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Page 1 of 1

1. EDT 608895

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Waste Treatment Systems Engineering	4. Related EDT No.: N/A
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7. Abstract <p>Campaign 94-1 took place between April 15 and June 14, 1994. From an available 2.87 million gallon feedstock of dilute waste contained in 102-AW, 106-AW and 103-AP, an overall Waste Volume Reduction (WVR) of 2.39 million gallons (83% WVR) was achieved. At the completion of the campaign, approximately 477,000 gallons of dilute double-shell slurry feed (DDSSF) was produced with a SpG. of 1.25-1.30. Total process condensate discharged to LERF was 3.09 million gallons, achieving a condensate/WVR ratio of 1.29. Throughput for Campaign 94-1 was 5.27 million gallons. Total steam condensate and cooling water discharge to B-pond was 4.7 and 216 million gallons respectively. The evaporator operated approximately 43 days of the 60 day campaign for a total operating efficiency (TOE) of 73%. Campaign 94-1 was completed without any discharge limit, OSD, or OSR violations.</p> <p>Major problems encountered during the run included the following: 1) high CA1 deentrainment pad dp's caused by foaming, 2) condensate pump P-C100 failure, and 3) IX column dp's and efficiency.</p>		
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LIST OF TERMS

ACW	242-A Cooling Water
AFPC	242-A Filtered Process Condensate
APC	242-A Process Condensate
ARP	Alarm Response Procedure
ASC	242-A Steam Condensate
cps	counts per second
DCG	Derived Concentration Guideline
DDSSF	Dilute Double Shell Slurry Feed
DST	Double Shell Tank
ECN	Engineering Change Notice
FDA	242-A Feed
LCO	Limiting Condition of Operation
LERF	Liquid Effluent Retention Facility
MCS	Monitor and Control System
OSD	Operating Specification Document
OSR	Operational Safety Requirement
PCP	Process Control Plan
ppb	parts per billion
ppm	parts per million
SAR	Safety Analysis Report
SLY	242-A Slurry
SpG	Specific Gravity
TOE	Total Operating Efficiency
USQ	Unreviewed Safety Question
WVR	Waste Volume Reduction
WVRF	Waste Volume Reduction Factor

DEFINITIONS

WVR = [Initial 242-A Feed Tank(s) Volume - Final feed tank(s) volume]

WVRF = WVR / total feedstock x 100%

THROUGHPUT = Total material transferred through Evaporator feed line

OR:
$$THROUGHPUT = \sum_{n=1}^p \frac{x}{\left(\frac{1}{1-WVRF}\right)^{n-1}} + (w)(t)$$

where t = processing time = throughput/feed rate (min)
 x = feedstock or amount of waste to be processed (gal)
 p = number of evaporator passes
 w = water addition rate from seal water and pad sprays (gpm)
 WVRF = waste volume reduction factor per evaporator pass

1.0 INTRODUCTION

The purpose of this post-run document is to summarize the results of 242-A Evaporator Campaign 94-1 as required per WHC-IP-0842 Section 8.12, subsection 6.2 "Process Evaluation Report".

Campaign 94-1 represents the first Evaporator operation since 1989, following completion of the B-534 upgrades and Liquid Effluent Retention Facility (LERF) construction. Approval to restart the Evaporator came only after an immense effort consisting of rewriting and approval of the SAR, equipment testing, procedure writing, readiness reviews, training, and cold runs. During the evaporator outage, lack of available Double Shell Tank (DST) space became a key issue for Hanford cleanup activities. Administrative controls were implemented to all Hanford waste generators to prevent loss of contingency space in the DST's. With many cleanup activities on hold, restart of the 242-A evaporator became a crucial event, and subsequently received a lot of scrutiny from oversight people. On April 5, 1994, permission was granted to restart the 242-A Evaporator by DOE Headquarters and actual startup commenced on April 15.

The purpose of Campaign 94-1 was to concentrate dilute waste from TK-102-AW, TK-106-AW, and TK-103-AP. Campaign 94-1 compliance with waste compatibility, radiological source term, criticality, and effluent discharge limits was evaluated prior to evaporator operation by WHC-SD-WM-PCP-008, *Process Control Plan for 242-A Evaporator Campaign 94-1* (Le 1994) and will be referred to as the "PCP" in this document.

2.0 SUMMARY

Campaign 94-1 took place between April 15 and June 14, 1994. From an available 2.87 million gallon feedstock of dilute waste contained in 102-AW, 106-AW and 103-AP, an overall Waste Volume Reduction (WVR) of 2.39 million gallons (83% WVRF) was achieved. At the completion of the campaign, approximately 477,000 gallons of dilute double-shell slurry feed (DDSSF) was produced with a SpG. of 1.25-1.30. Total process condensate discharged to LERF was 3.09 million gallons, achieving a condensate/WVR ratio of 1.29. Throughput for Campaign 94-1 was 5.27 million gallons. Total steam condensate and cooling water discharge to B-pond was 4.7 and 216 million gallons respectively. The evaporator operated approximately 43 days of the 60 day campaign for a total operating efficiency (TOE) of 73%. Campaign 94-1 was completed without any discharge limit, OSD, or OSR violations.

Major problems encountered during the run included the following: 1) high CAI deentrainment pad dp's caused by foaming, 2) condensate pump P-C100 failure, and 3) IX column dp's and efficiency.

3.0 FEED SOURCES

The feed for Campaign 94-1 consisted of dilute waste from 102-AW, 106-AW, and 103-AP. Tank selection for the campaign was not an issue as the evaporator feed and slurry tanks were full. Appendix C contains feed sample information taken during Campaign 94-1. Precampaign feed tank compositions are presented in the Process Control Plan (PCP). The sources and volumes of the wastes in these tanks at the time of startup are listed below.

TANK	SOURCE	VOLUME (inches)
102-AW	Partially concentrated dilute waste from Evaporator Run 89-2, and water additions from the evaporator training runs. SpG = 1.025	367.7
103-AP	Dilute non-complexed waste from 102-AY (200 East miscellaneous receiver tank) containing waste from 100, 300, and 400 areas, B-plant, 222-S lab waste, and aging waste condensate. SpG = 1.003	410
106-AW	Partially concentrated waste from Run 89-2, with some 102-AY miscellaneous waste and water additions from the evaporator training runs. SpG = 1.086	393.3

4.0 DISCUSSION

4.1 OPERATING PERFORMANCE

4.1.1 Waste Volume Reduction - The PCP initially specified that Campaign 94-1 would process approximately 2.89 million gallons with a waste volume reduction of 87%. Actual campaign figures came out slightly less at 83% (2.87 Mgal feed with 2.39 Mgal WVR). The reason the campaign did not achieve a predicted 87% WVR was due to conservative waste staging into 102-AW prior to the final pass. Approximately 50 inches of supernate above the highest previous sludge level reading was not staged from 106-AW to 102-AW during the final pass to minimize the transferring of solids into the feed tank. The evaporator campaign was terminated less than one pass away from fluoride and nitrate saturation to minimize solids production. Also contributing to the Campaign 94-1 83% WVR figure was the final evaporator deep flush, which was not included in the predicted 87% WVR figure. WVR information can be found in Appendix B.

4.1 OPERATING PERFORMANCE (Cont.)

4.1.2 Throughput - The PCP estimates for throughput were 5.3 Mgal for Campaign 94-1. Actual throughput compared quite closely with a value of 5.27 Mgal. Throughput was calculated by summing the evaporator feed totalizer readings (FQI-CA1-1) for the duration of the campaign. Throughput information is presented in Appendix B.

4.1.3 Total Operating Efficiency - Campaign 94-1 operated approximately 43 days of the 60 day campaign for a total operating efficiency of 73%, which compares quite favorably to past evaporator campaigns. The PCP pre-campaign estimates were accurate, estimating 49 operating days and 16 days of maintenance downtime. Evaporator downtime, however, was primarily due to process and equipment problems rather than scheduled maintenance and those problems are discussed in Section 5.0. Operating efficiency calculations are contained in Appendix B.

4.2 PROCESS CHEMISTRY

Campaign 94-1 sampling consisted of the following:

- Daily cooling water samples (ACW)
- Two protocol cooling water samples
- Daily steam condensate sample (ASC)
- Two protocol steam condensate samples
- Weekly process condensate samples (AFPC & APC)
- Five protocol process condensate samples
- One LERF radiological source term PC compliance sample
- Five vessel vent protocol samples
- Five slurry protocol samples (SLY)
- Six feed process control samples (FDA)

4.2.1 Organic Complexants - In the PCP, the waste in tanks 102-AW, 106-AW, and 103-AP was evaluated using the PREDICT computer program to determine if the waste was classified as complex (Allison 1984). Tanks 102-AW and 106-AW exceeded the 10 g/l criteria at the aluminate boundary and were defined as complex. 103-AP was determined to be non-complex waste. None of the three tanks, however, exceeded the 3 wt% dry basis TOC definition for complex waste (Carothers 1991).

During the final Campaign 94-1 evaporator pass, a slurry sample (V97/V111) was taken to determine if the final waste product was complex. The sample data was extrapolated using PREDICT and determined to be 15.2 g/l at the aluminate boundary, so by definition the Campaign 94-1 slurry was complex. The PREDICT run on the final pass slurry product is contained in Table 9 (Appendix D). A compatibility assessment was performed on the waste contained in 106-AW (Dodd 1994) to provide justification for transferring the final Campaign 94-1 product to complex receiver tank 106-AN. The transfer was performed on 9/9/94.

4.2 PROCESS CHEMISTRY (Cont.)

- 4.2.2 Phosphates - The PCP predicted that the waste in 102-AW, 106-AW, and 103-AP would not exceed the formation criteria of the gel-like sodium phosphate matrix (i.e. $[\text{PO}_4^{3-}] > 0.1 \text{ M}$ and $[\text{Na}^+] > 8 \text{ M}$) (Carothers 1991).

Campaign 94-1 slurry sample data ranged from (0.007 M - 0.027 M) for $[\text{PO}_4^{3-}]$ and ($< 4 \text{ M}$) for $[\text{Na}^+]$ which is below the phosphate matrix formation criteria.

- 4.2.3 Exotherms - OSD-T-151-00012, (Godfrey, 1993) limits feed to the evaporator that exhibits no exotherms below 335°F. DSC analysis on all feed samples taken during Campaign 94-1 showed no exotherms.

- 4.2.4 Waste Mixing - A precampaign mixing and compatibility study was performed on a composite of the feed tanks for Campaign 94-1 (Beck 1992) and showed no unusual color, temperature, clarity, or other visually determinable characteristic. Feed and slurry samples taken during the actual evaporator operation did not show any unusual characteristics.

