301/587-8202

SUPPORTING DOCUMENT

1. Total Pages 87

2. Title

CONCENTRATOR E-F11 WATER TEST

3. Number

WHC-SD-WM-PTR-011

4. Rev No.

0

5. Key Words

PUREX, E-F11, WATER TEST

6. Author

Name: P. R. Ethington

Signature

Organization/Charge Code 17210/K311A

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7. Abstract

This document is the Process Test Report for performing operational testing with water of the modified E-F11 concentrator in PUREX on water. The test was performed to determine the effects of the following concentrator modifications; routing concentrator off-gasses via the PUREX air tunnel to the main stack, blanking of condenser cooling water, blanking of process condensate route to a crib, restricting flow to steam tube bundles, and routing of steam condensate to TK-F12. The test was successful. Concentrator boil-off rates of 6-7 gpm were achieved while the overheads exited the PUREX plant in vapor form. With minor recommended modifications, this process is recommended for use in processing PUREX deactivation flush solutions and other miscellaneous wastes accumulated during the completion of the deactivation project.

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9. Impact Level N/A

10.

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PROCESS TEST REPORT

CONCENTRATOR E-F11 WATER TEST

Paul Ethington

CONCENTRATOR E-F11 WATER TEST

<u>TABLE OF CONTENTS</u>	<u>Page</u>
1.0 INTRODUCTION.....	3
2.0 DESCRIPTION OF TEST.....	4
3.0 TEST METHOD AND TEST EQUIPMENT.....	8
4.0 TEST RESULTS.....	9
5.0 CONCLUSIONS AND RECOMMENDATIONS.....	11
6.0 DISPOSITION OF TEST ITEMS.....	12
7.0 REFERENCES.....	12
TABLE 1, CONCENTRATOR TEST MONITORING INSTRUMENTATION.....	13
TABLE 2, PUREX WORK REQUESTS SUPPORTING CONCENTRATOR TESTING.....	15
TABLE 3, E-F11 TESTING SAMPLE RESULTS.....	16
TABLE 4, ACRONYMS AND MEASUREMENT UNITS USED.....	18
FIGURE 1, E-F11 CONCENTRATOR.....	19
FIGURE 2, E-F11 ASW CONFIGURATION.....	20
FIGURE 3, E-F11 TESTING CONFIGURATION.....	21
FIGURE 4, E-F11 MODIFIED TESTING CONFIGURATION.....	22
FIGURE 5, CONCENTRATOR E-F11 CALIBRATION CHART.....	23
FIGURE 6, E-F11 BOIL-OFF DATA.....	24
FIGURE 7, E-F11 BOIL-OFF DATA.....	25
FIGURE 8, E-F11 BOIL-OFF DATA.....	26
FIGURE 9, CANYON AIR FLOW AT 25K SCFM.....	27
FIGURE 10, CANYON AIR FLOW AT 30K SCFM.....	28
FIGURE 11, CANYON AIR FLOW AT 40K SCFM.....	29
FIGURE 12, CANYON AIR FLOW AT 50K SCFM.....	30
8.0 APPENDIXES.....	31
APPENDIX 1, E-F11 VENT JET TESTING DATA.....	32
APPENDIX 2, CANYON PREHEAT TESTING DATA.....	36
APPENDIX 3, CELL COVER BLOCK REMOVAL TESTING DATA.....	56
APPENDIX 4, E-F11 BOIL-OFF MONITORING TEST DATA.....	66
APPENDIX 5, E-F11 BOIL-OFF RATE DETERMINATION DATA.....	80
APPENDIX 6, CANYON HUMIDITY CALCULATIONS.....	83
APPENDIX 7, E-F11 BOIL-OFF RATE LIMITS.....	85

CONCENTRATOR E-F11 WATER TEST

TEST REPORT

1.0 INTRODUCTION

This Process Test Report discusses the test of the Ammonia Scrubber Waste Concentrator (E-F11) (Refer to Figure 1) as a low level waste water concentrator. The concentrator is located in F Cell of the Plutonium/Uranium Extraction (PUREX) facility canyon. Use of E-F11 is not a new operation. Ammonia scrubber wastes (ASW) have been processed in the past with the condensed vapors (ASD stream) being pumped to the Ammonia Crib (216-A-36), the off-gas vapors routed to the Ammonia Stack (296-A-24), and the concentrated solution being transferred to Underground Storage (UGS). ASW processing was stopped in 1987 when waste was transferred to the crib with ammonia concentration above release limits. E-F11 has been idle since shutdown except for some initial testing of the Ammonia Destruction Process (which was abandoned when the decision was made to deactivate PUREX) and using the concentrator spray tower (Refer to Figure 2) to scrub Ruthenium from exhaust vapors.

Processing plants have needed to become sensitive to waste minimization due to long lead times to obtain new storage tanks and a decreasing availability of space in Tank Farms. Prior to the PUREX deactivation decision, concern was raised over large amounts of low-level, non-dangerous wastes generated in non-process areas by the collection of rain water, steam condensate, and pipe breaks. These types of occurrences generate large amounts of waste water that take up valuable Tank Farms space. Concentration of waste in E-F11 was studied as a method for minimizing these wastes. Canyon jumpers which route the exhaust vapors to the PUREX air tunnel had been fabricated for Ammonia Destruction activities (which had been intended to replace transferring ammonia wastes to Tank Farms). By blocking the cooling water supply and the route to the Ammonia Crib, off-gasses could be routed out the PUREX Main Stack (291-A-1) along with the entrained vapors (Refer to Figure 3 for modified concentrator configuration).

Use of E-F11 was pursued as an option for handling non-routine, non-dangerous wastes and the activity became a major waste minimization activity for PUREX. Initial feasibility evaluations and waste permitting activities were for waste water processing only. While preparations were in progress to make the concentrator operable, the decision was made to deactivate PUREX rather than prepare it for re-start.

CONCENTRATOR E-F11 WATER TEST

1.0 INTRODUCTION (Cont.)

PUREX deactivation changed the focus of plant activities. Waste minimization using E-F11 became a deactivation activity and was expanded to include dangerous waste processing, to enable the concentration of deactivation flush solutions. The concentrator was readied for operation, flushed with water, and the flush solution sampled. Testing began on December 7, 1993 and ran through January 21, 1994.

2.0 DESCRIPTION OF TEST

Test Scope

The object of the test was to determine the maximum boil-off rate. Testing consisted of boiling solution at increasing rates until: 1) the concentrator vent jet could not handle the flow, 2) the PUREX ventilation exhaust system could not handle the vapor, or 3) the maximum steam flow was attained. Pre-heating the canyon inlet air and removing a cell cover block to channel more flow past E-F11 were seen as ways to increase maximum boil-off rate and these enhancements were tested with the concentrator both operating and shutdown.

Test Preparation

Several modifications had to be made to the configuration of the concentrator before operation. Modifications included re-routing the concentrator off-gasses to the PUREX air tunnel, blanking the E-F11 condenser cooling water, and blanking the condensate route to crib 216-A-36.

Routing the off-gasses to the PUREX air tunnel required installing three new jumpers. One of these jumpers included a steam jet for providing concentrator vacuum. Because the jet on the route to the air tunnel only had a capacity equivalent to 6 gallons per minute (gpm) and the concentrator was designed for 60 gpm, an orifice plate was placed in the steam supply to the right tube bundle. This reduced concentrator steam flow to range capable of controlling the boil-off rate.

Other configuration changes consisted of restoring previously altered routes. During most recent operation, E-F11 functioned as a catch tank which overflowed to Concentrator Feed Tank (TK-F12). The TK-F12 solution was then pumped to Scrubber Waste Transfer Tank (TK-G7) for transfer to UGS. The E-F11 feed route from TK-F12 was restored (although testing used water from the Aqueous Make Up (AMU) area from Demineralized Water Tank (TK-223)) and the E-F11 to TK-F18 (For transfer to UGS) route re-installed. Completion of configuration changes placed the concentrator in a configuration for testing.

CONCENTRATOR E-F11 WATER TEST

2.0 DESCRIPTION OF TEST (Cont.)

Concentrator testing was conducted in accordance with PUREX Work Plan, WP-P-93-046, using the process developed in Process Test Plan, WHC-SD-CP-PTP-053, and Process Test Procedure, WHC-SD-CP-TC-026. Test measurements were obtained by monitoring plant instrumentation and by sampling solutions in E-F11 and/or TK-F18. No special test equipment was used. Plant instrumentation used for testing is listed in Table 1. Plant instrumentation was calibrated to Calibration Recall System (CBRS) specifications per PUREX plant work request 2A-91-2295. Calibrated instruments were activated and placed on a 6 or 12 month calibration frequency as required by the CBRS system. Instruments failing calibration were evaluated and either removed from test use or repaired and re-calibrated. Plant work requests used in support of concentrator testing are listed in Table 2.

Test Conditions

E-F11 was tested using several different plant configurations to determine enhancements of concentrator operation for varying ambient conditions. These plant configuration tests included; testing the concentrator vent jet (which exhausts approximately 2 gpm steam to the PUREX air tunnel), pre-heating the PUREX canyon inlet air to 90 °F, and removing a canyon cover block (to channel more flow past the concentrator). Canyon pre-heat and cover block removal were believed to allow higher boil-off rates or allow for concentrator operation with ambient temperature and humidity outside the range where stable operation was expected (refer to appendix 6 and 7). Vent jet testing was needed to assess its contribution to the total effect of concentrator operations on the plant conditions.

Due to winter conditions (low temperature, high humidity) alternate plant configurations were tested before concentrator start-up. This was done to enable separation of the effects of altered plant configuration from the effects of concentrator operation. The canyon was pre-heated and a cover block removed over F-Cell. Plant variables were monitored for trend determination. The configuration changes were left in place for concentrator startup.

Test Description

Testing commenced with the canyon pre-heated, an F-Cell cover block removed and the tube bundle condensate routed through TK-F12 to the Cooling Water (CWL) stream. Testing was performed to determine maximum boil-off rate, concentrator efficiency and stability of operation.

CONCENTRATOR E-F11 WATER TEST

2.0 DESCRIPTION OF TEST (Cont.)

TK-F12 was sampled to determine make-up of the solution transferred to the CWL. Steam was applied to concentrator tube bundles while monitoring TK-F12 level. This was to determine the amount of condensate generated in the heat-up to boiling.

The concentrator was heated to boiling as indicated by a stabilization of temperature and temporary loss of vacuum. Once boiling, the boil-off rate was set by adjusting steam flow to the concentrator right (orificed) tube bundle and changed as requested by engineering. The concentrator and plant instrumentation was monitored and data recorded every two hours during periods of concentrator boiling. TK-223 and E-F11 were monitored to determine boil-off rates.

Boil-off rate was increased until the maximum rate was achieved. The removed cover block was replaced and the concentrator was restarted. This was followed by returning the pre-heat to pre-test conditions, leaving the concentrator operating without plant configuration enhancements. The concentrator was then shut down and both TK-F12 and E-F11 sampled.

Challenges Met

The E-F11 wide weight factor and SpG instrumentation were found inoperable during testing preparations. Leak checking of P&O Gallery equipment showed canyon side leakage on the long (middle) dip tube. The weight factor jumper was replaced with one from E-F6 and then with a new jumper. New dip tubes were also installed. Finally, the wall nozzle was blanked and the P&O Gallery piping again checked. This revealed either a leaking wall nozzle or on the piping penetration in the canyon wall (concrete). Operations and Engineering decided that testing with water could continue with only the narrow weight factor but that a permanent solution would be required prior to waste handling. An Engineering Services Request (ESR) was generated at that time to route the instrumentation to a different canyon wall nozzle.

