal = 4.50×10^4

Solution 15000 gallons * 3.7854 L/gal = 5.68×10^4

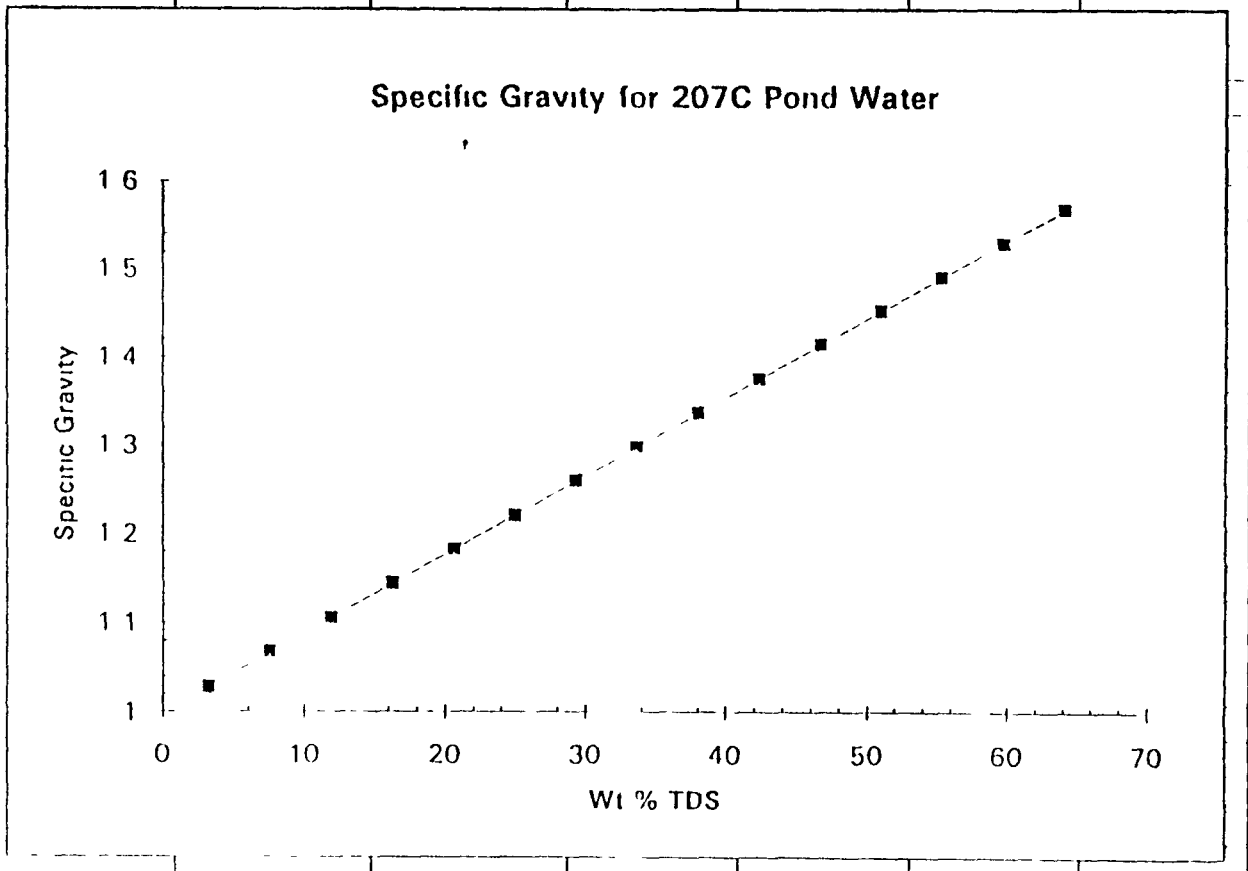
d. Release Fractions

Release fractions for the sludges and slurries

By A C Stalker Date 1/12/94 Chk By G S Reybold Date 1-12-94

207C Pond Liquid Specific Gravity to % TDS Correlation

Wt % TDS	Solution SG	Calculated SG			
			0 008852714	0 999753817	#N/A
3 21	1 028	1 028	4 13148E-06	0 000159453	#N/A
7 57	1 067	1 067	0 999997169	0 000301074	#N/A
11 92	1 105	1 105	4591365 077	13	#N/A
16 28	1 144	1 144	0 416185755	1 17839E 06	#N/A
20 63	1 182	1 182			
24 99	1 221	1 221			
29 34	1 26	1 259			
33 7	1 298	1 298			
38 05	1 337	1 337			
42 41	1 375	1 375			
46 76	1 414	1 414			
51 12	1 452	1 452			
55 47	1 491	1 491			
59 83	1 529	1 529			
64 18	1 568	1 568			
45		1 398			