- 4.2.5 Slurry Source Term - The PCP provides a preliminary radiological source term compliance assessment of the Campaign 94-1 feed tanks and requires a slurry sample to be taken at the end of the evaporator run to verify source term compliance.

A slurry sample was taken for source term compliance verification during the final evaporator pass of Campaign 94-1 (sample V97 taken on 6/9/94). None of the radionuclides exceeded the source term limits (Lavender 1993a). Table 6 (Appendix D) contains the slurry source term limits and the associated slurry product analysis.

- 4.2.6 LERF Source Term - The LERF source term limits are based upon maintaining the sum of the ratio of concentration to Derived Concentration Guide (DCG) value for 22 radionuclides at less than 5000 (Lavender 1993a). All process condensate samples (AFPC) taken during the campaign had total calculated DCG values of less than 10. Appendix E contains process condensate sample analysis, and DCG calculations.

4.2 PROCESS CHEMISTRY (Cont.)

4.2.7 LERF Liner (organic) Limits - The LERF Operating Specifications (Johnson 1993) specifies process condensate chemical limits for LERF. All process condensate RCRA samples taken during Campaign 94-1 were within the discharge limits for organics and pH and ammonia. Organic and ammonia analysis for LERF liner compatibility can be found in Appendix E.

4.2.8 Vessel Vent Discharge Limits - Vessel Vent protocol sample data was not available at the time of release of this document. An ECN will be written to update this section of the post-run document when data becomes available.

Campaign 94-1 vessel vent ammonia levels were negligible. Internal Memos 7CF40-94-004, -005, and -009 contain information on stack flow rates, ammonia concentration and stack temperature for the campaign. Based on these internal memo's, the approximate total campaign ammonia discharge to the atmosphere was 22 lbs (assuming an average ammonia concentration of 9.7 ppm). This is far below the CERCLA reportable quantity of 100 lbs/day.

To better support future ammonia reporting requirements, an ammonia totalizer (FQI-NH3-1) has been added to the evaporator Monitor and Control System and will be utilized during the next evaporator campaign.

4.2.9 Fissile Concentrations - Slurry samples taken from Campaign 94-1 indicated ^{239/240}Pu concentrations ranging approximately 1×10^{-4} to a final pass concentration of $< 6.5 \times 10^{-4}$ uCi/mL. This is significantly below the evaporator feed fissile limit of 0.162 uCi/mL (.01 g/gal) and waste storage tank limit of 0.486 uCi/mL (.05 g/gal) (RHO 1988). Appendix D contains information on ^{239/240}Pu slurry concentrations.

4.2.10 Tank Corrosion Specifications - OSD-T-151-00007 (Harris 1992) specifies limits for nitrate, nitrite and hydroxide concentrations to minimize deterioration rates of the underground storage tanks. In the PCP, the PREDICT program was used to extrapolate the anion concentrations during the campaign to ensure the tank corrosion specifications were not exceeded.

4.2 PROCESS CHEMISTRY (Cont.)

Slurry samples taken during Campaign 94-1 did not violate tank corrosion specifications. Table 7 (Appendix D) contains Campaign 94-1 slurry hydroxide, nitrite, and nitrate concentrations and associated corrosion specifications.

- 4.2.11 Separable Organic Layers - TK-C100 liquid level was operated at 50% WF during Campaign 94-1 to maximize the detectability of a potentially forming organic layer and to move the interface further from the condensate pump suction (O'Rourke 1992). The TK-C100 organic interface indicator LI-C100-1 did not alarm during the campaign indicating the lack of an organic layer.

Precampaign sampling indicated the lack of an organic layer in 102-AW, 106-AW, and 103-AP. A 6 inch minimum level limitation was imposed on 102-AW (instead of 100 inches required by WHC-SD-WM-TI-357) during the campaign due to the lack of an organic layer. The 6 in minimum level was not violated during Campaign 94-1.

- 4.2.12 Cooling Water Analysis - Daily cooling water samples (ACW) were taken during Campaign 94-1 and analyzed for total alpha, total beta, and pH to ensure compliance for discharge to B-Pond. Actual sample data averaged 2-3 orders of magnitude below the 2.0×10^{-05} uCi/mL OSD limit for total beta and 1 order of magnitude below the 6.0×10^{-08} uCi/mL OSD limit for total alpha (Godfrey 1993). Most of the sample results were reported as "less-than" values. Cooling water pH ranged between 7-8.5. Total campaign cooling water discharge to B-Pond was 216 million gallons. Information on Campaign 94-1 cooling water is found in Appendix F.

- 4.2.13 Steam Condensate Analysis - Steam condensate (ASC) samples were taken each time a steam condensate basin was filled (1-2 basins filled per day). As with cooling water, (ASC) samples are analyzed for total alpha, total beta, and pH to ensure compliance for discharge to B-Pond. ASC sample data obtained for Campaign 94-1 averaged 2-3 orders of magnitude below the 2.0×10^{-05} uCi/mL OSD limit for total beta and 1 order of magnitude below the 6.0×10^{-08} uCi/mL OSD limit for total alpha (Godfrey 1993).

4.2 PROCESS CHEMISTRY (Cont.)

Sample results were usually reported as "less-than" values (i.e. below the labs detection limits). Steam condensate pH ranged between 6.5 -8. Total campaign steam condensate discharge to B-Pond was 4.7 million gallons. Campaign 94-1 steam condensate information is contained in Appendix G.

- 4.2.14 Sludge Levels - Precampaign sludge level measurements of slurry tank 106-AW showed that the solids level in the tank ranged from 49 inches to 100 inches with an average measurement of 77 inches. One post-campaign measurement in 106-AW riser 16-C indicated a sludge level of 73.5 inches, which is a 1 inch increase in solids level from the previous measurement. The minimal increase in solids conforms to the PCP assumptions. Process Memo 94-069 was written to measure sludge levels in 106-AW and 102-AW after completion of the campaign, but these measurements have not yet been performed. An ECN will be written to this document when all post-run sludge measurements become available.
- 4.2.15 Slurry Transfer SpG - Specific gravity limitations for evaporator slurry were imposed during the campaign to reduce the potential for transfer line plugging. Slurry transfer from the evaporator to tank farms by gravity flow was limited to slurries with a SpG of < 1.3 (Nicholson, 1991). Slurries above SpG 1.3 were transferred using slurry pump PB2. Transfer line plugging did not occur during Campaign 94-1.
- 4.2.16 Evaporator Model Validation - Five sets of feed, slurry, process condensate, and vessel vent samples were taken during the evaporator run with the intent that the data obtained from the samples would be useful for evaporator model verification in addition to environmental compliance. Each stream was sampled at roughly the same time during evaporator equilibrium.

Organic analyses for slurry and vessel vent samples were not available at the time of issue of this document. Evaporator model validation cannot be performed until all data has been received and reviewed. Preliminary estimates are that the organic quantities present in the streams are too low for validation purposes.

4.3 CAMPAIGN HISTORY

Table 1 in Appendix A contains a listing of Campaign 94-1 chronological events. Appendix A also contains a listing of process memo's for the campaign (Table 2).

5.0 PROBLEMS

5.1 Condensate Pump P-C100 Failure - On 5/1/94, P-C100 pump drew high amps and tripped off-line, resulting in a facility shutdown. The spare pump was installed on 5/2/94 and successfully retested. The failed pump was disassembled and inspected. Cause of pump failure was failure of the front motor bearing due to excessive vibration. The rotating magnetic coupling was found to be rubbing the containment shell which overloaded the motor and caused the breaker to trip. Root cause of the pump failure was determined to be poor pump design. The close coupled pump relied on the motor bearings to support the magnetic coupling. Excessive motor tolerances resulted in internal rubbing. The pump manufacturer has since discontinued this model of pump.

5.2 Lower CA1 Deentrainment Pad Pressure Spiking - The evaporator shutdown seven times during the first half of Campaign 94-1 (on 4/19, 4/25, 5/2, 5/9, 5/10, 5/11, and 5/12) due to CA1 lower deentrainment pad pressure spiking caused by foaming. Initial indications of foaming occurred while raising steam flow to the reboiler on 4/19. The raised steam flow increased the frequency and magnitude of the lower deentrainment pad spiking until the dP interlock setpoint was reached. Previous feed boildown studies (Beck 1992) indicated foaming potential at 40 TORR vacuum. Although foaming was a suspected cause, as a precaution, numerous troubleshooting efforts took place prior to introduction of anti-foaming agent. Some of the troubleshooting included the following:

- retuning the air bleed-in controller
- varying evaporator vacuum setpoint
- dumping the vessel while rinsing the deentrainment pads with sprays and refilling with fresh feed
- calibrating deentrainment pad dP transmitter
- deentrainment/level dip tube blowdown
- lower deentrainment dP switch setpoint increased
- MCS smoothing function added to deentrainment dP signal

5.0 PROBLEMS (Cont.)

Antifoaming agent suitable for the evaporator was initially unavailable onsite so antifoam was emergency ordered. On 5/12, the evaporator was filled with fresh feed while simultaneously injecting DOW CORNING 1520-US antifoaming agent. Successful boiloff was established and there were no unplanned shutdowns due to foaming for the remainder of Campaign 94-1. Figure 21 (Appendix F) contains actual deentrainment spiking due to foaming both before and after antifoam was added.

- 5.3 IX Column - Several problems occurred with the ion exchange system during Campaign 94-1. On 4/11, the IX column media level was measured and found to be low, so 12 bags of clinoptilolite media were added to bring the resin level back to normal. A small backflush of the column was done to clear out any new fines. During performance of the backflush, it was noted that three-way valve 2-34 had been installed incorrectly and a backflush through the top of the column required 2-34 to be in the "normal" instead of "backflush" position. Procedure changes were initiated to compensate for the incorrect valve installation. After evaporator startup, it became apparent that the IX column upper screen dP's were limiting process condensate flow to 40 gpm. On 4/16, a column backflush through the flushports was performed, using process condensate, in attempt to reduce the dP's. After the 9750 gallon flush, the column upper screen dP's were reduced to very low readings (PDI-IDX-2 dropped from 7 to .1 psid). On 5/22, isolation valve 2-31 was found to be open. Normally valve 2-31 position has no effect on flow through the column. However, when 2-31 was closed, the IX column dP's began increasing. This indicated that throughout the first part of the campaign, the IX column had been partially bypassed due to the combination of valve 2-31 being open and three-way valve 2-34 being installed incorrectly. Valve 2-34 has since been corrected.