Personnel discovered that there was a discrepancy between the equipment and the drawing during the replacement of the E-F11 Weight Factor (WF) dip tubes. The jumper drawing and Instrument and Equipment Flow Diagram (IEFD) showed a difference of 60 inches between the long (the long dip tube rests on the concentrator bottom) and middle dip tubes while the fabrication drawing and visual examination showed a difference of 10 inches (the level in the tank is determined by comparing the pressure on the long or middle dip tubes to the pressure in the vapor space above the liquid level). The WF instrumentation was re-calibrated based on this difference and the calibration checked by adding calibrated amounts of water from TK-F12 and TK-223 per PUREX work plan WP-P-93-50. This test showed that the middle dip tube was approximately 60 inches above

CONCENTRATOR E-F11 WATER TEST

2.0 DESCRIPTION OF TEST (Cont.)

the tank bottom. With the 10 inch difference between dip tubes verified visually, the long dip tube may be 50 inches off of the bottom and the middle dip tube 60 inches off of the bottom. The data collected during calibration was entered into a spreadsheet and graphed to determine the relationship between weight factor reading and tank volume. The results of this calibration were incorporated into the testing and are shown in Figure 5.

The concentrator vent jet JC-F12-2 would not operate during initial testing because there was an interlock in the air supply to the steam supply valve. This interlock, which does not appear on any drawing, will not allow jet operation unless there is flow from TK-G7. Investigation showed that this was installed when operations included continuous transfer of Ammonia Scrubber Feed (ASF) solution to Tank Farms. A bypass was installed around this interlock per work request 2A-93-875 and the jet functioned normally. An Engineering Change Notice (ECN) made the bypass permanent.

Preparations for vent jet testing revealed that the F Cell sump level began to rise when the steam header was placed in service. This rise stopped when the vent jet was turned on, indicating that it was not a problem that would affect testing operations. When the vent jet was turned on, pressure recorder PR-F11-16 did not respond. This instrument was deactivated and testing modified to use differential pressure recorder DPR-F11-1. Both recorders receive the same data but PR-F11-16 is able to read pressure as well as vacuum.

After a potential leak was discovered in the SCD catch tank, it was decided that no additional inputs would be allowed. Steam condensate was routed to TK-F12 where it could be pumped to the CWL stream (Refer to Figure 4). Both the SCD and CWL are routed to the 214-A-42 diversion basin where the solution is sampled and transferred to B-Pond via the Chemical Sewer (CSL) stream. Flex jumpers were available for making only the right (orificed) tube bundle operable. The left tube bundle would require fabrication of a rigid jumper with a Diaphragm Operated Valve (DOV) to maintain pressure requirements during shut down. Fabrication could take several months.

The canyon jumper changes were made, a nozzle was opened on TK-F12 for pressure relief, and testing resumed. TK-F12 was filled with approximately 1000 gallons water to dampen temperature transients. The open vent nozzle was monitored for steam escape during concentrator start up. These changes added testing of TK-F12 as a steam condensate collection tank to the test scope.

CONCENTRATOR E-F11 WATER TEST

3.0 TEST METHOD AND TEST EQUIPMENT

Testing the concentrator operation included sampling test solutions. Before rinsing the concentrator, the solution in TK-F18 was sampled. TK-F18 solution was then sampled after each rinse. The difference in sample results provides the concentration of constituents in each rinse. TK-F12 was sampled to provide the concentration of constituents flushed out of the concentrator tube bundles. E-F11 was sampled at the completion of testing to compare the constituents of the concentrated sanitary water to the constituents of the flush solutions. TK-F18 was sampled by installed sampler while TK-F12 and E-F11 were dip sampled by the PUREX canyon crane. The samples were processed by the PUREX Laboratory. Sample results are listed in Table 3.

The concentrator vent jet JC-F12-2 was tested to ensure that the approximately 2 gpm steam it added to the air tunnel would be released through the main stack instead of collecting in canyon sumps or ventilation exhaust filters. The jet was turned on and plant instrumentation monitored. Data was collected every two hours during two days of testing and has been compiled in Appendix 1 (the units for variables recorded and acronyms used are listed in Table 4).

The canyon pre-heat test was performed by raising the inlet air temperature in 5 degree increments until a temperature of 90 °F was attained. Data was collected every two hours for six days (data showed no significant changes). Canyon inlet temperature were kept at 90 °F in preparation for continued testing.

The cover block removal test consisted of removing canyon cell cover block F-17A to channel more flow past E-F11 and into the air tunnel. After four days the data showed no significant changes and the two hour data recording was stopped. The cover block remained off for the start of concentrator operation. Data for monitoring of Canyon Pre-heat and Cover Block Removal Tests is contained in Appendices 2 and 3 (the units for variables and acronyms used are listed in Table 4).

The concentrator was operated 1 to 2 shifts per day. Data was taken before start-up, every two hours during operation, and just prior to shutdown. Boil-off rate data was collected by recording the levels in E-F11, TK-F12, and water feed tank TK-223. The boil-off rate was calculated and plotted using spreadsheet software. Data collected during concentrator operation is listed in Appendix 4 (the units for variables and acronyms used are listed in Table 4). Boil-off rate data is listed in Appendix 5 while Figures 6-8 show plots of the data.

CONCENTRATOR E-F11 WATER TEST

4.0 TEST RESULTS

Operational testing was designed to determine the effect of operational enhancements (canyon pre-heat and cell cover block removal) on concentrator operations and what conditions the concentrator could be operated under. The new concentrator vent jet has a design capacity of 8 gpm with 2 gpm of that being steam to operate the jet. The purpose of the test was to determine the maximum boil-off rate attainable without negative plant effects. The major negative effects are condensation of water in process cells or the air tunnel along with collection of water in the canyon sumps and/or the PUREX exhaust filters. The possible envelope of operations had been calculated prior to testing and is described in Appendices 6 and 7. A discussion of each part of the testing follows.

The concentrator vent jet was operationally tested then placed in service for two days to monitor for negative plant effects. Data was collected every two hours for a 48 hour period and the jet was shut off. The data (See Appendix 1) shows no unexplained changes in plant instrumentation during this period.

The effects of pre-heating the canyon supply air were tested by raising the temperature using temperature recorder/controller (TRC-V10-7-1). Data was collected every two hours during the test. Although the incoming air was heated to approximately 90 °F, the canyon temperature remained at approximately 63 °F as indicated on temperature recorder (TR-V11-3-1). This shows the facility structure absorbed the heat. No other effects were experienced during the testing. Pre-heat testing data is presented in Appendix 2.

Immediately after completing the canyon pre-heat test, cover block F-A17 was removed to channel more air past the concentrator. Data was collected initially and every two hours. The data shows no negative plant effects from the test. This data is presented in Appendix 3.

Pre-test conditions were restored after potential SCD catch tank leaks were discovered. After tube bundle condensate re-route to TK-F12, the canyon was pre-heated and cover block F-A17 was removed.

Concentrator testing started with the vent jet being turned on. Test personnel discovered that the vacuum was sufficient to draw all of the solution from the concentrator seal pot (used for over pressure protection). The vent jet steam supply valve was closed in steps until this did not happen during startup. When concentrator heat-up continued, there was a loss of concentrator vacuum at the point the concentrator reached boiling. This not the expected short loss of vacuum (used operationally to tell when boiling is attained) but a total loss of control. The steam supply was opened in increments. Vacuum could not be maintained with the jet steam supply fully open. Testing

CONCENTRATOR E-F11 WATER TEST

4.0 TEST RESULTS (Cont.)

was shut down. It was decided to test the operation with the seal pot evacuated. The concentrator was heated to boiling while the vacuum maintained at 1-6 psig.

While the concentrator was started up, TK-F12 was monitored for steam release. The lack of any visible vapor discharge indicates the formation of a seal loop between the concentrator and TK-F12. The condensate leaves the tube bundle at the approximately 590 ft level (relative to sea level), drops to 576 foot level, and then comes back up before entering TK-F12.

Concentrator testing continued over several days with periodic increases in the steam flow to the tube bundle. Heat-up to boiling took 15 to 30 minutes using the orificed tube bundle. This was much less than the 3 to 4 hours expected and enabled testing on day shift only. Concentrator level was operated at approximately 40 to 50 weight factor. Each time the concentrator reached 40 weight factor, it had to be shut down so that it could be refilled through the seal pot. The concentrator was restarted and the cycle repeated. This method of operation did not allow the concentrator to come to thermal equilibrium and decreased operational efficiency.

Each time the concentrator was restarted, the steam flow to the tube bundle was increased. The flow control valve reached 100% open and the maximum boil-off was reached. However, water was still being added through the seal pot. Concentrator efficiency had not yet been tested.

It was decided to add water from TK-223 through the concentrator spray nozzles. This would allow continued operation with an empty seal pot. The concentrator was re-started and the boil-off rate was determined by monitoring the drop out rates in both E-F11 and TK-223. In this way the concentrator could be operated for nearly an entire shift without needing to be shut down.

After reaching the maximum boil-off rate, the F-Cell cover block was replaced and the concentrator operated. This was followed by restoring the canyon pre-heat to the pre-test level. Data showed no effect from these changes. Rates of approximately 6-7 gpm were attained during testing with only the right tube bundle operational. Because boil-off rates were higher than expected and the concentrator heat-up was faster than expected, it was decided not to pursue making the left tube bundle operational. Figures 6-8 show the boil-off rate data. A plot of the boil-off rate is compared to the average boil-off rate and the concentrator efficiency (boil-off rate/condensate rate).

CONCENTRATOR E-F11 WATER TEST

4.0 TEST RESULTS (Cont.)

Winter weather conditions do not provide the best operating conditions. Appendix 7, "E-F11 Boil-off Rate Limits", shows decreases in boil-off rate with high humidity and low temperatures. Both the boil-off rate and efficiency were higher than expected under even the best conditions. Appendix 7 shows expected boil-off rates of 1.4 to 4.2 gpm for the temperature and humidity levels experienced during testing while values of 1.7 to 9 gpm were obtained (See Appendix 5 and figures 6-8 for efficiency and boil-off rate data). The efficiency was expected to be approximately 0.7 while values approaching 1.0 were attained. Boil-off rates show that the test was highly successful. As with other tests, no negative effects were experienced by the plant. Operational monitoring data is shown in Appendix 4.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The main performance requirement for this test was to achieve concentrator boiling at a controllable rate with the overheads exiting the PUREX plant via the main stack as vapor. This requirement was met. Test monitoring showed no collection of water in sumps, exhaust filters, or exhaust filter catch tanks. Another main performance criteria was to determine the maximum boil-off rate achievable. This was 6-7 gpm with the steam flow valve to the tube bundle full open. Even then, monitoring showed no negative effects. This indicates that it may be possible to use an orifice plate with a larger hole for greater steam flow and therefore produce a higher boil-off rate.

It is recommended that plans be continued to make the concentrator operational for future waste handling. It is also recommended that TK-F12 continue to be used for condensate collection and that the 3WF Decanter (TK-F10) be adapted as the concentrator feed tank. TK-F10 is next to E-F11 in the canyon, it receives solution from several areas of the canyon, and has an installed sampling system. Closeness and multiple inlet routes make it a good candidate for transferring solutions from other areas to E-F11 for processing. Sampling capability enables easier characterization of wastes before processing. Vessels such as E-F11 and TK-F12 require dip sampling with the crane. This sometimes requires the removal of several jumpers to access vessel nozzles and can become a complex operation.