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Subject Hazard Calculation For Remediation of 207C Pond and Clarifier
By [illegible] Date 1/7/94 Chk By [illegible] Date 1-12-94 Ong ☒ Rev ☐

2 d. cont are based on the work by Ballinger & Hodson (NUREG/CR-4658, 1986) The least squares fit for the data with the upper 95% confidence level is given on pages 19 and 20 of this calculation From this calculation a release fraction for each of the various solutions can be calculated

Material	viscosity cP	Release Fraction @ 95% CL
207C - 45% TDS + 5% TSS	50	1.93×10^{-6}
Clarifier mixed solution & sludge	400	3.55×10^{-7}
207C Liquid	19	4.10×10^{-6}

3 Release Accidents

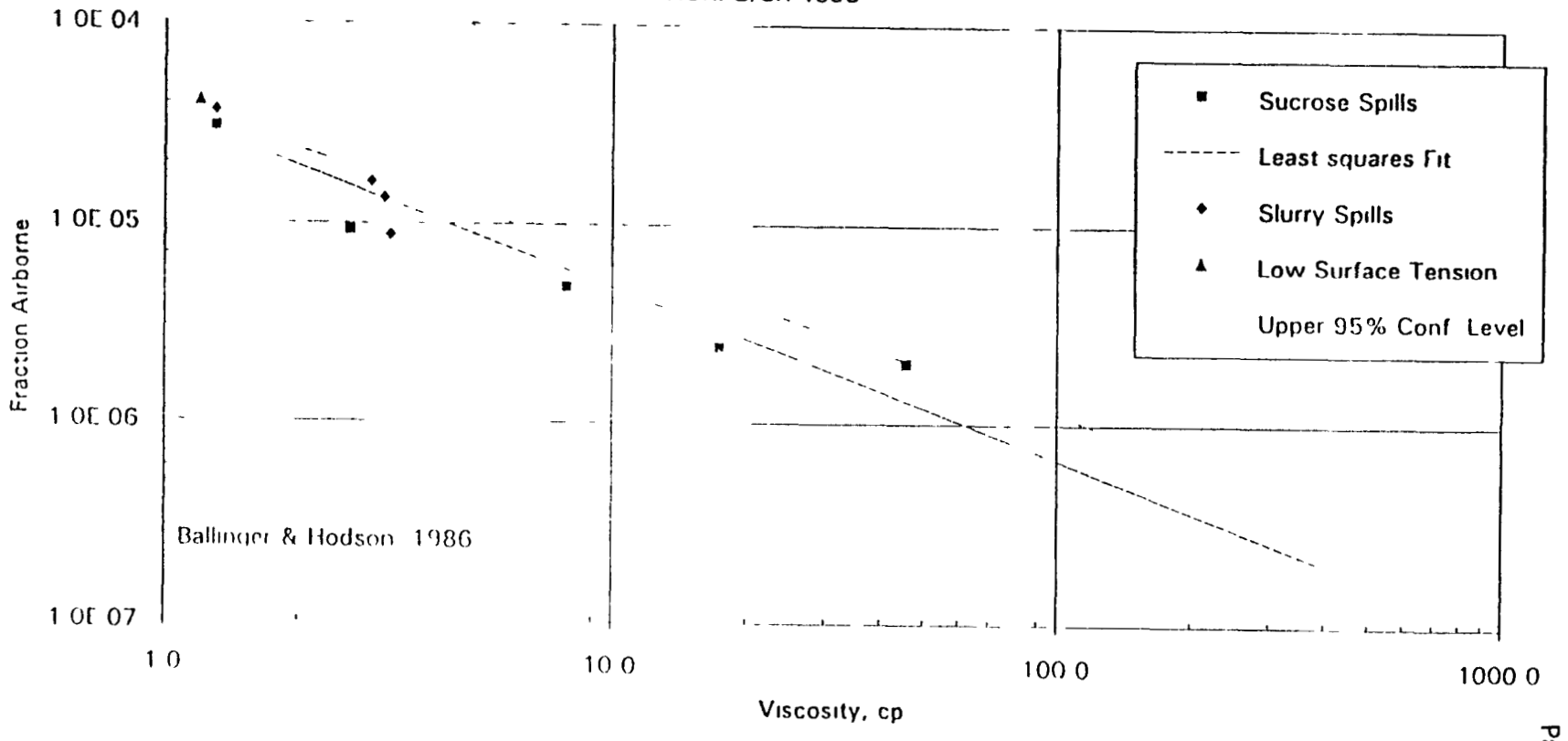
a 207C Pond