During Campaign 94-1, the process condensate concentrations (both APC and AFPC) were well below the LERF discharge limits. Comparison of the sample data before and after the IX column indicated that the IX column was not effectively removing cesium and strontium. This indicates that the column media was loaded and needed replacement.

5.0 PROBLEMS (Cont.)

Because the sample analysis indicated that the IX column was not necessary to meet discharge LERF discharge limits, a USQ evaluation (TF-94-0251) was performed to ensure facility SAR requirements were not violated and to allow continued operation with the column bypassed. Appendix E contains information on process condensate samples and comparisons between before (APC) and after column (AFPC) sample results.

- 5.4 Feed/Slurry Samplers - While taking the first set of Campaign 94-1 feed and slurry samples, two problems with the samplers were identified. First, the SAMP-F-2 internal sheetmetal splashguard interfered with the sample bottle holder and would not allow a sample bottle to reach the sample discharge port. To correct the problem, the sheetmetal angle was changed to allow the sample bottle to swing underneath and reach the discharge port. The second problem was a failed air pressure control valve on SAMP-F-1 combined with an internal crossleak between the isolock air cylinder and sample chamber. This resulted in the raw water flush line being pressurized with process air. The air backpressure caused the raw water backflow preventer BFP-RW-10 to purge. Subsequently, a work package was generated to replace the PCV-SMPL-1 and the SAMP-F-1 isolock. A sample procedure modification was made to eliminate the BFP purging problem by isolating the air supply to the isolock prior to performing the raw water flush.
- 5.5 Reboiler Temperature Differential - On 4/17, attempts to increase boiloff rate to greater than 33 gpm caused the reboiler differential temperature TDI-EA1-1 to alarm (setpoint 4°F). Review of past design indicated that reboiler temperature differential was measured across different sensing locations than the present design and 4°F was the normal operating design specification. Additionally, the B-534 project added insulation to the CA1 vessel. Due to the addition of insulation, the evaporator and pump rooms are no longer maintained within 5° of process temperature as was done in the past. An ECN was written to change the reboiler temperature setpoint from 4°F to 5.5°F to eliminate operation of the facility in an alarm condition on the following basis:
- 1) Historical studies were inconclusive on reboiler scaling causes (i.e no direct correlation between temperature differential and scaling).

5.0 PROBLEMS (Cont.)

- 2) Historical studies indicated reboiler scaling was not a problem below a SpG of 1.35
- 3) New MCS heat transfer coefficient calculation and reboiler pressure transmitters will identify scaling at early stages
- 4) Non safety related change

5.6 Raw Water Supply Pressure/Seal Water Flow and Filtration - There were several problems that occurred during Campaign 94-1 which were associated with the raw water supply and filtered raw water/seal water. A summary of the problems is listed below:

- Raw water supply fluctuations - Throughout the campaign, raw water supply pressure from the powerhouse fluctuated causing occasional problems with obtaining adequate flow/pressure to the PB1 and PB2 pump seals. The fluctuations came from power house fly-ash removal, water truck filling etc.
- Seal water pump device control/filter plugging - On 4/17, seal water low pressure alarms were received and the backup seal water pump was placed in operation. Shortly thereafter, both seal water pumps indicated a "Start-Fail" signal. While attempting to reset the "Start-Fail" indication on one pump per procedure, activation of the PB1 low seal water flow/pressure interlock shut the facility down. Subsequently, an Occurrence Report (RL-WHC-Tankfarm-1994-0021) was written due to the inadvertent process interruption. This, in combination with frequent seal water sock filter plugging from poor raw water supply quality, caused the following compensatory measures to be taken:
 - 1) Raw water service building pressure control valves were adjusted from 90 psig to 100 psig.
 - 2) Frequency of seal water sock filter checks was changed from daily to shiftly.

5.0 PROBLEMS (Cont.)

- 3) The Alarm Response Procedure (ARP) was modified to clarify operation of the seal water pump (i.e. use of the SF-RESET command in a STRTFAIL status).
- 4) Sock filters changed from 3 micron to 10 micron mesh because CVI data indicated 10 micron filters provided adequate filtration

5.7 Vessel Vent Deentrainment Pad Loading - Since the first trial run of the 242-A Evaporator after completion of the B-534 upgrades, deentrainment loading of the DU-C-1 unit has caused problems when operating the steam vacuum jets. This occurred on several occasions during Campaign 94-1. Typically, manual adjustment of the vessel vent air bleed-in valve 3-1 has controlled the moisture loading on DU-C-1. Much of the moisture loading problem on DU-C-1 comes from the mixing of cool air from the condenser room with the vapor coming from EC3 condenser. As a result, moisture begins to condense onto the deentrainment unit, restricting flow through the vessel vent system. To reduce the moisture loading problem, a work package was written to add heat trace and insulation to the affected piping.

5.8 IX Resin in RC3 Monitor - On 4/24/94, the RC3 radiation monitor increased to 35 counts per second (cps). A sampler flush was performed using decon solution and water. This brought the reading down to 22 cps. Later complete sample pig disassembly was required to remove what appeared to be IX resin fines.

On 5/16/94, the PC flow through the RC3 radiation monitor dropped to < 0.35 gpm. Four hours later, resin fines were found inside valve HV-RC3-1, which was reducing flow through the sampling system. The resin was removed and flow through the monitor was reestablished. Approximately 8830 gallons of process condensate were subsequently diverted to 102-AW. Occurrence report RL-WHC-Tankfarm-1994-0028 was written as a result of entering a Limiting Condition of Operation (LCO), however, no SAR requirements were violated.

5.0 PROBLEMS (Cont.)

- 5.9 Leaking CA1 Dump Valves - Health Physics technicians discovered surface contamination under dump valves HV-CA1-9 and HV-CA1-7 after post-campaign air samples indicated slightly elevated airborne contamination readings in the evaporator room. The HV-CA1-7 and HV-CA1-9 were later observed at the conclusion of a "cold" run and determined to be leaking from the valve packing in small quantities. During the observation, the packing gland nut on HV-CA1-9 was immediately tightened, stopping the leak. On a subsequent entry, the packing gland nut on HV-CA1-7 was tightened during a 300 gallon water dump and no leaks were observed. HV-CA1-7 was found to bind significantly during actuation.

6.0 RECOMMENDATIONS

- 6.1 P-C100 Design Change - Engineering has recommended that a new condensate pump be installed that utilizes a separate pump and motor combination mounted on a rigid base. This pump design utilizes a bearing box to support the magnetic coupling instead of relying on the motor bearings as the failed pump had done. Also, velocity transducers will be installed on the existing spare pump and new pump to provide continuous monitoring of pump vibration in the future.
- 6.2 Antifoam - Antifoaming agent suitable for evaporator operation was unavailable onsite for the start of Campaign 94-1. It is now recommended that when pre-campaign boildown studies indicate potential foaming, antifoaming agent should be used during evaporator operation. A stepwise reduction in antifoam injection rate may be used during operation to minimize quantity and cost. If pre-campaign boildown studies do not indicate potential foaming, then antifoam should be available on-site if needed.
- 6.3 IX Column Use - In past evaporator operations, as well as Campaign 94-1, the operation of the 242-A IX column has limited boiloff rate and reduced efficiency of the 242-A evaporator. Since the evaporator is no longer discharging process condensate to the soil, the IX column provides little benefit in meeting the new LERF discharge limits. Future use of the IX Column should be only on an "as-needed" basis (i.e. only if pre-campaign process analysis indicates reduction in Cs/Sr concentrations are needed to meet discharge limits).

6.0 RECOMMENDATIONS (Cont.)

If future IX column use is expected, a resin changeout will be required since poor decontamination efficiency was achieved in Campaign 94-1 due to low quality resin.

- 6.4 PB1/PB2 Seal Water - Due to potential fluctuations in raw water quality and pressure, engineering should provide a design to permit Control Room monitoring of seal water sock filter plugging and add an indication to the MCS to provide readily noticeable indication when the backup seal water pump has started. These modifications should reduce the chances of a plant shutdown due to the PB1 low seal water flow/pressure interlock.
- 6.5 Dump Valves - The bolts on the HV-CA1-7 valve body were determined to be tightened too much during the original installation of the valve, causing the valve to bind during actuation. Valve binding is serious enough to warrant valve replacement.
- 6.6 Other Recommendations - An Evaporator Self-Assessment was performed after completion of Campaign 94-1 and summarized in an internal memo titled "242-A Evaporator Self Assessment For Campaign 94-1", R.J. Shupe, 1994. Contained in the self-assessment (primarily in concerning Conduct of Operations) are lessons learned, future improvement areas, strengths, weaknesses and corrective actions.

7.0 REFERENCES

- Allison, J. M., 1984, *Computer Prediction of Evaporator Operations*, SD-WM-ADP-004, Rockwell Hanford Operations, Richland, Washington.
- Beck, M. A., 1992, "Evaporator Boildown Results", internal memo, Westinghouse Hanford Company, Richland, Washington.
- Carothers, K. G., 1991, *Tank Farm Waste Compatibility Program*, WHC-SD-WM-OCD-015, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Dodd, R. A., 1994, *242-A Evaporator Campaign 94-2 Waste Compatibility Assessment of Tank 241-AW-106 Waste with Waste Contained in Tank 241-AN-106*, Internal Memo 7CF10-025-094, Westinghouse Hanford Company, Richland, Washington.
- Flint, R., 1994, Occurrence Report RL-WHC-TANKFARM-1994-0021, Westinghouse Hanford Company, Richland, Washington.
- Flint, R., 1994, Occurrence Report RL-WHC-TANKFARM-1994-0023, Westinghouse Hanford Company, Richland, Washington.
- Flint, R., 1994, Occurrence Report RL-WHC-TANKFARM-1994-0025, Westinghouse Hanford Company, Richland, Washington.
- Flint, R., 1994, Occurrence Report RL-WHC-TANKFARM-1994-0028, Westinghouse Hanford Company, Richland, Washington.
- Godfrey, S. D., 1993, *Operating Specifications for the 242-A Evaporator-Crystallizer*, OSD-T-151-00012, Westinghouse Hanford Company, Richland Washington.
- Guthrie, M. D., 1994, *Ammonia Emissions Data for 242-A (Stack 296-A-22)*, Internal memo 7CF40-94-004, Westinghouse Hanford Company, Richland Washington.
- Harris, J. P., 1992, *Operating Specifications for the 241-AN, AP, AW, AY, AZ, & SY Tank Farms*, OSD-T-151-00007, Rev./Mod. H-5, Westinghouse Hanford Company, Richland, Washington.
- Hoover, D. R., 1994, *Ammonia Release for June 1994 (Stack 296-A-22)*, Internal memo 7CF40-94-009, Westinghouse Hanford Company, Richland Washington.