E-F11 was made operational for testing with water only. Several other items must be completed before waste can be handled. Other changes would make operation of the concentrator run more smoothly. Continued operation of E-F11 for PUREX waste concentration is contingent upon completion of the following items:

- Re-calibration of the concentrator weight factor instrumentation based on data collected during initial water calibration.

CONCENTRATOR E-F11 WATER TEST

5.0 CONCLUSIONS AND RECOMMENDATIONS (Cont.)

- Repair of pressure recorder PR-F11-16 which allows concentrator pressure to be monitored during positive pressure transients.
- Re-routing the concentrator weight factor/specific gravity instrumentation to a different canyon wall nozzle. Completion of this work will require another water calibration to verify wide weight factor readings. The calibration will also verify the distance of the long dip tube from the bottom of the concentrator.
- Design and fabrication of a feed jumper from the TK-F10 feed pump. This will be a flexible jumper with an orifice to reduce flow to approximately 10 gpm. A reduced flow is needed for continuous pump operation. This would soften out transients created by lowering and raising the concentrator level during operation. If the jumper is not completed by the time the concentrator is needed, a presently available flex could be used in the interim.
- Preparation of an operating procedure based on the test procedure results.
- A readiness review for concentrator waste handling.
- Resolution of any remaining environmental issues connected with dangerous and non-dangerous waste processing.

6.0 DISPOSITION OF TEST ITEMS

All test items will be left in place. The jumpers and instrumentation will be used in future operations.

7.0 REFERENCES

WHC-SD-CP-PTP-053,	CONCENTRATION OF WASTE IN CONCENTRATOR E-F11, PHASE I
WHC-SD-CP-TC-026,	CONCENTRATE WASTE IN CONCENTRATOR E-F11, PHASE I
WP-P-93-046,	CONCENTRATE WASTE IN CONCENTRATOR E-F11 PHASE I
WP-P-93-050,	CALIBRATE E-F11 WF INSTRUMENTATION

CONCENTRATOR E-F11 WATER TEST

TABLE 1

CONCENTRATOR TEST MONITORING INSTRUMENTATION

E-F11-1 INSTRUMENTATION REQUIRED OPERATIONAL FOR TEST

<u>VARIABLE</u>	<u>INSTRUMENT</u>	<u>CALIBRATION LOOP</u>
E-F11-2 CONDENSER TEMPERATURE	(TR-F11-2)	F0378
E-F11-1 CONCENTRATOR WIDE WF	(WFR-F11-2)	F0370
SEAL POT ADDITION VALVE	(DOV-F11-1)	F0164
SEAL POT ADDITION VALVE SWITCH	(VS-F11-1)	F0164
TUBE BUNDLE CONDENSATE	(DOV-F11-4)	F0352
TUBE BUNDLE CONDENSATE CONTROLLER	(VC-F11-4)	F0170
TUBE BUNDLE CONDENSATE	(DOV-F11-5)	F0171
TUBE BUNDLE CONDENSATE CONTROLLER	(VC-F11-5)	F0171
E-F11-1 SEAL POT LEVEL	(WFI-F11-1)	F0365
E-F11-1 TEMPERATURE	(TR-F11-4)	F0377
E-F11-1 SPECIFIC GRAVITY	(SGR-F11-1)	F0384
E-F11-1 DIFFERENTIAL PRESSURE	(DPR-F11-1)	F0364
E-F11-1 PRESSURE	(PR-F11-16)	F0346
E-F11-1 STEAM FLOW CONTROLLER	(FRC-F11-2)	F0169
E-F11-1 STEAM FLOW CONTROLLER	(FRC-F11-3)	F0307
E-F11-1 RIGHT TUBE BUNDLE PRESSURE	(PI-F11-3A)	F0347
E-F11-1 RIGHT TUBE BUNDLE PRESSURE	(PI-F11-3B)	F0348
E-F11-1 LEFT TUBE BUNDLE PRESSURE	(PI-F11-2A)	F0354
E-F11-1 LEFT TUBE BUNDLE PRESSURE	(PI-F11-2B)	F0352
TK-F12 WEIGHT FACTOR	(WFR-F12)	

OTHER PUREX INSTRUMENTATION REQUIRED OPERATIONAL FOR TEST

<u>VARIABLE</u>	<u>INSTRUMENT</u>	<u>PISCES LOOP</u>
CANYON SUPPLY TEMPERATURE	(TR-V10-46-1)	V1040
CANYON SUPPLY FLOW	(FR-V10-28-1)	V0373
CANYON EXHAUST FLOW	(FR-V11-23-1)	V0050
AIR TUNNEL TEMPERATURE	(TR-V11-3-1)	V0053
#4 FILTER TOTAL DP	(DPI-V11-71-1)	V1171
DEEP BED FILTER NO. 1	(DPI-V11-25-1)	V1125
DEEP BED FILTER NO. 1	(DPI-V11-26-1)	V1126
DEEP BED FILTER NO. 2	(DPI-V11-7-1)	V0462
CATCH TANK TK-202A-417 BETA/GAMMA	(RR-W30-3-1)	W3003-9
CATCH TANK TK-202A-417 ALPHA	(RR-W30-12-1)	W3012-9
CATCH TANK TK-202A-417 FLOW OUT	(FR-W30-1-1)	W3001-8

CONCENTRATOR E-F11 WATER TEST

OTHER PUREX INSTRUMENTATION REQUIRED OPERATIONAL FOR TEST (Cont.)

<u>VARIABLE</u>	<u>INSTRUMENT</u>	<u>PISCES LOOP</u>
CATCH TANK TK-V11 LEVEL	(WFR-V11-11-1)	V0035
CANYON SUMP LEVELS		
A CELL	(WFR-SA)	A0049
B CELL	(WFR-SB)	B0049
C CELL	(WFR-SC)	C0049
D CELL	(WFR-SD)	D0008
E CELL	(WFR-SE)	E0154
F CELL	(WFR-SFA)	F0075
F CELL	(WFR-SFB)	F0122
G CELL	(WFR-SG)	G0061
H CELL	(WFR-SH2)	H0026
L CELL	(WFR-SLL-1)	L0038
L CELL	(WFR-SLL-2)	L0039
R CELL	(WFR-SR)	R0040
J CELL	(WFR-SJ)	J0020
J CELL	(WFR-SJ2)	H0026
K CELL	(WFR-SK)	K0065
K CELL	(WFR-SLK)	L0031

CONCENTRATOR E-F11 WATER TEST

TABLE 2

PUREX WORK REQUESTS SUPPORTING CONCENTRATOR TESTING

WORK REQUEST No.	DESCRIPTION	STATUS
2a-91-00336	Repair E-F11 vacuum recorder PR-F11-16	Complete
2A-91-02107	Inspect and prep the TK-F12 DOV jumper	Complete
2A-91-02018	Inspect and prep the E-F11 process flex	Complete
2A-91-02019	Inspect and prep the E-F11 vent conversion jumper	Complete
2A-91-02029	Inspect and prep the E-F11 air tunnel jumper	Complete
2A-91-02030	Inspect and prep the E-F11 jet jumper	Complete
2A-91-02031	Inspect and prep the E-F11 jet steam supply jumper	Complete
2A-91-02040	Load jumpers into storage box and transport to PUREX	Complete
2A-91-02143	Remove standby blanks on E-F11 steam/air/water	Complete
2A-91-02295	Calibrate E-F11 instrumentation	Complete
2A-92-00015	Replace steam flow recorder FRC-F11-2 chart drive	Complete
2A-92-00421	Install flow reducing orifice in right tube bundle	Complete
2A-92-00737	Troubleshoot E-F11 wide weight factor recorder	Complete
2A-92-00835	Replace E-F11 long dip tube isolation valve	Complete
2A-92-01438	Replace E-F11 weight factor jumper	Complete
2A-93-00709	Replace E-F11 dip tube jumper	Complete
2A-93-00754	Re-gasket and re-seat E-F11 weight factor jumper	Complete
2A-93-00036	Repair dew point instrumentation	Complete
2A-93-00037	Repair E-F11 differential pressure recorder DPR-F11-1	Complete
2A-93-00047	Repair steam flow instrument FY-F11-2 ⁽¹⁾	Canceled
2A-93-00760	Leak test (smoke) E-F11 jumpers	Complete
2A-93-00875	Install bypass on vent jet steam supply	Complete
2A-93-00948	Move instrument lines to nozzle to F-G84	(2)
2A-93-00985	Re-route E-F11 WF jumper to nozzle F-G84	(2)
2A-93-01012	Prep and deliver E-F11 to TK-F12 jumpers	Complete
2A-94-00060	Modify vent jet for E-F11 testing (temporary)	Complete
2A-94-00136	Fabricate E-F11 feed jumper from TK-F10	(2)
J3-2A-93-2231	Troubleshoot E-F11 air sparge operation	Complete
J3-2A-94-00209	Re-calibrate E-F11 narrow weight factor	Complete
J3-2A-94-00210	Repair/re-calibrate PR-F11-16	Complete

(1) Instrumentation had been disconnected for several years, so it was decided not use it.

(2) These work requests will be completed as part of readying E-F11 for future waste processing.

CONCENTRATOR E-F11 WATER TEST

TABLE 3

E-F11 TESTING SAMPLE RESULTS

DATE	11/29/93	12/01/93	12/01/93	01/11/94	01/11/94	01/13/94
TANK	TK-F18	TK-F18	TK-F18	TK-F12	TK-F12	TK-F12
SAMPLE No.	P-1957	P-1960	P-1961	P-2095	P-2096	P-2097
TOTAL BETA (uCi/L)	1.33E ⁻¹	6.95E ⁻²	N/A	2.63	N/A	1.82
TOTAL ALPHA (uCi/L)	2.93E ⁻³	1.47E ⁻³	N/A	5.44E ⁻³	N/A	2.46E ⁻³
CePr ¹⁴⁴ (uCi/L)	1.37	7.24E ⁻⁴	N/A	<1.16E ⁻¹	N/A	<1.176E ⁻¹
Co ⁶⁰ (uCi/L)	1.48E ⁻²	<1.86E ⁻⁸	N/A	<1.24E ⁻²	N/A	<9.632E ⁻³
Cs ¹³⁴ (uCi/L)	2.34E ⁻¹	8.98E ⁻⁸	N/A	<8.981E ⁻³	N/A	<8.971E ⁻³
Cs ¹³⁷ (uCi/L)	4.46E ⁻¹	1.43E ⁻⁵	N/A	1.71E ⁻¹	N/A	2.05E ⁻¹
Nb ⁹⁵ (uCi/L)	1.13E ⁻²	<9.32E ⁻⁹	N/A	8.30E ⁻³	N/A	<1.023E ⁻²
Ru ¹⁰³ (uCi/L)	6.26E ⁻²	<3.76E ⁻⁸	N/A	<6.45E ⁻³	N/A	<9.701E ⁻³
RuRh ¹⁰⁶ (uCi/L)	1.67	1.55E ⁻⁶	N/A	<1.80E ⁻¹	N/A	<1.661E ⁻¹
Zr ⁹⁵ (uCi/L)	2.00E ⁻²	<1.85E ⁻⁸	N/A	1.42E ⁻²	N/A	<1.678E ⁻²
Sb ¹²⁵ (uCi/L)	1.51	1.95E ⁻⁷	N/A	1.91E ⁻¹	N/A	1.469E ⁻¹
Am ²⁴¹ (uCi/L)	6.46E ⁻¹	1.59E ⁻⁶	N/A	<6.97E ⁻²	N/A	1.04E ⁻¹
Cr (ppm)	3.84E ⁻¹	1.46E ⁻¹	N/A	<2.98E ⁻²	N/A	<2.98E ⁻²
NH ₄ (M)	<4.78E ⁻³	<4.78E ⁻³	N/A	2.68E ⁻³	N/A	1.53E ⁻³
NO ₃ (M)	N/A	3.18E ⁻³	N/A	1.62E ⁻⁴	N/A	1.10E ⁻⁴
pH	8.77	9.89	N/A	8.18	N/A	7.88
U (g/L)	N/A	2.66E ⁻¹	2.17E ⁻¹	7.26E ⁻⁴	7.26E ⁻⁴	5.66E ⁻⁴
Pu (g/L)	N/A	8.12E ⁻⁶	1.36E ⁻⁶	3.87E ⁻⁷	3.16E ⁻⁷	5.80E ⁻⁶
SAMPLE DESCRIPTION	TK-F18 initial data	TK-F18 initial plus flush solution	TK-F18 initial plus flush solution	TK-F12 initial water data	TK-F12 initial water data	TK-F12 first flush to CWL