The pond will have sufficient water added to provide a total volume of 450,000 gallons This will be mixed to solubilize as much of the soluble salt as possible and then the insoluble sludge/silt/salt mixture will be mixed to the extent possible This solution/slurry will be ~~pumped~~ sucked with the [illegible] of the solar pond, driven into the tent containing the double walled polyethylene tanks The truck volume is 3-32 gallons Two accidents are to be analyzed Complete spillage of the truck outside of the tent and complete spillage of one 10,000 gallon tank inside of the tent

By A C Stalker Date 1/13/94 Chk By G S Rayfield Date 1-13-94

Fraction Airborne from Sucrose and Slurry Spills

NUREG/CR-4658



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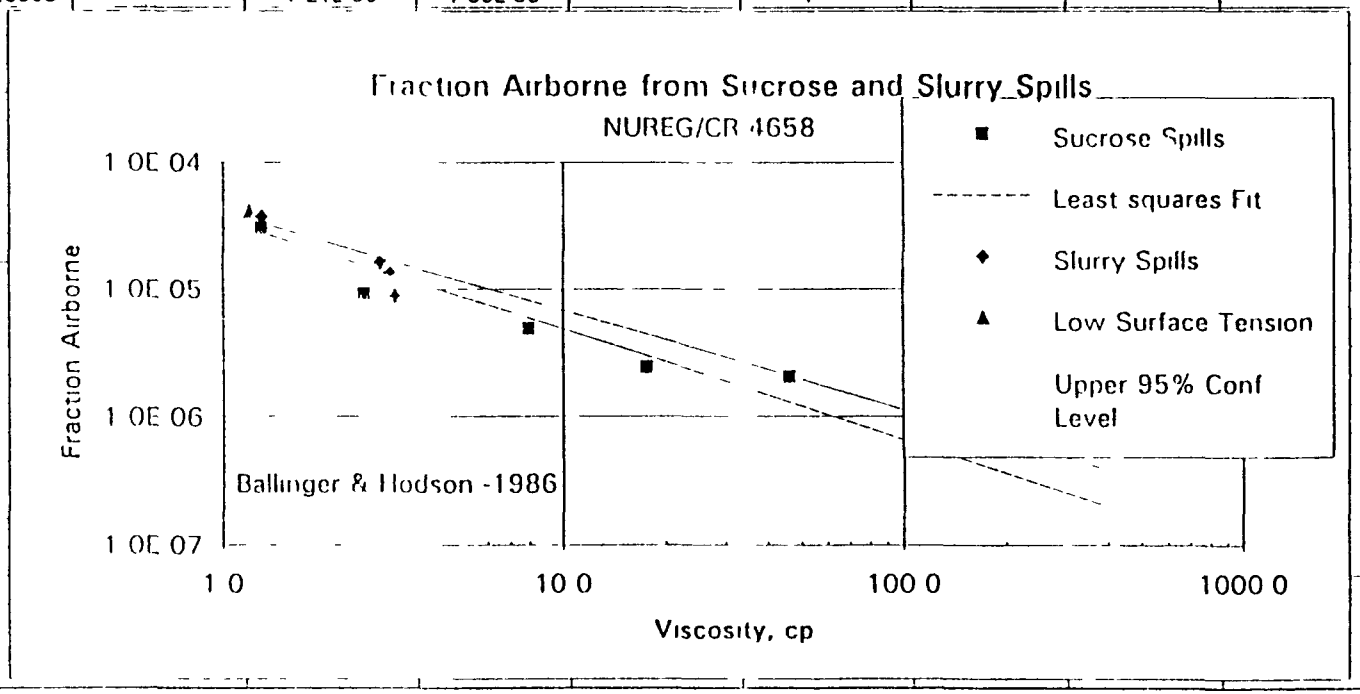
By [illegible] Date 1/13/94 Chk By [illegible] Date 1/15/94