7.0 REFERENCES (Cont.)

- Johnson, P. G., 1993, *Operating Specification Document for the Liquid Effluent Retention Facility (LERF)*, OSD-T-151-00029, Westinghouse Hanford Company, Richland, Washington.
- Lavender, 1993a, *Final Safety Analysis Report, Project W-105, Liquid Effluent Retention Facility*, WHC-SD-W105-SAR-001, Rev. 0-C, Westinghouse Hanford Company, Richland, Washington.
- Lavender, 1993b, *242-A Evaporator/Crystallizer Safety Analysis Report*, WHC-SD-WM-SAR-023, Rev. 1-B, Westinghouse Hanford Company, Richland, Washington.
- Le, E. Q., 1994, *Process Control Plan for 242-A Evaporator Campaign 94-1*, WHC-SD-WM-PCP-008, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Le, E. Q., 1994, *Ammonia Release for May 1994 (Stack 296-A-22)*, Internal memo 7CF40-94-005, Westinghouse Hanford Company, Richland Washington.
- Nicholson, R. S., 1991, "Plugging Potential of 242-A Slurry Out Lines", Internal Memo #76420-91-029, August 28, 1991, Westinghouse Hanford Company, Richland, Washington.
- RHO, 1988, *Criticality Prevention Specification for Waste Storage Tanks and Associated Equipment*, CPS-T-149-00010, Rev. D-0, Rockwell Hanford Operations, Richland, Washington.
- Tranbarger, R. K., 1992, WHC-SD-WM-OCD-016, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A
CAMPAIGN 94-1 HISTORY

WHC-SD-WM-PE-053 Rev. 0

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A-1.1

Table 1: CAMPAIGN 94-1 TIMELINE

April 5, 1994

DOE Headquarters gives authorization for Evaporator restart.

4/8

LERF receives condensate from transfer line connection leak test.

4/11

102-AW 24" ALC started. 12 bags of resin added to IX column.

4/12

Initial facility valve lineup started. Backflushed IX column with 770 gallons of raw water.

4/13

Performed a small transfer from 106-AW to 102-AW. Started prestart and electrical lineup procedures. Vessel vent ammonia monitor started. Cooling water started and then shut down because HV-EC1-2 was not responding. HV-EC1-2 exercised and cooling water finally established. Steam vacuum jets started.

4/14

Started steam to the reboiler. PCV-EA1-1 failed to control steam pressure. Facility placed in recirculation without vacuum. PCV-EA1-1 taken apart and repaired.

4/15

Evaporator vacuum reestablished. Steam to reboiler started. Feed pump P-AW-102 fails to start. Troubleshooting identifies a start control signal wire connected to the wrong lead in the MCC. P-AW-102 restarted. Hot feed introduced into the Evaporator. LERF receives process condensate from the evaporator. Process condensate flow through IX column limited due to high dp's on screens. Gravity slurry flow to 106-AW.

4/16

Leak detectors testing for 106-AW to 102-AW transfer causes P-AW-102 to shutdown. Failure of leak detectors to reset causes PB1 to shut down on low level due to lack of feed. Steam is lost to reboiler. Boiloff successfully reestablished after leak detectors clear. IX column backflush performed using 9750 gallons of process condensate. First 106-AW to 102-AW recycle transfer completed.

4/17

Reboiler temperature differential TDI-EA1-1 alarming at high steam flows. Clogged seal water sock filters in conjunction with a substantial raw water pressure fluctuation causes shutdown of PB1 and subsequent loss of steam. Seal water pump control logic also suspect. Facility shut down in "recirculation with vacuum".

4/18

Off-Normal issued. Boiloff reestablished. PB2 later shut down due to power blip. Started second 106-AW to 102-AW recycle transfer.

Table 1: CAMPAIGN 94-1 TIMELINE cont.

- 4/19 Second 106-AW to 102-AW recycle transfer completed. Began increasing steam to reboiler and experienced high deentrainment dP on the lower pad. Steam and vacuum were lost as a result of the deentrainment dP interlock.
- 4/20 Restarted evaporator. Limited boiloff to < 40gpm to prevent further deentrainer dP occurrences. First (of 2) protocol samples taken of steam condensate and cooling water.
- 4/21 No significant events/problems. Boiloff = 41 gpm, slurry = 50 gpm, SpG = 1.12.
- 4/22 Started third 106-AW to 102-AW recycle transfer. Performed an RC3 sampler flush due to high background readings. Occasional lower deentrainment pad pressure spiking. Boiloff = 48 gpm, slurry = 50 gpm, SpG = 1.12-1.09.
- 4/23 RC3 sampler continues to increase in background count rate reading. Flushing of RC3 only temporarily working.
- 4/24 Shutdown evaporator to "recirculation with vacuum" for troubleshooting of RC3 monitor. Discontinued third 106-AW to 102-AW recycle transfer.
- 4/25 Decontaminated RC3 well assembly. While performing evaporator startup, high vessel vent deentrainer dP's did not allow a vacuum to be pulled on the evaporator. Later, careful air bleed-in adjustment on the vessel vent system allowed a vacuum to be established.
- 4/26 Restarted evaporator boiloff with gravity slurry.
- 4/27 Evaporator shutdown due to inadvertant alarm testing of the vessel vent beta-gamma CAM. Unable to obtain first feed, slurry, and vessel vent and process condensate samples due to plant shutdown.
- 4/28 Evaporator restarted. Boiloff = 37 gpm, slurry = 33 gpm. Attempted to bump 103-AP pump and it failed to start. LERF leak detector alarm problem causes PC to divert to 102-AW. Both LERF leak detector and AP pump problems are investigated.
- 4/29 Bad contacts in 103-AP pump control circuit replaced. Set route 103-AP to 102-AW. Boiloff = 39 gpm, slurry = 33 gpm.

Table 1: CAMPAIGN 94-1 TIMELINE cont.

- 5/1 Condensate pump P-C100 seizes. Shutdown facility to recirculation mode. A partial pot dump occurred during performance of shutdown procedure due to the false low level interlock on PBI received while removing vacuum. Refilled evaporator with feed from 102-AW to clear level alarms. Began the fourth 106-AW to 102-AW recycle transfer.
- 5/2 P-C100 replaced and tested. Attempted to pull vacuum on evaporator and high deentrainer dP's shut it down.
- 5/3 Vacuum successfully pulled on evaporator, however, clogged steam strainer prevented adequate steam flow to reboiler. Facility is placed in recirculation without vacuum.
- 5/4 Restarted Evaporator. Obtained first (of 5) feed, slurry, and vessel vent and process condensate samples. Boiloff = 30 gpm, slurry = 33 gpm, SpG = 1.14.
- 5/5 Started transfer of 103-AP to 102-AW. 103-AP transfer lasted 3.5 hours at 245 gpm until material balance limit was reached. Transfer was then terminated.
- 5/6 Restarted 103-AP to 102-AW transfer. Received several lower deentrainment pad dP spikes. Operated lower pad sprays due to deentrainment spikes.
- 5/7 Terminated 103-AP transfer due to material balance discrepancy problems. Approximately 200 inches from 103-AP were transferred.
- 5/8 No significant events/problems. Boiloff = 40 gpm, slurry = 45 gpm.
- 5/9 Obtained second (of 5) set of feed, slurry, and process condensate samples. Unable to take vessel vent sample. RC1 sampler low flow alarm activating sporadically. High deentrainer pad dP spike eventually shuts down the evaporator.
- 5/10 Retuned air bleed-in controller. Adjusted vacuum to 50 TORR. While bringing evaporator to boiloff, lower deentrainment pad dP spiked and shut the evaporator down.

Table 1: CAMPAIGN 94-1 TIMELINE cont.

5/11

Recalibrated deentrainment pad dP transmitter. Adjusted vacuum to 70 TORR. Lower deentrainment pad dP spike shuts down evaporator again. Severe foaming is suspect. Initiated a controlled evaporator dump, while rinsing with pad sprays.

5/12

Filled evaporator with fresh feed. Air bleed-in valve tuning parameters set to original values. Vacuum established at 60 TORR. Evaporator shut down while attempting to reach boiloff. Lower Deentrainment pad dP spike occurred as before. Evaporator placed in recirculation mode without vacuum.

5/13

Performed the following: calibrated evaporator level transmitters, dip tubes blown down, pressure control transmitter calibration checked and actuator cleaned, deentrainer dP hardwired switch setpoint increased, MCS analog smoothing function added to deentrainer dP signal. Evaporator was dumped to 102-AW.

5/14

Filled evaporator with fresh feed and antifoaming agent. Successfully established boiloff at 30 gpm, and gravity slurry. IX screen high dP's begin showing.

5/15

Boiloff = 35 gpm, slurry = 33 gpm. Obtained second (of 5) vessel vent protocol samples. LDS-BSN43 leak detector alarming and would not clear, causing diversion of PC to 102-AW. Later, a spider was found between the LD-43 contact probes. Started fifth 106-AW to 102-AW recycle transfer.

5/16

Completed third (of 5) sampling of feed, slurry, process condensate, and vessel vent. Received low flow alarm through process condensate rad monitor RC3. Cleaned out resin fines in valve HV-RC3-1 to eliminate low flow condition. Subsequently, a total of 8830 gallons of PC were diverted to 102-AW.

5/17

Cooling water and steam condensate protocol samples taken. Terminated fifth 102-AW to 106-AW recycle transfer.

5/18

Boiloff = 42 gpm, slurry = 45 gpm. Started second 103-AP to 102-AW transfer.

5/19

Boiloff = 42 gpm, slurry = 45 gpm. 103-AP to 102-AW transfer in progress.

Table 1: CAMPAIGN 94-1 TIMELINE cont.

5/20 103-AP to 102-AW transfer in progress.

5/21 103-AP transfer shutdown.

5/22 Diverted 3170 gal process condensate to 102-AW after receiving a false alarm that temporarily shut down P-C100. Found IX backflush isolation valve 2-31 open and when it was thought to be closed, dP problems began occurring on the IX column. Column was subsequently backflushed with PC through flushports to reduce dP's.

5/23 Reduced steam flow to reboiler to reduce PC flow through IX column. Backflushed column again with 6090 gallons of PC. Obtained fourth set of feed, slurry, and process condensate samples. USQ evaluation written to allow bypassing of IX column. Flushed slurry line with 200 gallons flushwater to increase gravity slurry flow from 26 to 29 gpm.

5/24 Completed vessel vent protocol sampling. Started 106-AW to 102-AW transfer.