CONCENTRATOR E-F11 WATER TEST

TABLE 3

E-F11 TESTING SAMPLE RESULTS

DATE	11/29/93	01/26/94	01/26/94	01/26/94	01/26/94	
TANK	TK-F12	E-F11	E-F11	TK-F12	TK-F12	
SAMPLE No.	P-2098	P-2105	P-2106	P-2107	P-2108	
TOTAL BETA (uCi/L)	N/A	7.27	N/A	$5.94E^{-1}$	N/A	
TOTAL ALPHA (uCi/L)	N/A	$<2.53E^{-2}$	N/A	$4.85E^{-3}$	N/A	
CePr ¹⁴⁴ (uCi/L)	N/A	$<6.49E^{-2}$	N/A	$<1.074E^{-1}$	N/A	
Co ⁶⁰ (uCi/L)	N/A	$<3.01E^{-2}$	N/A	$<1.42E^{-2}$	N/A	
Cs ¹³⁴ (uCi/L)	N/A	$<5.48E^{-2}$	N/A	$<1.15E^{-2}$	N/A	
Cs ¹³⁷ (uCi/L)	N/A	9.56	N/A	$2.03E^{-1}$	N/A	
Nb ⁹⁵ (uCi/L)	N/A	$<2.42E^{-2}$	N/A	$<8.21E^{-3}$	N/A	
Ru ¹⁰³ (uCi/L)	N/A	$<6.57E^{-2}$	N/A	$<8.81E^{-3}$	N/A	
RuRh ¹⁰⁶ (uCi/L)	N/A	1.39	N/A	$<1.64E^{-1}$	N/A	
Zr ⁹⁵ (uCi/L)	N/A	$<4.99E^{-2}$	N/A	$<1.53E^{-2}$	N/A	
Sb ¹²⁵ (uCi/L)	N/A	1.36	N/A	$<1.16E^{-2}$	N/A	
Am ²⁴¹ (uCi/L)	N/A	$<3.24E^{-1}$	N/A	$<5.52E^{-2}$	N/A	
Cr (ppm)	N/A	N/A	N/A	$<2.98E^{-2}$	N/A	
NH ₄ (M)	N/A	$1.15E^{-3}$	N/A	$8.61E^{-4}$	N/A	
NO ₃ (M)	N/A	$4.23E^{-3}$	N/A	$5.55E^{-5}$	N/A	
pH	N/A	8.04	N/A	6.82	N/A	
U (g/L)	$5.68E^{-4}$	$7.65E^{-4}$	$7.44E^{-4}$	$2.2E^{-5}$	$2.75E^{-5}$	
Pu (g/L)	$5.46E^{-6}$	$3.03E^{-7}$	$<3.89E^{-7}$	$3.59E^{-7}$	$<3.89E^{-7}$	
SAMPLE DESCRIPTION	TK-F12 first flush to CWL	E-F11 end of test sample	E-F11 end of test sample	TK-F12 last transfer to CWL		

CONCENTRATOR E-F11 WATER TEST

TABLE 4

ACRONYMS AND MEASUREMENT UNITS USED

ACRONYM	DEFINITION	UNITS
ASD	Ammonia Scrubber Distillate	N/A
ASF	Ammonia Scrubber Feed	N/A
ASW	Ammonia Scrubber Waste	N/A
AMU	Aqueous Make-up Unit	N/A
CBRS	Calibration Recall System	N/A
CSL	Chemical Sewer	N/A
CWL	Cooling Water stream	N/A
DP	Differential Pressure	inches
DPI	Differential Pressure Indicator	inches
DPR	Differential Pressure Recorder	inches
DPTR	Dew Point Temperature Recorder	°F
ECN	Engineering Change Notice	N/A
E-F11	Ammonia Scrubber Waste Concentrator	N/A
FR	Flow Recorder	scfm
GPM	Gallons per minute	gpm
IEFD	Instrument Engineering Flow Diagram	N/A
JC	Jet Controller	N/A
L	Liter	L
M	Molarity	moles/L
°F	Degrees Fahrenheit	°F
PI	Pressure Indicator	psig.
PPM	Parts Per Million	ppm
PR	Pressure Recorder	Inches
PSIG	Pounds Per Square Inch, Gauge	psig
PUREX	Plutonium/Uranium Extraction	N/A
SCD	Steam Condensate	N/A
SCFM	Standard Cubic Feet Per Minute	scfm
SpG	Specific Gravity	None
TK-223	Demineralized Water Feed Tank	N/A
TK-F10	3WF Decanter	N/A
TK-F12	Concentrator Feed Tank	N/A
TK-F18	Sump and Waste Receiver Tank	N/A
TK-G7	Scrubber Waste Transfer Tank	N/A
TR	Temperature Recorder	°F
TRC	Temperature Recorder/Controller	°F
UCI	Microcuries	uCi
UGS	Underground Storage	N/A
WF	Weight Factor	Percent of Chart
WFI	Weight Factor Indicator	Percent of Chart
WFR	Weight Factor Recorder	Percent of Chart

CONCENTRATOR E-F11 WATER TEST

FIGURE 1

E-F11 CONCENTRATOR

CONCENTRATOR E-F11 WATER TEST

E-F11 ASW CONFIGURATION

* Existing sampling/monitoring point

PRE/02/17/94

FIGURE 2

CONCENTRATOR E-F11 WATER TEST

E-F11 TESTING
CONFIGURATION

* Existing sampling/monitoring point

PRE/02/17/94

FIGURE 3

CONCENTRATOR E-F11 WATER TEST

E-F11 MODIFIED TESTING
CONFIGURATION

PRE/02/17/94

FIGURE 4

CONCENTRATOR E-F11 WATER TEST

FIGURE 5

CONCENTRATOR E-F11 WATER TEST

FIGURE 6

CONCENTRATOR E-F11 WATER TEST

EF-11 Evaporator
Boil-off Rate

*Note: 2nd Y-scale

FIGURE 7

CONCENTRATOR E-F11 WATER TEST

FIGURE 8

CONCENTRATOR E-F11 WATER TEST

Canyon Airflow = 25 kSCFM

Canyon air h rel=90% @ exhaust

FIGURE 9

CONCENTRATOR E-F11 WATER TEST

FIGURE 10

CONCENTRATOR E-F11 WATER TEST

FIGURE 11

CONCENTRATOR E-F11 WATER TEST

Figure 8

FIGURE 12

CONCENTRATOR E-F11 WATER TEST

8.0

APPENDIXES

CONCENTRATOR E-F11 WATER TEST

APPENDIX 1

Page 1 of 2

E-F11 VENT JET TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/06/93	12/06/93	12/06/93	12/06/93	12/06/93	12/06/93	12/06/93	12/07/93
TIME	11:00 ¹	13:00	15:00	17:00	19:00	21:00	23:00	01:00
TR-F11-2	17	17	17	17	17	17	17	17
WFR-F11-3	39	39	39	39	39	39	39	39
CANYON DP.	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.51
DPR-F11-1	65%	65%	67%	67.5%	67.5%	67.55%	67.5%	67.5%
PR-F11-16	52%	52.5%	52.5%	52%	52.5%	52.5%	53%	54%
TEMPERATURE (°F)	35	36	38	32	32	31	31	29
HUMIDITY	57%	60%	52%	70%	77%	77%	81%	83%
TR-V10-46-1	60	60	60	60	60	60	60	62
FR-V10-28-1	45,000	46,000	47,000	47,000	47,000	47,000	47,000	47,000
FR-V11-23-1	84,000	86,000	86,000	86,000	86,000	86,000	86,000	86,000
DPTR-V11-2-1	32	32	32	32	32	32	32	32
TR-V11-3-1	63	63	63	63	63	63	63	64
DPI-V11-25-1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
DPI-V11-26-1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
DPR-V11-7-1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
DPI-V11-8-1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
WFR-SA	0	0	0	0	0	0	0	0
WFR-SB	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
WFR-SC	0	0	0	0	0	0	0	0
WFR-SD	0	0	0	0	0	0	0	0
WFR-SE	0	0	0	0	0	0	0	0
WFR-SFA	0	0	0	0	0	0	0	0
WFR-SFB	11	11	11	11	11	11	11	11
WFR-SG	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
WFR-SH2	0	0	0	0.5	0	0	0	0

CONCENTRATOR E-F11 WATER TEST

APPENDIX 1

Page 2 of 2

E-F11 VENT JET TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/06/93	12/06/93	12/06/93	12/06/93	12/06/93	12/06/93	12/06/93	12/07/93
TIME	11:00	13:00	15:00	17:00	19:00	21:00	23:00	01:00
WFR-SJ	4	4	4	4	4	4	4	4
WFR-SJ2	0	0.5	0.5	0.5	0.5	0.5	0.5	1
WFR-SK	0	0	0	0	0	0	0	0
WFR-SLK	6	6	6	6	6	6	6	6
WFR-SLL-2	0	0	0	0	0	0	0	0
WFR-SR	19	19	19	19	19	19	19	19
WFR-V11-11-1	65%	N/A	N/A	65%	N/A	N/A	N/A	65%
216-TK-A-2 LVL	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5

Notes:

- (1) The concentrator vent jet was turned on at 11:00. Previous jet operation has shown steam leakage into the canyon when the steam header was placed in service. This leakage stopped when a load, such as the vent jet, was placed on the system. This would indicate that the leakage was from other sources than the E-F11 concentrator.

CONCENTRATOR E-F11 WATER TEST

APPENDIX 1

Page 1 of 2

E-F11 VENT JET TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/07/93	12/07/93	12/07/93	12/07/93				
TIME	03:00	05:00	07:00	09:00 ¹				
TR-F11-2	17	17	17	17				
WFR-F11-3	39	39	39	39				
CANYON DP.	0.50	0.50	0.50	0.50				
DPR-F11-1	67.5%	67.5%	67.5%	67.5%				
PR-F11-16	56	58	60	61.5				
TEMPERATURE (°F)	32	31	30	31				
HUMIDITY	82%	87%	96%	97%				
TR-V10-46-1	62	60	62	60				
FR-V10-28-1	47,000	47,000	47,000	47,000				
FR-V11-23-1	86,000	86,000	86,000	86,000				
DPTR-V11-2-1	32	32	32	32				
TR-V11-3-1	63	63	63	63				
DPI-V11-25-1	2.2	2.2	2.2	2.2				
DPI-V11-26-1	0.3	0.3	0.3	0.3				
DPR-V11-7-1	1.3	1.3	1.3	1.3				
DPI-V11-8-1	0.8	0.8	0.8	0.8				
WFR-SA	0	0	0	0				
WFR-SB	2.5	2.5	2.5	2.5				
WFR-SC	0	0	0	0				
WFR-SD	0	0	0	0				
WFR-SE	0	0	0	0				
WFR-SFA	0	0	0	0				
WFR-SFB	11	11	10.5	10.5				
WFR-SG	0.5	0.5	0.5	0.5				
WFR-SH2	0	0	0	0				
WFR-SJ	4	4	4	4				

CONCENTRATOR E-F11 WATER TEST

APPENDIX 1

Page 2 of 2

E-F11 VENT JET TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/07/93	12/07/93	12/07/93	12/07/93				
TIME	03:00	05:00	07:00	09:00 ¹				
WFR-SJ2	1	1	1	1				
WFR-SK	0	0	0	0				
WFR-SLK	6	6	6	6				
WFR-SLL-2	0	0	0	0				
WFR-SR	19	19	19	20				
WFR-V11-11-1	N/A	N/A	N/A	65%				
216-TK-A-2 LVL	15.5	15.5	15.5	15.5				

Notes:

- (1) The vent jet was shut off at 11:00 just before another set of readings would have been taken.