Viscosity cp	Fraction Airborne	LOG Viscosity cp	LOG Fraction Airborne	Calculated Fraction Airborne	+ 2 sigma Calculated Fraction Airborne	Regression Analysis m	b	Sucrose	Slurry	Low Surface Tension
1 3	3 0E 05	0 262364264	10 41098539	2 79E 05	3 29E 05	0 860537342	-10 26122295	3 0E 05		
2 6	9 2E 06	0 955511445	11 59630707	1 54E 05	1 92E 05	0 084005488	0 143374146	9 2E 06		
7 9	4 8E 06	2 066862759	12 24689464	5 90E 06	8 11E 06	0 921008221	0 315630167	4 8E 06		
17 5	2 4E 06	2 862200881	12 94004182	2 98E 06	4 37E 06	104 935907	9	2 4E 06		
46 0	2 0E 06	3 828641396	13 12236338	1 30E 06	2 06E 06	10 45396712	0 896601619	2 0E 06		
1 3	3 7E 05	0 262364264	10 21546232	2 79E 05	3 29E 05				3 7E 05	
1 3	3 0E 05	0 262364261	10 40766863	2 79E 05	3 29E 05				3 0E 05	
2 9	1 6E 05	1 064710737	11 04292184	1 40E 05	1 77E 05				1 6E 05	
3 1	1 3E 05	1 131402111	11 22025585	1 32E 05	1 68E 05				1 3E 05	
3 2	8 7E 06	1 16315081	11 65218753	1 29E 05	1 64E 05				8 7E 06	
1 2	4 1E 05	0 182321557	10 10193849	2 99E 05	3 50E 05					4 1E 05
19 0		2 944438979		2 77E 06	4 10E 06					
400 0		5 991464547		2 02E 07	3 85E 07					
50 0		3 912023005		1 21E 06	1 93E 06					



Subject Hazard Calculation For Remediation of 207C Pond + Clarifier
By A.C. Stalker Date 1/7/94 Chk By G S Rayl Date 1-13-94 Orig ☒ Rev ☐

3 a cont' A minimum of 45 tanks will be required Two cases will be considered 1) The expected 45% TDS + 5% TSS case, and 2) 207C liquid only

b Clarifier

The clarifier liquid solution will be mixed with the sludge to form a pumpable slurry. This slurry will be sucked into the "Guzzler" truck at the clarifier, driven to the tent with the 10000 gallon tanks, and the sludge/slurry will be pumped into a tank Two accident cases will be evaluated 1) complete spillage of the truck outside of the tent and complete spillage of one 10,000 gallon tank inside of the tent Three tanks will be required to hold the contents of the clarifier.

4. HAZARD CALCULATION

For the local worker

$$\text{Air concentration} = \frac{\text{Material-at-risk (MAR)} \times \text{Release fraction (RF)}}{\text{Air volume}}$$

For the co-located worker and off-site person

$$\text{air conc} = \frac{\text{MAR} \times \text{RF} \times \text{H/G (atmospheric dispersion)}}{\text{duration of release}}$$

Release Fractions were covered under 2 d pages 16, 18-20

a. Atmospheric Dispersion

Subject Hazard Calculation For Remediation of 207C Pond & Clarifier
By [signature] Date 1/7/94 Chk By [signature] Date 1-17-94 Orig ☒ Rev ☐

4.a. cont

Two different volumes are used for the local dispersion volume 1000 m^3 is use for the clairifyer solution sludge, due to the high viscosity (400 cP) that is expected, the sludge from a spilled tank will spread throughout the entire tent. The liquids from 207C Pond, however, will spread throughout the entire tent so the tent #4 free volume is used, 3360 m^3

For the onsite co-located worker and off-site individual F stability class with 1 m/s wind speed meteorology is assumed

Sheets 6, 9, 10, 11 contain the calculated exposure concentrations

b Toxic Chemical Exposure

The Threshold Limit Values - Time Weighted Average (TLV-TWA) as published by the American Conference of Governmental Industrial Hygienists (ACGIH) is used in the evaluation is the endpoint for comparison. For the local worker and the on-site co-located worker, the TLV-TWA is used directly for the off-site maximum exposed individual (MOI) 0.1 x TLV-TWA is used

The safety fraction = $\sum_i \frac{\text{conc chemical form}_i}{\text{TLV-TWA}_i}$

and the safety fraction is compared to 1.0

The resultant safety fraction calculation are

Subject Hazard Calculation for Remediation of 207C Pond and Clarifier
By A C Stalker Date 1/7/94 Chk By G S Rayfel Date 1-13-94 Orig ☒ Rev ☐