5/25 106-AW to 102-AW transfer ongoing.

5/26 106-AW to 102-AW transfer secured.

5/28 Flushed lower deentrainment pad twice due to slight increase in dP. Ramped up antifoam flow.

5/31 Performed a brief 106-AW to 102-AW batch transfer.

6/2 Performed a slow shutdown of the evaporator. Dumped evaporator contents to 102-AW. Started final 106-AW to 102-AW batch transfer.

6/3 Completed evaporator shutdown.

6/5 Completed 106-AW to 102-AW transfer. Ready for final evaporator pass.

6/6 Filled evaporator with feed. Pulled one feed sample while filling vessel for final pass analysis.

6/7 Attempted to start up evaporator. Vessel vent deentrainment pad dP's causing problems when pulling vacuum.

6/8 Reached boiloff after having difficulties with vessel vent deentrainer. Careful air bleed-in adjustment (valve 3-1) cleared deentrainment problem.

Table 1: CAMPAIGN 94-1 TIMELINE cont.

6/9

Performed final sampling of feed, slurry, process condensate, and vessel vent. Discovered that vacuum jet system would not increase vacuum below 52 TORR. Jetted pump room sump.

6/13

102-AW FIC stops at 16.6". Proceed to shutdown the evaporator. Slurried most of vessel contents to 106-AW and dumped remainder to 102-AW. Began filling vessel with flush water from evaporator flush line and from AW service pit for final deep flush.

6/14

Steam strainer required cleanout to obtain adequate reboiler steam for deep flush water heatup. Vessel eventually heated to 140 F.

6/15

Flushed slurry line with 800 gallons of deep flush water. Dumped contents to 102-AW. 102-AW pressurization problems occurred which slowed down the dumping process.

Table 2: PROCESS MEMOS

Campaign 94-1 Process Memos	
PM #	Description
94-011	242-A Evaporator Campaign 94-1
94-022	Operate 102-AW ALC's
94-029	Add Media to 242-A IX Column
94-030	Back Flush 242-A IX Column
94-031	242-A Evaporator Campaign 94-1 (Revision)
94-032	242-A Liquid Effluent Protocol Samples - Effort One
94-033	242-A Process Protocol Samples - Effort One
94-035	242-A Evaporator Campaign 94-1 (Revision)
94-036	242-A Process Protocol Samples - Effort One (Rev)
94-038	242-A Process Condensate Samples for Biology Study
94-041	242-A LEF Protocol Samples - Effort Two
94-042	242-A Process Protocol Samples - Effort Two
94-043	242-A Process Protocol Samples - Effort Three
94-044	Dump, Rinse, and Fill 242-A Evaporator
94-047	242-A Evaporator Campaign 94-1 (Revision)
94-048	102-AW ALC Operation
94-049	242-A Evaporator (Dump and Fill)
94-050	242-A Process Protocol Samples - Effort Four
94-051	Anti-Foam Addition at the 242-A Evaporator
94-053	242-A Evaporator Campaign 94-1 (Revision)
94-054	242-A Process Protocol Samples - Effort Five
94-064	242-A Evaporator Campaign 94-1 (Final Pass)
94-065	Flush 242-A Evaporator Vessel
94-069	102-AW and 106-AW Sludge Weight Measurements
94-072	Rinse 242-A Pump Room Sump

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APPENDIX B
PERFORMANCE

B-1.1

Figure 1

CAMPAIGN 94-1 STATISTICS

TOTAL WVR = 2.39 million gallons
TOTAL PC to LERF = 3.09 million gallons
TOTAL THROUGHPUT = 5.27 million gallons

Figure 2

CAMPAIGN 94-1 TANK LEVELS

—□— 102-AW LL —▲— 106-AW LL —+— 103-AP LL

FINAL TANK LEVELS (inches): 102-AW = 29, 106-AW = 260, 103-AP = 10
TOTAL TANK WVR (inches) = 870

Table 3: TOTAL OPERATING EFFICIENCY

Unplanned Outages

<u>Dates</u>	<u>Comments</u>	<u>Total Downtime</u>
4/19-4/20 and 5/9-5/14	Deentrainer dP spiking (foaming)	121 hours
4/24-4/26	Resin in RC3 Rad monitor	53 hours
4/27-4/28	Vessel vent CAM test button	16 hours
5/1-5/4	P-C100 failure	68 hours
Total		<u>258 hours</u> (~ 11 days)

Planned Outages

6/2-6/8	Final waste sampling/staging for final pass	~ 6 days
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Total Operating Efficiency (TOE)

Downtime	17 days
Run period 4/15-6/13	60 days

$$TOE = (60-17)/60 \times 100\% = 73\%$$

Table 4: PERFORMANCE DATA

DATE	WVR	WVR SUM	PC	PC SUM	FEED	TP	PC/WVR	DAY	102-AW	106-AW	103-AP	
4/15									0	367.7	393.3	410
4/16	17875	17875	24472	24472	40165	40165	1.37		1	355.3	399.2	410
4/17	27225	45100	42680	67152	71099	111264	1.49		2	371.9	372.7	410
4/18	51425	96525	65785	132937	102586	213850	1.38		3	337.1	388.8	410
4/19	45375	141900	57604	190541	96167	310017	1.34		4	363.7	345.7	410
4/20	42075	183975	56297	246838	96184	406201	1.34		5	349.7	344.4	410
4/21	28325	212300	41578	288416	61658	467859	1.36		6	330.7	353.1	410
4/22	65725	278025	73540	361956	118123	585982	1.30		7	288.6	371.3	410
4/23	51425	329450	81146	443102	144577	730559	1.34		8	261.9	375.3	410
4/24	57475	386925	64220	507322	134773	865332	1.31		9	315.3	301	410
4/25	-7700	379225	7666	514988	5	865337	1.36		10	327.4	291.7	410
4/26	-3025	376200	4281	519269	5	865342	1.38		11	328.6	291.6	410
4/27	26950	403150	39390	558659	54762	920104	1.39		12	310.9	299.5	410
4/28	21175	424325	28037	586696	44661	964765	1.38		13	296.4	306.3	410
4/29	40975	465300	57305	644001	97659	1062424	1.38		14	268	319.8	410
4/30	64625	529925	75713	719714	115734	1178158	1.36		15	227.6	336.7	410
5/1	58850	588775	76115	795829	116059	1294217	1.35		16	189.3	353.6	410
5/2	15400	604175	20853	816682	41031	1335248	1.35		17	193	344.3	410
5/3	-1925	602250	3258	819940	3850	1339098	1.36		18	280.5	257.5	410
5/4	-1650	600600	8897	828837	3960	1343058	1.38		19	280.8	257.8	410
5/5	38225	638825	50973	879810	76635	1419693	1.38		20	256.1	268.6	410
5/6	62425	701250	77661	957471	131893	1551586	1.37		21	228.7	290.8	393.5
5/7	67925	769175	81393	1038864	138053	1689639	1.35		22	295.1	313.5	279.7
5/8	57750	826925	72064	1110928	126450	1816089	1.34		23	314.4	335.7	217.2
5/9	56375	883300	71112	1182040	129147	1945238	1.34		24	270.5	359.1	217.2
5/10	49225	932525	63285	1245325	114312	2059548	1.34		25	231.7	380	217.2
5/11	-3225	927300	4039	1249364	3667	2063215	1.35		26	233.6	360	217.2
5/12	-30800	896500	1978	1251342	5	2063220	1.40		27	244.8	380	217.2
5/13	20625	917125	1403	1252745	25227	2088447	1.37		28	237.1	380.2	217.2
5/14	-28875	888250	0	1252745	5	2088452	1.41		29	247.7	380.1	217.2
5/15	45925	934175	28451	1281196	55612	2144064	1.37		30	229.7	381.4	217.2
5/16	38775	972950	50578	1331774	103044	2247108	1.37		31	234.3	362.7	217.2
5/17	50875	1023825	62829	1394603	130530	2377638	1.36		32	286.4	292.2	217.2
5/18	61600	1085425	72699	1467302	132326	2509964	1.35		33	296.5	259.7	217.2
5/19	62150	1147575	73335	1540637	132983	2642947	1.34		34	268.8	282.5	199.5
5/20	63250	1210825	73414	1614051	133029	2775976	1.33		35	295.8	305.4	126.6
5/21	63525	1274350	72683	1686734	132192	2908168	1.32		36	366.5	328.2	10
5/22	62975	1337325	74725	1761459	134588	3042756	1.32		37	320.7	351.1	10
5/23	58575	1395900	63253	1824712	132358	3175114	1.31		38	276.5	374	10
5/24	38775	1434675	55116	1879828	101421	3276535	1.31		39	245.8	390.6	10
5/25	61875	1496550	72672	1952500	115057	3391592	1.30		40	248.1	365.8	10
5/26	67650	1564200	79123	2031623	136384	3529976	1.30		41	264.6	294.7	10
5/27	68200	1632400	79821	2111444	140026	3670002	1.29		42	304.8	259.7	10
5/28	69575	1701975	81271	2192715	141397	3811399	1.29		43	256.3	282.9	10
5/29	72325	1774300	80566	2273281	139919	3951318	1.28		44	207.5	305.4	10
5/30	67100	1841400	80555	2353836	139355	4090573	1.28		45	160.5	328	10
5/31	70950	1912350	81793	2435629	140863	4231536	1.27		46	112	350.7	10
6/1	75075	1987425	86533	2522162	145830	4377366	1.27		47	90.5	344.9	10
6/2	75075	2062500	86286	2608448	145107	4522473	1.26		48	40.5	367.6	10
6/3	825	2063325	34498	2642946	59904	4582377	1.28		49	36.6	371.2	10
6/4	0	2063325	0	2642946	0	4582377	1.28		50	144.6	263.6	10
6/5	0	2063325	0	2642946	0	4582377	1.28		51	241.7	166.9	10
6/6	0	2063325	0	2642946	0	4582377	1.28		52	258.7	150.6	10
6/7	0	2063325	0	2642946	0	4582377	1.28		53	251.2	150.2	10
6/8	0	2063325	0	2642946	0	4582377	1.28		54	251.2	150.1	10
6/9	52800	2116125	65521	2708467	73860	4658237	1.28		55	227.1	156.1	10
6/10	71500	2187625	87716	2796183	140024	4796261	1.28		56	179.6	177.6	10
6/11	73425	2261050	88253	2884436	144063	4940324	1.28		57	130.1	200.4	10
6/12	72600	2333650	87137	2971573	142747	5083071	1.27		58	81	223.1	10
6/13	69300	2402950	83874	3055447	139692	5222763	1.27		59	33	245.9	10
6/14	11825	2414775	30880	3086327	49280	5272043	1.28		60	18.5	261	10
6/15	-25575	2389200	0	3086327	0	5272043	1.29		61	29.7	260.9	10