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 1 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/07/93	12/07/93	12/07/93	12/07/93	12/07/93	12/07/93	12/08/93	12/08/93
TIME	12:30	14:30	16:30	18:30	20:30	22:30	00:30	02:30
TEMPERATURE (°F)	70	70	72	65	65	65	65	65
CANYON DP.	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
TR-V10-46-1	60	67	77	72	70	70	70	70
FR-V10-28-1	46,000	46,000	46,000	46,000	46,000	46,000	46,000	46,000
FR-V11-23-1	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000
DPTR-V11-2-1	32	32	32	32	32	32	32	32
TR-V11-3-1	63	63	63	63	63	63	63	63
DPI-V11-25-1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
DPI-V11-26-1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
DPI-V11-7-1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
DPI-V11-8-1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
WFR-SA	0	0	0	0	0	0	0	0
WFR-SB	3	3	3	3	2.5	2.5	2.5	2.5
WFR-SC	0	0	0	0	0	0	0	0
WFR-SD	0	0	0	0	0	0	0	0
WFR-SE	0	0	0	0	0	0	0	0
WFR-SFA	5	4.5	4	4	4	4	4	4
WFR-SFB	00S ¹	00S ¹	10	10	10	10	10	10
WFR-SG	00S ¹	00S ¹	2	2	2	2	2	2
WFR-SH2	0	0	0	0	0	0	0	0
WFR-SJ	4	4	4	4	4	4	4	4
WFR-SJ2	00S ¹	00S ¹	1	1	1	1	1	1
WFR-SK	0	0	0	0	0	0	0	0
WFR-SLK	6	6	6	6	6	6	6	6
WFR-SLL-2	0	0	0	0	0	0	0	0
WFR-SR	21	21	21	21	21	20.5	21.5	27 ²

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

E-F11 CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/07/93</u>	<u>12/07/93</u>	<u>12/07/93</u>	<u>12/07/93</u>	<u>12/07/93</u>	<u>12/07/93</u>	<u>12/08/93</u>	<u>12/08/9</u>
TIME	12:30	14:30	16:30	18:30	20:30	22:30	00:30	02:30
AMBIENT TEMP. (°F)	33	35	33	31	31	32	33	33
AMBIENT DP. (°F)	32.7	32.2	32	31	30	31	32	32

Notes:

- 1 Charts out-of-service for repairs.
- 2 Rise in sump level due to rainwater.

Page 1 of 2

[illegible]

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/8/93</u>	<u>12/8/93</u>	<u>12/8/93</u>	<u>12/8/93</u>	<u>12/8/93</u>	<u>12/8/93</u>	<u>12/8/93</u>	<u>12/8/93</u>
TIME	0430	0630	0830	1030	1230	1430	1630	1830
AMBIENT TEMP. (°F)	33	31	32	32	33	37	34	46
AMBIENT DP. (°F)	31	30	31	32	32.8	35	33	33

Notes:¹ Chart recorder removed for repairs.

CONCENTRATOR E-F11 WATER TEST

[illegible]

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/8/93</u>	<u>12/8/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>
TIME	2030	2230	0030	0230	0430	0630	0830	1030
AMBIENT TEMP. (°F)	47	47	45	43	43	45	44	47
AMBIENT DP. (°F)	34	34	34	31	34	34	33	33

Notes:

[illegible]

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/9/93</u>	<u>12/10/93</u>	<u>12/10/93</u>
TIME	1230	1430	1630	1830	2030	2230	0030	0230
AMBIENT TEMP. (°F)	48	45	43	41	40	40	56	59
AMBIENT DP. (°F)	37	42	42	40	39	39	39	30

Notes:

* Flow changes due to high winds.

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/10/93</u>	<u>12/10/93</u>	<u>12/10/93</u>	<u>12/10/93</u>	<u>12/10/93</u>	<u>12/10/93</u>	<u>12/10/93</u>	<u>12/10/93</u>
TIME	0430	0630	0830	1030	1230	1430	1630	1830
AMBIENT TEMP. (°F)	55	55	56	61	56	52	49	47
AMBIENT DP. (°F)	37	37	38	40	41	41	42	44

Notes:

- * Flow changes due to winds

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATE	TIME	TEMPERATURE (°F)	CANYON DP.	TR-V10-46-1	FR-V10-28-1	FR-V11-23-1	DPTR-V11-2-1	TR-V11-3-1	DPI-V11-25-1	DPI-V11-26-1	DPI-V11-7-1	DPI-V11-8-1	WFR-SA	WFR-SB	WFR-SC	WFR-SD	WFR-SE	WFR-SFA	WFR-SFB	WFR-SG	WFR-SH2	WFR-SJ	WFR-SJ2	WFR-SK	WFR-SLK	WFR-SLL-2	WFR-SR
	12/10/93	2030	79	.49	86	46,000	84,000	32	63.5	2.5	.3	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	
	12/10/93	2230	75	.49	83	46,000	84,000	32	63.5	2.2	.3	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	
	12/11/93	0030	76	.49	86	46,000	84,000	32	63.5	2.2	.3	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	
	12/11/93	0230	76	.49	84	46,000	84,000	32	63.5	2.2	.3	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	
	12/11/93	0430	76	.49	84	46,000	84,000	32	63.5	2.2	.3	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	
	12/11/93	0630	79	.49	86	40,000	84,000	32	63.5	2.2	3.	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	
	12/11/93	0830	79	.49	86	41,000	84,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	
	12/11/93	1030	79	.49	87	41,000	84,000	31.5	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2.5	7	0	0	4	1	0	6	0	

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/10/93	12/10/93	12/11/93	12/11/93	12/11/93	12/11/93	12/11/93	12/11/9
TIME	2030	2230	0030	0230	0430	0630	0830	1030
AMBIENT TEMP. (°F)	46	45	44	44	42	37	39	42
AMBIENT DP. (°F)	44	42	41	40	38	36	38	40

Notes:

CONCENTRATOR E-F11 WATER TEST

CANYON PREHEAT TESTING DATA

VARIABLE	DATE	TIME	TEMPERATURE (°F)	CANYON DP.	TR-V10-46-1	FR-V10-28-1	FR-V11-23-1	DPTR-V11-2-1	TR-V11-3-1	DPI-V11-25-1	DPI-V11-26-1	DPI-V11-7-1	DPI-V11-8-1	WFR-SA	WFR-SB	WFR-SC	WFR-SD	WFR-SE	WFR-SFA	WFR-SFB	WFR-SG	WFR-SH2	WFR-SJ	WFR-SJ2	WFR-SK	WFR-SLK	WFR-SLL-2	WFR-SR
DATA	12/11/93	1230	79	.49	88	41,000	84,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2	6.5	0	0	4	1	0	6	0	0
DATA	12/11/93	1430	79	.49	86	46,000	84,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2	6.5	0	0	4	1	0	6	0	0
DATA	12/11/93	1630	79	.49	86	46,000	84,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2	6.5	0	0	4	1	0	6	0	0
DATA	12/11/93	1830	82	.49	90	46,000	84,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2	6.5	0	0	4	1	0	6	0	0
DATA	12/11/93	2030	82	.50	90	46,000	83,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2	6.5	0	0	4	1	0	6	0	0
DATA	12/12/93	0030	82	.50	90	46,000	83,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2	6.5	0	0	4	1	0	6	0	0
DATA	12/12/93	0230	82	.50	90	46,000	83,000	32	63	2.2	.3	1.3	.75	0	2.5	0	0	0	2	6.5	0	0	4	1	0	6	0	0

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/11/93	12/11/93	12/11/93	12/11/93	12/11/93	12/11/93	12/12/93	12/12/93
TIME	1230	1430	1630	1830	2030	2230	0030	0230
AMBIENT TEMP. (°F)	48	47	50	49	48	46	42	40
AMBIENT DP. (°F)	40	40	37	36	32	31	24	25

Notes:

[illegible]

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/12/93	12/12/93	12/12/93	12/12/93	12/12/93	12/12/93	12/12/93	12/12/9
TIME	0430	0630	0830	1030	1230	1430	1630	1830
AMBIENT TEMP.	40	40	42	48	50	50	46	44
AMBIENT DP. (°F)	26	26	27	25	26	28	32	30

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/12/93</u>	<u>12/12/93</u>	<u>12/13/93</u>	<u>12/13/93</u>	<u>12/13/93</u>	<u>12/13/93</u>	<u>12/13/93</u>	<u>12/13/9</u>
TIME	2030	2230	0030	0230	0430	0630	0830	1030
AMBIENT TEMP. (°F)	43	41	41	37	37	37	38	41
AMBIENT DP. (°F)	30	30	30	30	31	30	33	31

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 1 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/13/93							
TIME	1230							
TEMPERATURE (°F)	83							
CANYON DP.	.50							
TR-V10-46-1	90							
FR-V10-28-1	46,000							
FR-V11-23-1	86,000							
DPTR-V11-2-1	32							
TR-V11-3-1	64							
DPI-V11-25-1	2.2							
DPI-V11-26-1	.3							
DPI-V11-7-1	1.3							
DPI-V11-8-1	.75							
WFR-SA	0							
WFR-SB	2.5							
WFR-SC	0							
WFR-SD	0							
WFR-SE	0							
WFR-SFA	1							
WFR-SFB	6							
WFR-SG	0							
WFR-SH2	0							
WFR-SJ	4							
WFR-SJ2	1							
WFR-SK	0							
WFR-SLK	6							
WFR-SLL-2	0							
WFR-SR	N/A							

CONCENTRATOR E-F11 WATER TEST

APPENDIX 2

Page 2 of 2

CANYON PREHEAT TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/13/93							
TIME	1230							
AMBIENT TEMP. (°F)	36							
AMBIENT DP. (°F)	34							