4. b cont

found on sheets 6, 10, 13, 14, & 15 The TLV-TWAs are listed on sheets 7, 10, & 15

c. Radiological Exposure

All releases are assumed to occur over a 15 minute (900 seconds) period. The exposure is also assumed to occur over this period. The results of the exposure is given in Rem committed effective dose equivalent (CEDE) to the whole body due to inhalation of the radionuclides. Dose conversion factors are taken from ICRP-30 as published in Federal Guidance Report #. Gross α is assumed to be ^{239}Pu and Gross β is assumed to be all ^{241}Pu. Results of the calculation are shown on sheets 6, 7, 10, 13, 14 and 15

5. Conclusions

The 207C sludge, solution, and the clarifier sludge/solution mixture can be safely transported to and stored on the 207C Pond

** QA RECORD WHEN COMPLETED **

NUCLEAR SAFETY ENGINEERING CALCULATION
GENERAL CHECKING CRITERIA

Calculation No 94-SAE-001 Checked By G S Ragold Date 2-13-94

Title Hazard Calculation for Remediation of 207C Pond and Clairifyer

Hand Calculation Checklist		Yes	No	N/A	Comments
1	Are analytical methods appropriate?	✓			
2	Are assumptions correct?	✓			
3	Is calculation complete?	✓			
4	Is calculation mathematically accurate?	✓			
5	Do calculational parameters comply with design criteria/dimensions?	✓			
6	Were input data appropriate?	✓			
7	Does the calculation reference or list applicable assumptions and major equation sources?	✓			

Computer Code Checklist					
1	Was an applicable and valid computer program used?*			✓	
2	Are assumptions in input correct?			✓	
3	Was the input entered correctly?			✓	
4	Do the output results seem reasonable?			✓	

Additional Comments

see review/comment sheet.

* When stored on floppy disk, confirm that the controlled working copy of the applicable diskette was checked out

NS-049, Rev 0, (09/09/93)

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Nuclear Safety Department
Document Review and Comment Sheet

Page 1 of 2

To G Roybal

Address B 886 B

Date 1 / 13 / 94

Please review the attached (referenced) document, provide your comments (if any), and return this form to A C Stalker

Address B 893 A

Phone 848-1

Due Date

Document Number 94-SAE-001 Rev 0 Draft Date / /

Title Hazard Calculation for Remediation of 207C Pond and Clarifier

- ☐ No comment
- ☐ Comments concerning the document are for consideration prior to approval
- ☐ Comments concerning the document are to be dispositioned before the document is submitted for approval

ITEM	SECTION OR PARAGRAPH	COMMENT	RESOLUTION
1	page 5 of 23 I-27	NO2 - mg/L should be 2600 not 2761	1 NO_2^- = 2500 as (N) must use 3.29 x 2500 = 8225 mg/L to correct
2	I-28	NO3 mg/L should be 2500 not 11573	2 NO_3^- is 2600 as (N) must use 4.43 x 2600 = 11518 mg/L as listed
3	I-33	TOC - mg/L should be 54.9 not 5480	3 Corrected TOC to 54.9
4	I-38	TDS mg/L should be 400,000 not 444,000	4 Corrected TDS to 400000
5	page 11 of 23 C-58	Gross Beta pCi/g should be 500 not 5	5 Corrected to 500
6	D-57	Gross alpha should be 0 not 3022	6 Corrected to 0
7	D-60	U 235 should be 0.1 not 098	7 Corrected to 0.1
8	E-58	Gross beta should be 0 not 146	8 Corrected to 0
9	G-61	U 235 should be 31. not 3.1	9 corrected to 31

Signature of Reviewer	Phone Number	Date	Department
G Roybal	6113	1 15 94	SAE

Comments not signed or initialed by addressee will be considered as unofficial comments

Form NS 006 Rev 1 (2/22/91)

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Nuclear Safety Department
Document Review and Comment Continuation Sheet

Document Number 94-SAE-001 Revision 0 Draft _____ Page 2 of 2

ITEM	SECTION OR PARAGRAPH	COMMENT	RESOLUTION
10	page 12 of 23 N-8	2-Extreme should be 0.11 not 8 3cc CC	10 Corrected to 0.11

Form NS 006A, Rev 0 (2/22/91)