APPENDIX C

FEED

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C-1.1

Figure 3

242-A CAMPAIGN 94-1

Daily Feed to Evaporator

Total Campaign 94-1 Feed (Throughput) = 5.27 million gallons

Table 5

CAMPAIGN 94-1 FEED SAMPLE SUMMARY

DATA	UNITS	T-734	T-831	T-901	T-937	T-1057
Date		4/27/94	5/6/94	5/13/94	5/19/94	6/8/94
TB-LIQ	uCi/L	2.85E 04	1.65E 04	2.54E 04	2.30E 04	5.68E 04
AT-LIQ	uCi/L	1.04E 01	1.90E 01	2.75E 01	3.96E 02	8.21
As	mg/L	1.35	6.77E-01	9.11E-01	5.18E-01	1.05
Cl	M	5.76E-03	4.80E-03	8.59E-03	3.90E-03	1.56E-03
TIC	M	1.06E-01	6.67E-02	9.28E-02	7.50E-02	2.38E-01
TOC	G/L C	5.77E-01	3.69E-01	4.40E-01	2.59E-01	1.07
TDS	G/L	7.28E 01	4.89E 01	6.18E 01	4.11E 01	N/A
F	M	2.11E-01	1.20E-01	1.77E-01	1.32E-01	4.74E-01
Cs-137	uCi/L	2.24E 04	1.10E 04	1.74E 04	1.30E 04	4.35E 04
Hg	mg/L	5.00E-03	5.00E-03	5.00E-03	5.00E-03	N/A
I-129	uCi/L	5.52E-02	2.87E-02	3.00E-02	3.10E-02	6.00E-02
NH4	M	1.65E-03	1.39E-02	2.25E-03	2.27E-03	1.90E-03
NO2	M	1.04E-01	6.35E-02	7.94E-02	6.97E-02	1.87E-01
NO3	M	2.32E-01	1.87	2.17E-01	1.97E-01	6.56E-01
OH-	M	1.89E-01	2.40E-01	1.99E-01	1.07E-01	1.28E-01
pH	N/A	1.28E 01	1.28E 01	1.29E 01	1.28E 01	1.28E 01
PO4	M	2.59E-03	3.62E-03	4.81E-03	2.50E-03	9.20E-04
Pu-239/240	uCi/L	7.04E-02	8.04E-02	5.25E-02	4.14E-02	1.63E-01
Se	Mg/L	9.71E-03	5.21E-03	N/A	N/A	N/A
SO4	M	1.66E-02	8.03E-03	1.80E-02	9.30E-03	2.81E-02
Sr-89/90	uCi/L	1.59E 01	2.64E 02	5.89E 01	3.49E 01	3.49E 02
Am241	uCi/L	3.08E-02	2.17E-01	4.67E-02	2.06E-01	6.61E-01
SPG	N/A	1.04	1.1068	1.04	9.92E-01	1.09
% SOLIDS	WT%	6.40	3.90	2.10	3.40	1.29E 01
%H2O	%H2O	9.36E 01	9.61E 01	9.79E 01	9.66E 01	8.71E 01
Al	MG/L	8.28E 02	5.84E 02	7.85E 02	4.83E 02	1.59E 03
Zn	MG/L	4.10E-01	2.10E-01	2.73E-01	2.10E-01	1.01
Fe	MG/L	2.05	1.05	1.05	1.05	5.05
Ca	MG/L	4.10	2.10	2.10	2.10	1.01
Ba	MG/L	2.05	1.05	1.05	1.05	5.05
Na	MG/L	2.38E 04	1.42E 04	1.96E 04	1.32E 04	4.33E 04
Pb	MG/L	4.10	8.08	2.10	2.10	1.01E 01
Ag	MG/L	9.02E-01	2.94E-01	2.10E-01	0.42	1.21
Cd	MG/L	4.51E-01	2.10E-01	2.10E-01	2.10E-01	1.01
Mn	MG/L	4.10E-01	2.10E-01	2.10E-01	2.10E-01	1.01
Cr	MG/L	2.07E 01	1.12E 01	2.10E-01	1.12E 01	3.97E 01

APPENDIX D

SLURRY

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D-1.1

Figure 4

242-A CAMPAIGN 94-1

Daily Slurry Discharge

Table 6: CAMPAIGN 94-1 SLURRY SOURCE TERM

Radionuclide	Limit ($\mu\text{Ci/mL}$)	Final Pass Slurry Sample (# V97)
^{14}C	0.26	1.72×10^{-4}
^{60}Co	1.2	$< 2.25 \times 10^{-2}$
^{79}Se	7.8×10^{-2}	1.22×10^{-4}
^{90}Sr	220	4.38×10^{-2}
$^{94}\text{Nb}^2$	9.8×10^{-2}	$< 5 \times 10^{-5}$
^{99}Tc	2.0	2.81×10^{-2}
^{106}Ru	53	< 1.31
^{129}I	2.6×10^{-3}	$< 3.17 \times 10^{-5}$
^{134}Cs	15	2.79
^{137}Cs	1,500	9.85×10^1
^{154}Eu	5.0	$< 6.2 \times 10^{-2}$
^{155}Eu	7.0	$< 1.78 \times 10^{-1}$
$^{226}\text{Ra}^2$	3.3×10^{-2}	4.38×10^{-6}
$^{238}\text{Pu}^2$	1.3×10^{-3}	$< 1.39 \times 10^{-4}$
$^{239/240}\text{Pu}$	0.16	$< 5.57 \times 10^{-4}$
$^{241}\text{Pu}^2$	15	$< 2.28 \times 10^{-2}$
^{241}Am	1.0	$< 1.48 \times 10^{-3}$
$^{244}\text{Cm}^3$	1.3×10^{-2}	8×10^{-6}

¹From 242-A Evaporator/Crystallizer Safety Analysis Report (Lavender 1993b).

²Calculated from equations in WHC-SD-WM-OCD-016 (Tranbarger 1992)

³The analytical results were not detectable. The ^{244}Cm detection limit of 1×10^{-6} was utilized (Griffin 1991) and multiplied by $1/(1-\text{WVRF})$ to obtain maximum estimated slurry concentration.

Table 7

Slurry Analysis for Tank Corrosion Spec

DOUBLE SHELL TANK CORROSION SPECIFICATIONS (Harris 1992)

Limit (M) for $[NO_3] < 1.0$ M

Hydroxide $0.01 \leq [OH] \leq 5.0$
 Nitrite $0.011 \leq [NO_2] \leq 5.5$

Limit (M) for $1.0 \text{ M} < [NO_3] < 3.0 \text{ M}$

Hydroxide $0.1 \times [NO_3] \leq [OH] \leq 10$
 Nitrite $[OH] + [NO_2] \geq 0.4 \times [NO_3]$

Limit (M) for $3.0 \text{ M} < [NO_3] < 5.0 \text{ M}$

Hydroxide $0.3 \leq [OH] \leq 10$
 Nitrite $[OH] + [NO_2] \geq 1.2$

Table 8

CAMPAIGN 94-1 SLURRY SAMPLE SUMMARY

ANALYSIS	UNITS	V81	V85	V89	V93	V97
Date		5/5/94	5/10/94	5/18/94	5/25/94	6/10/94
SPG	NA	1.11	1.047	1.07	1.051	1.19
OH-	uG/ML	7390	6220	7100	4270	19300
H3	uCi/ML	0.0048	0.00376	0.00294	0.00417	0.00489
Hg	uG/ML	<5E-03	<5E-03	<5E-03	<5E-03	<5E-3
F-	uG/ML	11900	4950	7500	4780	5200
NO2-	uG/ML	10500	6530	N/A	5870	21700
NO3-	uG/ML	37500	26200	N/A	20600	80000
CN	uG/ML	13.5	6.94	3.53	2.448	36.5
TIC	uG C/ML	3000	1750	2050	1850	5780
NH4	uG/ML	<8E03	<1.6E03	<1.6E03	<1.6E03	<8E03
Pu239/240	uCi/ML	0.00046	0.00023	<1.01E-04	0.00015	<6.52E-04
Am241	uCi/ML	0.00128	<6.41E-04	<3.76E-04	<1.7E-3	<2.06E-2
Sr90	uCi/ML	0.258	0.187	0.0112	0.169	0.0402
As	uG/ML	1.44	1.17	1.55	N/A	5.75
TB	uCi/ML	64.9	34.1	41.5	37.8	132
AT	Uci/ML	<1.15E-02	<1.2E-02	0.0133	<8.35E-3	<2.2E-02
Cs-137	Uci/ML	23.8	24.1	13.2	26.8	98.5
Cs-134	Uci/ML	0.0839	N/A	0.106	0.0714	0.29
Se	uG/ML	0.047	<5E-02	0.0324	0.0423	0.165
Cl-	uG/ML	N/A	1000	409	234	825
PO4-	uG/ML	N/A	1830	N/A	677	2560
SO4-	uG/ML	N/A	5270	N/A	1820	6250
Co60	uCi/ML	N/A	N/A	<4.42E-03	N/A	2.48E-02
U	uG/ML	N/A	N/A	N/A	N/A	23.9
Tc99	uCi/ML	N/A	N/A	N/A	N/A	0.0281
I129	uCi/ML	N/A	N/A	N/A	N/A	<3.39E-05
C14	uCi/ML	N/A	N/A	N/A	N/A	0.000157
Se79	uCi/ML	N/A	N/A	N/A	N/A	0.000122
RuRh106	uCi/ML	N/A	N/A	N/A	N/A	<1.34
Eu154	uCi/ML	N/A	N/A	N/A	N/A	<6.2E-02
Eu155	uCi/ML	N/A	N/A	N/A	N/A	<1.81E-01

Table 9: PREDICT RUN FOR COMPLEX DETERMINATION

PASS ONE DOUBLE SHELL SLURRY FEED RUN

PASS STOPPED AT 50% WVR LIMIT.