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 1 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/14/93	12/14/93	12/14/93	12/14/93	12/14/93	12/14/93	12/14/93	12/14/9
TIME	0830	1030	1230	1430	1630	1830	2030	2230
TRC-V10-7-1	83	83	83	83	82	82	82	82
CANYON DP.	.50	.50	.50	.50	.495	.495	.495	.50
TR-V10-46-1	90	90	91	90	90	90	90	90
FR-V10-28-1	44,000	45,000	46,000	46,000	46,000	46,000	45,500	45,000
FR-V11-23-1	88,000	92,000	92,000	92,000	92,000	92,000	92,000	92,000
DPTR-V11-2-1	32	32	32	32	32	32	32	32
TR-V11-3-1	63	63	63	63	63.5	63.5	63.5	63.5
DPI-V11-25-1	2.2	2.3	2.3	2.3	2.4	2.4	2.4	2.4
DPI-V11-26-1	.3	.3	.3	.3	.3	.3	.3	.3
DPI-V11-7-1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
DPI-V11-8-1	.8	.8	.8	.8	.8	.8	.8	.8
WFR-SA	0	0	0	0	0	0	0	0
WFR-SB	2.5	2.5	25	2.5	2.5	2.5	2.5	2.52
WFR-SC	0	0	0	0	0	0	0	0
WFR-SD	0	0	0	0	0	0	0	0
WFR-SE	0	0	0	0	0	0	0	0
WFR-SFA	1	1	1	1	1	1	1	1
WFR-SFB	5	5	5	5	5	5	5	5
WFR-SG	0	0	0	0	0	0	0	0
WFR-SH2	0	0	0	0	0	0	0	0
WFR-SJ	4	4	4	4	4	4	4	4
WFR-SJ2	1	1	1	1	1	1	1	1
WFR-SK	0	0	0	0	0	0	0	0
WFR-SLK	6	6	6	6	6	6	6	6
WFR-SLL-2	0	0	0	0	0	0	0	0
WFR-SR								

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 2 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/14/93</u>	<u>12/14/93</u>	<u>12/14/93</u>	<u>12/14/93</u>	<u>12/14/93</u>	<u>12/14/93</u>	<u>12/14/93</u>	<u>12/14/9</u>
TIME	0830	1030	1230	1430	1630	1830	2030	2230
AMBIENT TEMP. (°F)	38	39.9	42.9	44	41	40	41	40
AMBIENT DP. (°F)	36	36.6	36.5	35	36	36	35	34

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 1 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93
TIME	0030	0230	0430	0630	0830	1030	1230	1430
TRC-V10-7-1	82	82	82	82	83	83	83	83
CANYON DP.	.50	.50	.50	.50	.50	.50	.50	.50
TR-V10-46-1	90	91	90	90	90	90	90.5	90.5
FR-V10-28-1	45,000	45,000	45,000	45,000	44,000	44,500	44,500	44,500
FR-V11-23-1	92,000	92,000	92,000	91,000	91,000	91,000	91,500	90,500
DPTR-V11-2-1	32	32	32	32	32	32	31.5	31.5
TR-V11-3-1	64	64	64	64	63	63.5	63.5	63
DPI-V11-25-1	2.4	2.4	2.4	2.4	2.3	2.3	2.4	2.3
DPI-V11-26-1	.3	.3	.3	.3	.4	.4	.4	.4
DPI-V11-7-1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
DPI-V11-8-1	.8	.8	.8	.8	.8	.8	.8	.8
WFR-SA	0	0	0	0	0	0	0	0
WFR-SB	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
WFR-SC	0	0	0	0	0	0	0	0
WFR-SD	0	0	0	0	0	0	0	0
WFR-SE	0	0	0	0	0	0	0	0
WFR-SFA	1	1	1	1	.5	.5	.5	.5
WFR-SFB	5	5	5	5	6	6	6	6
WFR-SG	0	0	0	0	0	0	0	0
WFR-SH2	0	0	0	0	0	0	0	0
WFR-SJ	4	4	4	4	4	4.5	4.5	4.5
WFR-SJ2	1	1	1	1	1	1	1	1
WFR-SK	0	0	0	0	0	0	0	0
WFR-SLK	6	6	6	6	6	6	6	6
WFR-SLL-2	0	0	0	0	0	0	0	0
WFR-SR								

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 2 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93	12/15/93
TIME	0030	0230	0430	0630	0830	1030	1230	1430
AMBIENT TEMP. (°F)	40	40	40	38	36	44	47	44
AMBIENT DP. (°F)	34	33	33	32	32	34	32	32

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 1 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/15/93	12/15/93	12/15/93	12/15/93	12/16/93	12/16/93	12/16/93	12/16/93
TIME	1630	1830	2030	2230	0030	0230	0430	0630
TRC-V10-7-1	83	83	83	83	83	82	80	79
CANYON DP.	.50	.50	.50	.50	.50	.50	.50	.50
TR-V10-46-1	91	90	90	90	90	91	88	88
FR-V10-28-1	43,000	43,000	43,000	43,000	42,000	42,000	42,000	42,000
FR-V11-23-1	89,000	88,000	88,000	89,000	89,000	89,000	89,000	89,000
DPTR-V11-2-1	32	32	32	32	32	32	32	32
TR-V11-3-1	63	63	63	63	63	63	63	64
DPI-V11-25-1	3.2	3.0	3.0	3.0	3.0	3.3	3.3	3.3
DPI-V11-26-1	.4	.4	.4	.4	.4	.4	.4	.4
DPI-V11-7-1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
DPI-V11-8-1	.8	.8	.8	.8	.8	.8	.8	.8
WFR-SA	0	0	0	0	0	0	0	0
WFR-SB	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
WFR-SC	0	0	0	0	0	0	0	0
WFR-SD	0	0	0	0	0	0	0	0
WFR-SE	0	0	0	0	0	0	0	0
WFR-SFA	.5	.5	.5	.5	.5	.5	.5	0
WFR-SFB	6	6	6	6	6	6	6	5.5
WFR-SG	0	0	0	0	0	0	0	0
WFR-SH2	0	0	0	0	0	0	0	0
WFR-SJ	4.5	4.5	4.5	4.5	4	4	4	4
WFR-SJ2	1	1	1	1	1	1	1	1
WFR-SK	0	0	0	0	0	0	0	0
WFR-SLK	6	6	6	6	6	6	6	6
WFR-SLL-2	0	0	0	0	0	0	0	0
WFR-SR								

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 2 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/15/93</u>	<u>12/15/93</u>	<u>12/15/93</u>	<u>12/15/93</u>	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/16/93</u>
TIME	1630	1830	2030	2230	0030	0230	0430	0630
AMBIENT TEMP. (°F)	36	31	29	28	26	27	26	25
AMBIENT DP. (°F)	32	29	28	27	25	26	26	24

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 1 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/16/93	12/17/93
TIME	0830	1030	1515	1715	1915	2115	2315	0115
TRC-V10-7-1*	80	83	83	82	82	82	81	82
CANYON DP.	.50	.50	.50	.50	.50	.50	.50	.50
TR-V10-46-1	89	89.5	91	92	92	92	93	87
FR-V10-28-1	42,000	41,000	42,000	42,000	42,000	42,000	42,000	46,000
FR-V11-23-1	89,000	89,000	90,000	90,000	90,000	90,000	90,000	90,000
DPTR-V11-2-1	32	32	32	32	32	32	32	32
TR-V11-3-1	63.5	63.5	64	64	64	64	64	63
DPI-V11-25-1	2.5	2.3	2.1	2.1	2.1	2.1	2.1	2.2
DPI-V11-26-1	.4	.4	.3	.3	.3	.3	.3	.4
DPI-V11-7-1	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
DPI-V11-8-1	.8	.8	.8	.8	.8	.8	.8	.8
WFR-SA	0	0	0	0	0	0	0	0
WFR-SB	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
WFR-SC	0	0	0	0	0	0	0	0
WFR-SD	0	0	0	0	0	0	0	0
WFR-SE	0	0	0	0	0	0	0	0
WFR-SFA	0	0	0	0	0	0	0	.5
WFR-SFB	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5
WFR-SG	0	0	0	0	0	0	0	0
WFR-SH2	0	0	0	0	0	0	0	0
WFR-SJ	4.5	4.5	4	4	4	4	4	4
WFR-SJ2	1	1	1	1	1	1	1	1
WFR-SK	0	0	0	0	0	0	0	0
WFR-SLK	5.5	5.5	6	6	6	6	6	6
WFR-SLL-2	0	0	0	0	0	0	0	0
WFR-SR								

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 2 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/16/93</u>	<u>12/17/93</u>
TIME	0830	1030	1515	1715	1915	2115	2315	0115
AMBIENT TEMP. (°F)	30	31	33	32	32	32	31	31
AMBIENT DP. (°F)	30	31	30	30	30	28	28	28

Notes:

Obtain canyon temperature
from TRC-V10-6-1 when running SF-V10-1

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 1 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	12/17/93	12/17/93	12/17/93					
TIME	0315	0515	0715					
TRC-V10-7-1*	82	89	90					
CANYON DP.	.50	.50	.50					
TR-V10-46-1	89.6	90	90					
FR-V10-28-1	46,500	46,000	45,500					
FR-V11-23-1	90,000	90,000	90,000					
DPTR-V11-2-1	32	32	32					
TR-V11-3-1	63	63	63					
DPI-V11-25-1	2.2	2.3	2.5					
DPI-V11-26-1	.4	.4	.4					
DPI-V11-7-1	1.4	1.4	1.4					
DPI-V11-8-1	.8	.8	.8					
WFR-SA	0	0	0					
WFR-SB	2.5	2.5	2.5					
WFR-SC	0	0	0					
WFR-SD	0	0	0					
WFR-SE	0	0	0					
WFR-SFA	.5	.5	.5					
WFR-SFB	5	4.5	4.5					
WFR-SG	0	0	0					
WFR-SH2	0	0	0					
WFR-SJ	4	4	4					
WFR-SJ2	1	1	1					
WFR-SK	0	0	0					
WFR-SLK	6	6	6					
WFR-SLL-2	0	0	0					
WFR-SR								

CONCENTRATOR E-F11 WATER TEST

APPENDIX 3

Page 2 of 2

CELL COVER BLOCK REMOVAL TESTING DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	112/17/93	112/17/93	112/17/93					
TIME	0315	0515	0715					
AMBIENT TEMP. (°F)	31	31	31					
AMBIENT DP. (°F)	28	28	28					

Notes:

- * Obtain canyon temperature TRC-V10-6-1 when running SF-V10-1.

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 1 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/12/94	1/12/94	1/12/94	1/12/94	1/12/94			
TIME	1530	1630	1730	1830	1930			
TR-F11-2	23	24	24	26	28			
WFR-F11-3	38.5	37	34	31	29			
CANYON DP.	.5	.5	.5	.5	.5			
WFI-F11-1	47	45	45	45	45			
TR-F11-4	30	71	104	101	98			
SpG (Weekly)	1	1	1	1	1			
DPR-F11-1	2.5	22	2.5	4	5			
PI-F11-3A	0	28	29	17	17			
PI-F11-2A	0	0	0	0	0			
Boil-off RATE								
AMBIENT TEMP. (°F)	48	45	43	42	41			
AMBIENT DEW PT. (°F)	42	41	42	41	40			
TR-V10-46-1	88	90	91	90	90			
FR-V10-28-1	48,000	49,000	49,000	49,000	49,000			
FR-V11-23-1	88,000	90,000	91,000	92,000	92,000			
DPTR-V11-2-1	32	32	32	32	32			
TR-V11-3-1	64	64	64	64	64			
DPI-V11-25-1	1.9	2	2	2	2			
DPI-V11-26-1	.4	.4	.4	.4	.4			
DPI-V11-7-1	.9	.9	.9	.9	.9			
DPI-V11-8-1	.7	.7	.7	.7	.7			
WFR-F12	21	24	27	29	31			
TR-F12	46	46	46	46.5	47			
WFR-SE	0	0	0	0	0			
WFR-SA	0	0	0	0	0			
WFR-SB	2.5	2.5	2.5	2.5	2.5			

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 2 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>1/12/94</u>	<u>1/12/94</u>	<u>1/12/94</u>	<u>1/12/94</u>	<u>1/12/94</u>			
TIME	1530	1630	1730	1830	1930			
WFR-SC	0	0	0	0	0			
WFR-SD	0	0	0	0	0			
WFR-SFA	0	0	0	0	0			
WFR-SFB	3	2.5	2.5	2.5	2.5			
WFR-SG	0	0	0	0	0			
WFR-SH2	0	0	0	0	0			
WFR-SJ	3.5	3.5	3.5	3.5	3.5			
WFR-SJ2	1	1	1	1	1			
WFR-SK	0	0	0	0	0			
WFR-SLK	5	5	5	5	5			
WFR-SLL-2	0	0	0	0	0			
WFR-V11-11-1	64	64	64.5	64.5	64			
216-TK-A-2 LVL	42	41.5	41.5	41.5	41.5			
BASIN LEVEL	4'	4'	4'	4'	4'			

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 1 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/14/94	1/14/94	1/14/94	1/14/94	1/14/94	1/14/94		
TIME	1100	1300	1500	1700	1900	2100		
TR-F11-2	26	28	28	28	28	28		
WFR-F11-3	39	39	35	30	37	31		
CANYON DP.	.5	.5	.5	.5	.5	.5		
WFI-F11-1	48	44	0	44	0	0		
TR-F11-4	50	101	105	100	106	107		
SpG (Weekly)	1	1	1	1	1	1		
DPR-F11-1	6	7	4	45	3	3		
PI-F11-3A	12	25	27	26	23	28		
PI-F11-2A	0	0	0	0	0	0		
Boil-Off RATE			1 gpm			2.06 gpm		
AMBIENT TEMP. (°F)	35	44	42	40	37	38		
AMBIENT DEW PT. (°F)	35	38	38	37	36	36		
TR-V10-46-1	89	88	88	88	89	90		
FR-V10-28-1	42,000	42,000	42,000	42,000	42,000	42,000		
FR-V11-23-1	82,000	83,000	84,000	84,000	83,000	83,000		
DPTR-V11-2-1	32	32	32	32	32	32		
TR-V11-3-1	64	64	64	64	64	64		
DPI-V11-25-1	1.8	1.8	1.8	1.8	1.8	1.8		
DPI-V11-26-1	.3	.3	.3	.3	.3	.3		
DPI-V11-7-1	.8	.8	.8	.8	.8	.8		
DPI-V11-8-1	.7	.7	.7	.7	.7	.7		
WFR-F12	32	39	43	47	26	31		
TR -F12	55	55	55	55	76	76		
WFR-SE	0	0	0	0	0	0		
WFR-SA	0	0	0	0	0	0		
WFR-SB	2.5	2.5	2.5	2.5	2.5	2.5		

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 2 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>1/14/94</u>	<u>1/14/94</u>	<u>1/14/94</u>	<u>1/14/94</u>	<u>1/14/94</u>	<u>1/14/94</u>		
TIME	1100	1300	1500	1700	1900	2100		
WFR-SC	0	0	0	0	0	0		
WFR-SD	0	0	0	0	0	0		
WFR-SFA	0	0	0	0	0	0		
WFR-SFB	9	9	9	9	9	9		
WFR-SG	13	13.5	0	0	0	0		
WFR-SH2	0	0	0	0	0	0		
WFR-SJ	3	3	3	3	3	3		
WFR-SJ2	1	1	1	1	1	1		
WFR-SK	0	0	0	0	0	0		
WFR-SLK	5	5	5	5	5	5		
WFR-SLL-2	0	0	0	0	0	0		
WFR-V11-11-1	64	64	64	64	64	64		
216-TK-A-2 LVL	41.5	41.5	41.5	41.5	41.5	41.5		
BASIN LEVEL	4	4	4					

4 Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 1 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/17/94	1/17/94	1/17/94	1/17/94	1/17/94	1/17/94	1/17/94	
TIME	1000	1200	1400	1600	1800	2000	2200	
TR-F11-2	29	30	34	34	34	34	34	
WFR-F11-3	39	36	36	37	38.5	41	33	
CANYON DP.	.5	.5	.5	.5	.5	.5	.5	
WFI-F11-1	52	52	48	0	48	0	0	
TR-F11-4	56	94	95	108	100	102	108	
SpG (Weekly)	1	1	1	1	1	1	1	
DPR-F11-1	3	4	4	2	30	2	3	
PI-F11-3A	15	30	12	28	22	29	28	
PI-F11-2A	0	0	0	0	0	0	0	
Boil-Off RATE		2.3			4 gpm		4 gpm	
AMBIENT TEMP. (°F)	39	47	48	44	42	39	36	
AMBIENT DEW PT. (°F)	33	36	37	36	34	34	32	
TR-V10-46-1	88	89	89	88	87	88	87	
FR-V10-28-1	42,000	46,000	48,000	49,000	50,000	50,000	50,000	
FR-V11-23-1	82,000	90,000	91,000	93,000	93,000	94,000	94,000	
DPTR-V11-2-1	32	32	32	32	32	32	32	
TR-V11-3-1	64	64	64	64	64	64	64	
DPI-V11-25-1	1.8	1.8	1.9	2.0	2.0	2.0	2.1	
DPI-V11-26-1	.4	.4	.4	.4	.4	.4	.4	
DPI-V11-7-1	.8	.8	.8	.9	.8	.9	.9	
DPI-V11-8-1	.7	.7	.7	.8	.8	.8	.8	
WFR-F12	35	41	47	51	24	26	34	
TR-F12	64.5	64	63.5	63.5	84	83	82	
WFR-SE	0	0	0	0	0	0	0	
WFR-SA	0	0	0	0	0	0	0	
WFR-SB	2.5	2.5	2.5	2.5	2.5	2.5	2.5	

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 2 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>1/17/94</u>	<u>1/17/94</u>	<u>1/17/94</u>	<u>1/17/94</u>	<u>1/17/94</u>	<u>1/17/94</u>	<u>1/17/94</u>	
TIME	1000	1200	1400	1600	1800	2000	2200	
WFR-SC	0	0	0	0	0	0	0	
WFR-SD	0	0	0	0	0	0	0	
WFR-SFA	0	0	0	0	0	0	0	
WFR-SFB	7	7	7	7	7	7	7	
WFR-SG	0	0	0	0	0	0	0	
WFR-SH2	0	0	0	0	0	0	0	
WFR-SJ	3	3	3	3	3	3	3	
WFR-SJ2	1	1	1	1	1	1	1	
WFR-SK	0	0	0	0	0	0	0	
WFR-SLK	5	5	5	5	5	5	5	
WFR-SLL-2	0	0	0	0	0	0	0	
WFR-V11-11-1	62	56	56	56	56	56	56	
216-TK-A-2 LVL	42	42	42	42	42	42	42	
BASIN LEVEL	4'	4'	4'	4'	4'	4'	4'	

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 1 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/18/94	1/18/94	1/18/94	1/18/94				
TIME	0900	1100	1300	1500				
TR-F11-2	34	34	34	34				
WFR-F11-3	40	41	34	39				
CANYON DP.	.5	.5	.5	.5				
WFI-F11-1	48	0	0	0				
TR-F11-4	82	108	107	104				
SpG (Weekly)	1	1	1	1				
DPR-F11-1	3	6	5	6				
PI-F11-3A	12	22	24	22				
PI-F11-2A	0	0	0	0				
Boil-Off RATE			3.5 gpm	4 gpm				
AMBIENT TEMP. (°F)	33	37.5	39.2	41.2				
AMBIENT DEW PT. (°F)	32.5	35.3	35.8	35.6				
TR-V10-46-1	88	87	87	86				
FR-V10-28-1	48,000	47,000	47,000	47,000				
FR-V11-23-1	90,000	90,000	90,000	110,000				
DPTR-V11-2-1	32	32	32	32				
TR-V11-3-1	64	64	64	64				
DPI-V11-25-1	2	2	2	1.8				
DPI-V11-26-1	.4	.4	.4	.5				
DPI-V11-7-1	.9	.9	.9	.9				
DPI-V11-8-1	.7	.8	.8	.8				
WFR-F12	22	27	32	36				
TR-F12	84	81	80	80				
WFR-SE	0	0	0	0				
WFR-SA	0	0	0	0				
WFR-SB	2.5	2.5	2.5	2.5				

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 2 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>1/18/94</u>	<u>1/18/94</u>	<u>1/18/94</u>	<u>1/18/94</u>				
TIME	0900	1100	1300	1500				
WFR-SC	0	0	0	0				
WFR-SD	0	0	0	0				
WFR-SFA	0	0	0	0				
WFR-SFB	7	7	7	7				
WFR-SG	0	0	0	0				
WFR-SH2	0	0	0	0				
WFR-SJ	3.5	3.5	3.5	3.5				
WFR-SJ2	1	1	1	1				
WFR-SK	0	0	0	0				
WFR-SLK	5.5	5.5	5.5	5.5				
WFR-SLL-2	0	0	0	0				
WFR-V11-11-1	56	56	56	56				
216-TK-A-2 LVL	42	42	42	42				
BASIN LEVEL	4	4	4	4				

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 1 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/19/94	1/19/94	1/19/94					
TIME	1000	1300	1500					
TR-F11-2	32	48	43					
WFR-F11-3	41	40	28					
CANYON DP.	.5	.5	.5					
WFI-F11-1	48	48	0					
TR-F11-4	82	107	107					
SpG (Weekly)	1	1	1					
DPR-F11-1	6	2.5	6					
PI-F11-3A	12	12	16					
PI-F11-2A	0	0	0					
Boil-Off RATE								
AMBIENT TEMP. (°F)	34	50	50					
AMBIENT DEW PT. (°F)	32	35	35					
TR-V10-46-1	86	88	92					
FR-V10-28-1	48,000	42,000	42,000					
FR-V11-23-1	89,000	83,000	83,000					
DPTR-V11-2-1	32	32	32					
TR-V11-3-1	64	64	64					
DPI-V11-25-1	1.9	1.6	2.7					
DPI-V11-26-1	.4	.4	.4					
DPI-V11-7-1	.8	.8	.8					
DPI-V11-8-1	.7	.7	.7					
WFR-F12	23	26	37					
TR-F12	76	74	74					
WFR-SE	0	0	0					
WFR-SA	0	0	0					
WFR-SB	2.5	2.5	2.5					

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 2 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/19/94	1/19/94	1/19/94					
TIME	1000	1300	1500					
WFR-SC	0	1	0					
WFR-SD	0	0	0					
WFR-SFA	0	0	0					
WFR-SFB	6	6	6					
WFR-SG	0	0	0					
WFR-SH2	0	0	0					
WFR-SJ	3	3	3					
WFR-SJ2	1	1	1					
WFR-SK	0	0	0					
WFR-SLK	5	5	5					
WFR-SLL-2	0	0	0					
WFR-V11-11-1	56	56	56					
216-TK-A-2 LVL	42	42	42					
BASIN LEVEL	4'	4'	4'					

Notes:

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 1 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>1/20/94</u>	<u>1/20/94</u>	<u>1/20/94</u>	<u>1/20/94</u>				
TIME	0900	1100	1300	1500				
TR-F11-2	32	34	36	39				
WFR-F11-3	40	34	38	39				
CANYON DP.	.5	.5	.5	.5				
WFI-F11-1	48	0	0	0				
TR-F11-4	74	108	108	108				
SpG (Weekly)	1	1	1	1				
DPR-F11-1	3	5	6	4				
PI-F11-3A	18	26	24	26				
PI-F11-2A	0	0	0	0				
Boil-Off RATE								
AMBIENT TEMP. (°F)	38	45	50	50				
AMBIENT DEW PT. (°F)	33	34	34	33				
TR-V10-46-1	86	87	88	89				
FR-V10-28-1	42,000	40,000	42,000	42,000				
FR-V11-23-1	82,000	86,000	84,000	84,000				
DPTR-V11-2-1	32	32	32	32				
TR-V11-3-1	63	64	64	64				
DPI-V11-25-1	1.8	2	2.1	2.1				
DPI-V11-26-1	.4	.4	.4	.4				
DPI-V11-7-1	.8	.8	.8	.8				
DPI-V11-8-1	.7	.7	.7	.7				
WFR-F12	38	31	42	52				
TR-F12	78	77	77	77				
WFR-SE	0	0	0	0				
WFR-SA	0	0	0	0				
WFR-SB	2.5	2.5	2.5	2.5				

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 2 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/20/94	1/20/94	1/20/94	1/20/94				
TIME	0900	1100	1300	1500				
WFR-SC	4	4	4.5*	5*				
WFR-SD	0	0	0	0				
WFR-SFA	0	0	0	0				
WFR-SFB	5.5	5.5	5.5	5.5				
WFR-SG	0	0	0	0				
WFR-SH2	0	0	0	0				
WFR-SJ	3	3	3	3				
WFR-SJ2	1	1	1	1				
WFR-SK	0	0	0	0				
WFR-SLK	5	5	5	5				
WFR-SLL-2	0	0	0	0				
WFR-V11-11-1	56	56	56	56				
216-TK-A-2 LVL	42	45**	45	45				
BASIN LEVEL	4	4	4	4				

Notes:

* SC rise due to steam being valved in for dissolver transfers.