TEMPERATURE 45.0 C 113.0 F PRESSURE 57.7 Torr
 PASS WVR 50.0 TOTAL WVR 50.0

	FEED	SLURRY	EVAPORATOR CONDITIONS		TANK CONDITIONS 20.0 C	
			SUPERNATE	SOLIDS*	SUPERNATE	SOLIDS
VOLUME, gal	.399E+06	.201E+06	.199E+06	.137E+04	.199E+06	.273E+04
HYDROXIDE, M	1.138	2.261	2.276	.000	2.276	.000
ALUMINATE, M	.118	.234	.236	.000	.236	.000
NITRATE, M	1.314	2.611	2.629	.000	2.629	.000
NITRITE, M	.478	.950	.957	.000	.957	.000
CARBONATE, M	.098	.195	.197	.000	.197	.000
PHOSPHATE, M	.027	.055	.055	.000	.000	.027
SULFATE, M	.068	.135	.136	.000	.136	.000
FLUORIDE, M	.275	.546	.095	.227	.095	.227
ORGANIC, G/L	2.600	5.165	5.200	.000	5.200	.000

PASS TWO DOUBLE SHELL SLURRY FEED RUN

PASS STOPPED AT 50% WVR LIMIT.

TEMPERATURE 45.0 C 113.0 F PRESSURE 47.7 Torr
 PASS WVR 50.0 TOTAL WVR 74.7

	FEED	SLURRY	EVAPORATOR CONDITIONS		TANK CONDITIONS 20.0 C	
			SUPERNATE	SOLIDS*	SUPERNATE	SOLIDS
VOLUME, gal	.197E+06	.108E+06	.983E+05	.961E+04	.983E+05	.149E+05
HYDROXIDE, M	2.276	4.147	4.553	.000	4.553	.000
ALUMINATE, M	.236	.430	.472	.000	.472	.000
NITRATE, M	2.629	4.790	3.451	.903	2.031	1.613
NITRITE, M	.957	1.743	1.913	.000	1.913	.000
CARBONATE, M	.197	.359	.052	.171	.044	.175
PHOSPHATE, M	.000	.000	.000	.000	.000	.000
SULFATE, M	.136	.249	.273	.000	.273	.000
FLUORIDE, M	.095	.173	.033	.079	.033	.079
ORGANIC, G/L	5.200	9.474	10.400	.000	10.400	.000

PASS THREE DOUBLE SHELL SLURRY FEED RUN

PASS STOPPED AT ALUMINATE BOUNDARY.

TEMPERATURE 45.0 C 113.0 F PRESSURE 36.7 Torr
 PASS WVR 32.9 TOTAL WVR 81.5

	FEED	SLURRY	EVAPORATOR CONDITIONS		TANK CONDITIONS 20.0 C	
			SUPERNATE	SOLIDS*	SUPERNATE	SOLIDS
VOLUME, gal	.834E+05	.569E+05	.560E+05	986.	.560E+05	.512E+04
HYDROXIDE, M	4.553	6.668	6.785	.000	6.785	.000
ALUMINATE, M	.472	.691	.703	.000	.703	.000
NITRATE, M	2.031	2.975	2.645	.256	1.324	1.143
NITRITE, M	1.913	2.802	2.851	.000	2.142	.476
CARBONATE, M	.044	.064	.030	.024	.010	.037
PHOSPHATE, M	.000	.000	.000	.000	.000	.000
SULFATE, M	.273	.400	.407	.000	.407	.000
FLUORIDE, M	.033	.048	.023	.018	.023	.018
ORGANIC, G/L	10.400	15.231	15.499	.000	15.499	.000

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APPENDIX E
PROCESS CONDENSATE

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E-1.1

Figure 5

242-A CAMPAIGN 94-1

Daily Process Condensate Discharges

TOTAL PROCESS CONDENSATE DISCHARGE = 3.09 million gallons

Figure 6

242-A CAMPAIGN 94-1

Process Condensate Organics (RCRA data)

■ Acetone	▲ MEK	+ MIBK
□ 2-Propanol	× Tetrahydrofuran	

Limits ¹ :	Acetone	MEK	MIBK	2-Propanol	Tetrahydrofuran
(ppb)	600000	20000	10000	10000	20000

¹From 242-A Evaporator Waste Analysis Plan (Lol1 1993)

Campaign 94-1 Process Condensate DCG Values

Figure 7

Campaign 94-1 Process Condensate Alpha Concentrations

Figure 8
(uCi/L)

■ APC ▲ AFPC

Campaign 94-1 Process Condensate

Beta Concentrations

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Figure 9

E-6

Campaign 94-1 Process Condensate

Cs-137 Concentrations

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Figure 10

—■— APC —▲— AFPC

E-7

Campaign 94-1 Process Condensate

Sr-90 Concentrations

Figure 11

(uCi/L)

■ APC ▲ AFPC

Campaign 94-1 Process Condensate

H-3 Concentrations

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Figure 12

—■— AFPC

Campaign 94-1 Process Condensate

NH₃ Concentrations

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Figure 13

Molar

—■— AFPC

E-10

Figure 14

Campaign 94-1 Process Condensate pH Levels

Table 10: Process Condensate Sample Summary (page 1 of 2)

Date	Sample #	Sample Point	AT ($\mu\text{Ci/L}$)	TB ($\mu\text{Ci/L}$)	Sr-90 ($\mu\text{Ci/L}$)	Cs-137 ($\mu\text{Ci/L}$)	H-3 ($\mu\text{Ci/L}$)	I-129 ($\mu\text{Ci/L}$)	DCGs ¹	TOC (g/L)	NH ₃ ²		pH ³
											(M)	(ppm)	
18-Apr-94	T660	APC	7.46e-05	3.72e-03	5.99e-04	2.24e-03			7.0				10.29
18-Apr-94	T659	AFPC	4.50e-05	2.06e-03	1.19e-03	1.01e-03	2.60e+00	<1.87e-04	5.6	0.0130	0.00264	45.0	9.25
22-Apr-94	T703	APC	3.79e-04	1.27e-02	2.99e-04	8.02e-03			28.0				10.12
22-Apr-94	T700	AFPC	6.98e-05	2.28e-03	3.49e-04	ND	3.78e+00	<8.53e-05	6.7	0.0230	0.00338	57.6	9.49
24-Apr-94	T717	AFPC	1.07e-04	2.44e-03	2.00e-04	1.24e-03	3.96e+00	<9.58e-05	8.6	0.0210	0.0033	56.2	9.64
29-Apr-94	T748	APC	1.58e-04	6.77e-03	3.00e-04	4.91e-03			13.7				10.22
29-Apr-94	T747	AFPC	6.69e-05	2.70e-03	2.66e-04	1.35e-03	4.54e+00	<7.25e-05	7.8	<0.0055	0.00338	57.6	9.50
06-May-94	T827	APC	1.69e-05	1.29e-03	4.55e-05	1.05e-03			2.2				10.26
06-May-94	T826	AFPC	3.67e-05	2.33e-03	1.68e-04	1.35e-03	4.04e+00	<5.06e-05	6.1	<0.0055	0.00288	49.1	8.99
15-May-94	T904	AFPC	6.04e-05	1.68e-03	1.01e-04	1.09e-03	3.55e+00	<8.36e-05	6.0	<0.0055	0.00354	60.3	9.01
16-May-94	T913	APC	2.55e-05	5.55e-04	2.60e-05	<4.03e-04			1.5				10.17
16-May-94	T912	AFPC	<1.17e-05	7.75e-04	9.77e-05	<4.91e-04	6.03e-01	<9.78e-05	1.8	<0.0055	0.00321	54.7	9.25
20-May-94	T956	APC	2.01e-05	6.01e-04	3.13e-05	ND			1.3				10.20
20-May-94	T951	AFPC	<2.35e-05	5.75e-04	5.01e-05	ND	3.62e+00	<9.24e-05	3.4	0.0061	0.00282	48.1	9.14
23-May-94	T977	APC	<1.28e-05	1.26e-03	3.67e-05	8.96e-04			2.0				10.00
23-May-94	T976	AFPC	<1.28e-05	2.76e-04	2.41e-05	<4.82e-04	4.23e+00		3.0	0.0077	0.00288	49.1	9.12
26-May-94	T991	AFPC	see page 2										
27-May-94	T1005	APC	3.91e-05	2.47e-03	3.41e-05	1.24e-03	4.34e+00	<6.28e-05	6.5	0.0060	0.00164	27.9	10.10
27-May-94	T1004	AFPC	<1.35e-05	4.65e-04	2.32e-05	2.54e-04	4.49e+00	<4.49e-05	3.3	<0.0055	0.00138	23.5	8.85
10-Jun-94	T1070	APC	<2.02e-05	7.78e-04	6.57e-05	5.22e-04	7.32e-01	<5.85e-05	2.1	<0.0055	0.00068	11.6	9.68

Limits:

- 1) Total DCGs $\leq$ 5000. The total DCGs is approximated by the following equation:

$$\frac{AT (\mu\text{Ci/L})}{3.0\text{E-}5} + \frac{TB (\mu\text{Ci/L})}{1.0\text{E-}3} + \frac{Cs-137 (\mu\text{Ci/L})}{3.0\text{E-}3} + \frac{H-3 (\mu\text{Ci/L})}{2.0} + \frac{I-129 (\mu\text{Ci/L})}{5.0\text{E-}4}$$

- 2) Ammonia < 13,600 ppm.
 3) 7.5 < pH < 11.

Table 10: Process Condensate Sample Summary (page 2 of 2)

Analyte	T991 ($\mu\text{Ci/L}$)	DCG ($\mu\text{Ci/L}$)	T991/ DCG
H-3	4.16e+00	2.0e+00	2.08
C-14	<2.32e-07	7.0e-02	0.00
Co-60	ND	5.0e-03	0.00
Se-79	<1.44e-04	2.0e-02	0.01
Sr-90	1.25e-05	1.0e-03	0.01
Nb-94 ¹	5.00e-02	3.0e-02	1.67
Tc-99	<2.16e-04	1.0e-01	0.00
Ru-106	ND	6.0e-03	0.00
I-129	<4.81e-05	5.0e-04	0.10
Cs-134	ND	2.0e-03	0.00
Cs-137	ND	3.0e-03	0.00
Ce-144	ND	7.0e-03	0.00
Eu-154	ND	2.0e-02	0.00
Eu-155	ND	1.0e-01	0.00
Ra-226 ¹	1.25e-09	1.0e-04	0.00
U ²	1.85e-06	5.0e-04	0.00
Np-237 ³	ND	3.0e-05	0.00
Pu-238 ¹	<3.30e-07	4.0e-05	0.01
Pu-239/240	<1.32e-06	3.0e-05	0.04
Pu-241 ¹	<5.41e-05	2.0e-03	0.03
Am-241	<1.45e-08	3.0e-05	0.00
Cm-244	<1.45e-08	6.0e-05	0.00
Total DCGs			3.95

Notes:

- 1) Nb-94, Ra-226, Pu-238, and Pu-241 concentrations are conservatively estimated by the following (refer to OSD-T-151-00029 for basis):

Nuclide	Concentration ($\mu\text{Ci/mL}$)
Nb-94	5.0E-5
Ra-226	1.0E-4 x [Sr-90]
Pu-238	0.25 x [Pu-239/240]
Pu-241	41.0 x [Pu-239/240]

- 2) The uranium result of 2.99E-07 g/L is converted to $\mu\text{Ci/L}$ by applying the specific activity for U-234, 0.0062 Ci/g.
- 3) The reported Np result of 1.95E-02 is not included for the following reasons:
- Result is below the 95% confidence level of 3.9E-02.
 - Analysis is run with 250 μL sample volume, which may not be representative of the entire sample.
 - Total alpha (AT) results from this campaign are 2 - 3 orders of magnitude less than the Np result.

APPENDIX F
COOLING WATER

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Figure 15

242-A Campaign 94-1 Daily Cooling Water Releases

Total Campaign 94-1 Cooling Water Discharge -- 216000000 gal

Campaign 94-1 ACW Sample Data

Total Beta (TB) Concentration

Table 11

Campaign 94-1 Cooling Water Samples

(SUMMARY)

Sample Number	Date	TB-LIQ uCI/L	TA-LIQ uCI/L	pH
T-637	4/15/94	2.33E-05	9.41E-06	8.07
T-643	4/15/94	3.38E-05	5.75E-06	8.19
T-649	4/17/94	2.19E-05	1.23E-05	8.13
T-655	4/18/94	2.82E-05	7.83E-06	8.27
T-633	4/19/94	3.26E-05	9.06E-06	8.14
T-673	4/20/94	2.18E-05	9.47E-06	8.43
T-675	4/21/94	3.99E-05	7.04E-06	8.09
T-698	4/21/94	3.75E-05	1.23E-05	8.23
T-713	4/22/94	2.34E-05	1.04E-05	8.55
T-718	4/24/94	1.63E-05	8.88E-06	8.40
T-724	4/25/94	2.05E-05	7.71E-06	8.31
T-731	4/27/94	2.31E-05	6.34E-06	8.30
T-738	4/27/94	2.97E-05	3.86E-06	8.31
T-743	4/29/94	1.94E-05	4.98E-06	8.48
T-753	4/29/94	4.83E-05	1.53E-05	8.21
T-757	5/1/94	5.27E-05	5.73E-06	8.33
T-761	5/2/94	3.11E-05	5.70E-06	7.28
T-780	5/3/94	3.83E-05	1.28E-05	8.25
T-782	5/4/94	2.81E-05	6.05E-06	7.58
T-787	5/4/94	1.75E-05	4.55E-06	8.32
T-824	5/5/94	2.25E-06	8.03E-06	8.30
T-834	5/7/94	2.43E-05	4.53E-06	8.30
T-840	5/7/94	1.48E-05	4.38E-06	8.28
T-844	5/8/94	1.48E-05	3.60E-06	7.29
T-862	5/10/94	3.86E-05	1.82E-05	8.34
T-881	5/11/94	1.34E-05	3.93E-05	8.43
T-895	5/11/94	2.33E-05	5.34E-06	8.23
T-899	5/13/94	3.19E-05	2.61E-05	8.30
T-914	5/16/94	3.32E-04	1.57E-05	8.09
T-920	5/17/94	2.72E-05	9.26E-06	8.10
T-924	5/18/94	1.98E-05	4.98E-06	8.11
T-935	5/19/94	1.63E-05	9.25E-06	7.59
T-952	5/20/94	1.89E-05	6.51E-06	8.27
T-960	5/21/94	2.56E-05	4.98E-06	8.04
T-964	5/21/94	1.80E-05	8.19E-06	8.16
T-970	5/23/94	1.59E-04	1.19E-05	7.82
T-980	5/24/94	1.54E-05	3.38E-06	8.33
T-987	5/25/94	2.56E-05	1.89E-05	8.20
T-992	5/26/94	2.92E-05	5.66E-06	8.27
T-1000	5/27/94	3.08E-05	6.85E-06	8.28
T-1009	5/27/94	1.59E-05	6.74E-06	8.15
T-1014	5/28/94	3.03E-05	4.47E-06	8.07
T-1020	5/30/94	1.83E-05	1.27E-05	8.18
T-1026	5/30/94	2.87E-05	4.14E-06	8.18
T-1032	6/1/94	2.48E-05	7.83E-06	8.32
T-1038	6/1/94	2.08E-05	5.69E-06	8.18
T-1048	6/3/94	2.44E-05	4.63E-06	8.08
T-1053	6/7/94	3.90E-05	8.28E-06	8.08
T-1060	6/9/94	2.03E-05	6.85E-06	8.35
T-1066	6/10/94	2.97E-05	8.08E-06	8.06
T-1073	6/11/94	3.08E-05	4.98E-06	8.34
T-1079	6/12/94	2.61E-05	5.38E-06	8.35
T-1085	6/12/94	2.64E-05	8.47E-06	8.36
T-1089	6/14/94	2.75E-05	6.45E-06	8.30

Campaign 94-1 ACW Sample Data

Total Alpha (AT) Concentration

APPENDIX G

STEAM CONDENSATE

Figure 18

242-A Campaign 94-1

Daily Steam Condensate Releases

Total Campaign 94-1 Steam Condensate Discharge -- 4730880 gal.

Campaign 94-1 ASC Sample Data

Total Beta (TB) Concentration

Table 12

Campaign 94-1 Steam Condensate Samples

(Summary)

Sample Number	Date	TB-LIQ	TA-LIQ	pH
		uCI/L	uCI/L	
T-645	4/15/94	2.25E-05	8.54E-06	7.57
T-647	4/16/94	3.38E-05	9.97E-06	7.20
T-651	4/17/94	2.98E-05	1.23E-05	7.50
T-653	4/17/94	2.76E-05	5.75E-06	7.57
T-661	4/18/94	3.07E-05	8.22E-06	7.13
T-665	4/19/94	7.45E-05	5.75E-06	7.09
T-671	4/20/94	2.25E-05	5.34E-06	7.94
T-677	4/21/94	2.53E-05	7.04E-06	7.47
T-696	4/21/94	2.30E-05	6.42E-06	7.13
T-709	4/22/94	3.59E-05	5.75E-06	6.89
T-711	4/22/94	1.59E-05	5.09E-06	6.94
T-715	4/23/94	1.63E-05	7.24E-06	6.72
T-720	4/24/94	1.63E-05	7.32E-06	8.08
T-729	4/26/94	2.80E-05	6.80E-06	6.97
T-736	4/27/94	2.39E-05	6.74E-06	7.34
T-741	4/28/94	2.35E-05	3.36E-06	6.82
T-745	4/29/94	1.56E-05	4.98E-06	7.30
T-751	4/30/94	1.65E-05	4.44E-06	6.84
T-755	4/30/94	3.10E-05	8.13E-06	7.16
T-759	5/1/94	1.72E-05	4.54E-06	6.89
T-763	5/2/94	1.59E-05	4.47E-06	7.49
T-785	5/4/94	1.96E-05	6.41E-06	7.54
T-789	5/4/94	1.98E-05	4.54E-06	7.44
T-814	5/5/94	2.41E-05	4.89E-06	7.11
T-828	5/6/94	2.33E-05	5.34E-06	7.51
T-832	5/6/94	1.62E-04	1.06E-05	7.20
T-836	5/7/94	3.26E-05	7.64E-06	7.32
T-838	5/7/94	1.55E-05	5.26E-06	7.13
T-842	5/8/94	2.89E-05	1.17E-05	7.32
T-846	5/8/94	2.08E-05	6.05E-06	7.33
T-864	5/10/94	5.72E-04	6.83E-06	7.11
T-893	5/16/94	2.43E-05	4.78E-06	8.19
T-902	5/14/94	3.18E-05	1.42E-05	7.58
T-906	5/15/94	1.48E-05	4.78E-06	8.05
T-908	5/16/94	2.25E-05	6.93E-06	7.14
T-918	5/16/94	2.89E-05	4.98E-06	6.94
T-922	5/17/94	1.79E-05	4.98E-06	7.77
T-926	5/18/94	1.54E-05	4.79E-06	7.44
T-933	5/18/94	1.70E-05	9.65E-06	7.00
T-938	5/19/94	1.63E-05	8.03E-06	6.88
T-954	5/19/94	2.50E-05	1.32E-05	7.61
T-958	5/20/94	2.33E-05	4.54E-06	7.13
T-962	5/21/94	1.54E-05	4.47E-06	7.32
T-966	5/21/94	1.48E-05	4.05E-06	7.27
T-968	5/22/94	2.22E-05	5.73E-06	7.13
T-974	5/23/94	1.63E-05	5.76E-06	7.09
T-985	5/24/94	2.53E-05	6.76E-06	7.05
T-978	5/23/94	2.39E-05	6.85E-06	7.13
T-989	5/24/94	2.47E-05	5.34E-06	7.27
T-994	5/26/94	1.54E-05	3.38E-06	7.26
T-998	5/26/94	2.96E-05	4.94E-06	6.98
T-1002	5/27/94	1.97E-05	8.03E-06	6.98
T-1007	5/27/94	1.63E-05	4.98E-06	6.91
T-1012	5/28/94	1.91E-05	5.38E-06	6.76
T-1016	5/28/94	3.07E-05	6.34E-06	7.09
T-1018	5/29/94	1.63E-05	9.26E-06	6.85
T-1024	5/30/94	2.80E-05	4.63E-06	7.25
T-1028	5/30/94	1.82E-05	4.87E-06	7.55
T-1034	6/1/94	2.35E-05	4.74E-06	6.92
T-1036	6/1/94	4.16E-05	5.26E-06	6.81
T-1046	6/2/94	2.39E-05	6.60E-06	6.60
T-1055	6/7/94	5.71E-05	1.27E-06	7.99
T-1058	6/8/94	7.25E-05	1.81E-05	7.32
T-1064	6/9/94	1.92E-05	7.24E-06	7.26
T-1068	6/10/94	1.65E-05	6.40E-06	7.10
T-1071	6/10/94	1.74E-05	4.98E-06	7.00
T-1075	6/11/94	1.75E-05	5.07E-06	7.41
T-1077	6/11/94	1.75E-05	5.36E-06	7.17
T-1081	6/12/94	1.86E-05	5.77E-06	7.39
T-1083	6/13/94	1.75E-05	6.74E-06	7.11

Campaign 94-1 ASC Sample Data

Total Alpha (AT) Concentration

APPENDIX H
DEENTRAINMENT PROBLEMS

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Figure 21

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