** Change due to water being added to floor drains.

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 1 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	1/21/94	1/21/94	1/21/94					
TIME	0930	1130	1400					
TR-F11-2	33	34	38					
WFR-F11-3	39	34.5	35					
CANYON DP.	.5	.5	.5					
WFI-F11-1	0	0	4					
TR-F11-4	80	108	108					
SpG (Weekly)	1	1	1					
DPR-F11-1	8	6	2					
PI-F11-3A	13	28	27					
PI-F11-2A	0	0	0					
Boil-Off RATE								
AMBIENT TEMP. (°F)	29	35	41					
AMBIENT DEW PT. (°F)	28	32	33					
TR-V10-46-1	72	74	78					
FR-V10-28-1	44,000	42,000	41,000					
FR-V11-23-1	85,000	85,000	84,000					
DPTR-V11-2-1	32	32	32					
TR-V11-3-1	64	64	64					
DPI-V11-25-1	2	2.1	2.1					
DPI-V11-26-1	.4	.4	.4					
DPI-V11-7-1	.8	.8	.8					
DPI-V11-8-1	.7	.7	.7					
WFR-F12	23	32	47					
TR-F12	83	81	81					
WFR-SE	0	0	0					
WFR-SA	0	0	0					
WFR-SB	2.5	2.5	2.5					

CONCENTRATOR E-F11 WATER TEST

APPENDIX 4

Page 2 of 2

E-F11 BOIL-OFF MONITORING TEST DATA

VARIABLE	DATA	DATA	DATA	DATA	DATA	DATA	DATA	DATA
DATE	<u>1/21/94</u>	<u>1/21/94</u>	<u>1/21/94</u>					
TIME	0930	1130	1400					
WFR-SC	8	9*	0**					
WFR-SD	0	0	0					
WFR-SFA	0	0	0					
WFR-SFB	5	5	5					
WFR-SG	0	0	0					
WFR-SH2	0	0	0					
WFR-SJ	3	3	3					
WFR-SJ2	1	1	1					
WFR-SK	0	0	0					
WFR-SLK	5	5	5					
WFR-SLL-2	0	0	0					
WFR-V11-11-1	56	56	56					
216-TK-A-2 LVL	45	45	45					
BASIN LEVEL	4'	4'	4'					

Notes:

* Increase in sump is caused by P&O Gallery sub header being valved in.

** Sump jet.

CONCENTRATOR E-F11 WATER TEST

APPENDIX 5

E-F11 BOIL-OFF DETERMINATION DATA

DATE	TIME	MINUTES BOILING	E-F11 WF	TK-223 WF	E-F11 BOIL-OFF RATE	E-F11 DROP OUT RATE	TK-223 DROP OUT RATE	AVE. BOIL-OFF RATE	TK-F12 WF	TK-F12 VOL.	F12 RATE	BOIL-OFF EFFIC.
01/21/94	10:20	0	35.5	2322	7.1			6.3	25.5	1796	8.0	0.9
01/21/94	10:57	37	34.5	2111	7.1	1.37	5.70	6.3	29.5	2093	8.0	0.9
01/21/94	11:02	42	34.5	2111	5.9	0.00	0.00	6.3	29.75	2112	7.1	0.8
01/21/94	12:21	123	34.75	1721	4.7	-0.16	4.81	6.3	36.5	2612	6.2	0.8
01/21/94	14:00	222	35.25	1120	5.8	-0.26	6.07	6.3	45.75	3296	6.9	0.8
01/21/94	14:38	260	35.5	1014	2.5	-0.33	2.79	6.3	49	3537	6.3	0.4
01/21/94	14:55	277	32.5	1014	9.0	8.97	0.00	6.3	51	3685	8.7	1.0
01/21/94	15:08	290	30.25	1014	8.8	8.80	0.00	6.3	52.25	3778	7.2	1.2
01/20/94	09:15	0	40	0	0.0	0.00	0.00	0	23	1612	ERR	ERR
01/20/94	09:30	15	40	0	0.0	0.00	0.00	0	24	1686	4.9	0.0
01/20/94	09:45	30	39.5	0	1.7	1.69	0.00	4.83	25	1759	4.9	0.3
01/20/94	10:00	45	37.75	0	5.9	5.93	0.00	4.83	26	1833	4.9	1.2
01/20/94	10:15	60	36.25	0	5.1	5.08	0.00	4.83	27.25	1925	6.1	0.8
01/20/94	10:30	75	35	0	4.2	4.24	0.00	4.83	28.25	2000	5.0	0.8
01/20/94	10:45	90	33.5	0	5.1	5.08	0.00	4.83	29.5	2093	6.2	0.8
01/20/94	11:00	105	33	0	1.7	1.69	0.00	4.83	31.5	2241	9.9	0.2
01/20/94	11:15	120	32	0	3.4	3.39	0.00	4.83	32.5	2315	4.9	0.7

CONCENTRATOR E-F11 WATER TEST

APPENDIX 5

E-F11 BOIL-OFF DETERMINATION DATA

DATE	TIME	MINUTES BOILING	E-F11 WF	TK-223 WF	E-F11 BOIL-OFF RATE	E-F11 DROP OUT RATE	TK-223 DROP OUT RATE	AVE. BOIL-OFF RATE	TK-F12 WF	TK-F12 VOL.	F12 RATE	BOIL-OFF EFFIC.
01/20/94	11:30	135	31.5	3446	6.3	1.69	0.00	4.83	33.75	2408	6.2	1.0
01/20/94	12:45	210	37.5	2441	9.3	-4.07	13.40	4.83	41.5	2982	7.7	1.2
01/20/94	13:30	255	38	2193	4.9	-0.56	5.51	4.83	44.25	3186	4.5	1.1
01/20/94	14:00	285	38.5	2083	2.8	-0.85	3.67	4.83	47	3389	6.8	0.4
01/20/94	14:30	315	39.5	1832	6.7	-1.69	8.37	4.83	50	3611	7.4	0.9
01/20/94	15:00	345	39	1690	5.6	0.85	4.73	4.83	52.5	3796	6.2	0.9
01/18/94	16:40	0	37.5	0	0.0	0.00	0.00	0	23	1612	0.0	0.0
01/18/94	16:48	5	37	0	5.1	5.08	0.00	2.75	23	1612	0.0	0.0
01/18/94	16:50	10	37	0	0.0	0.00	0.00	2.58	23.5	1649	7.4	0.0
01/18/94	16:56	16	36.5	0	4.2	4.24	0.00	2.58	24	1686	6.2	0.7
01/18/94	17:01	21	36.25	0	2.5	2.54	0.00	2.58	24.25	1704	3.6	0.7
01/18/94	17:15	35	35.75	0	1.8	1.82	0.00	2.58	25	1759	3.9	0.5
01/18/94	17:22	42	35	0	5.4	5.45	0.00	2.58	25.25	1778	2.7	2.0
01/18/94	17:36	57	34.75	0	0.8	0.85	0.00	2.58	26	1833	3.7	0.2
01/18/94	17:57	77	34.5	0	0.6	0.64	0.00	2.58	27	1906	3.7	0.2
01/18/94	18:20	100	32.25	0	5.0	4.97	0.00	2.58	18.25	2000	4.1	1.2
01/18/94	18:47	127	31	0	2.4	2.35	0.00	2.58	29.5	2093	3.4	0.7

CONCENTRATOR E-F11 WATER TEST

APPENDIX 5

E-F11 BOIL-OFF DETERMINATION DATA

DATE	TIME	MINUTES BOILING	E-F11 WF	TK-223 WF	E-F11 BOIL-OFF RATE	E-F11 DROP OUT RATE	TK-223 DROP OUT RATE	AVE. BOIL-OFF RATE	TK-F12 WF	TK-F12 VOL.	F12 RATE	BOIL-OFF EFFIC.
01/18/94	19:30	170	29	0	2.4	2.36	0.00	2.58	31	2204	2.6	0.9

CONCENTRATOR E-F11 WATER TEST

APPENDIX 6

CANYON HUMIDITY CALCULATIONS

TO:G.R. Tardiff

FROM:R.K. Bhatia

RE:Design Basis for the E-F-11 Concentrator Humidity Calculations

DATE:June 7, 1991

The humidity calculations were done assuming there would be no increase in temperature of the canyon exhaust stream upon mixing the steam and air. In actual operation the temperature of the exhaust steam would increase due to radiant heat from the canyon and enthalpic effects of steam. A representative calculation is shown below:

$$d_{\text{air}} = P \cdot m_w / RT$$

$$= (1 \text{ atm})(29 \text{ lb/mol}) / (.7302 \text{ ft}^3\text{-atm/mol-R})(550 \text{ R})$$

$$= 0.072 \text{ lb/ft}^3$$

$$m_{\text{air}} = Q_{\text{air}} \cdot d_{\text{air}}$$

$$= (60,000 \text{ ft}^3/\text{min})(0.072 \text{ lb/ft}^3)$$

$$= 4,332 \text{ lb/min}$$

$$@ 90^\circ\text{F} \text{ \& } h_{\text{rel}} = 20\% \text{ ----} \rightarrow h_{\text{abs}} = 0.0060 \text{ \# H}_2\text{O/\# air}$$

$$@ 90^\circ\text{F} \text{ \& } h_{\text{rel}} = 80\% \text{ ----} \rightarrow h_{\text{abs}} = 0.0247 \text{ \# H}_2\text{O/\# air}$$

The mass flow rate of steam that corresponds to this increase in humidity at the same temperature can be calculated as:

$$m_{\text{steam}} = m_{\text{air}} \{ h_a(80\%) - h_a(20\%) \}$$

$$= (4332 \text{ lb/min}) \cdot \{ (0.0247 - 0.0060) \text{ \# H}_2\text{O/\# air} \}$$

$$= 81 \text{ lb/min} = 9.7 \text{ GPM}$$

So adding 9.7 GPM steam at 90°F will increase the relative humidity from 20% to 80%.

CONCENTRATOR E-F11 WATER TEST

Canyon Inlet Conditions

Temperature: 50 - 90 °F (atmospheric conditions)

Inlet flow rate: 30 KSCFM

Canyon Exhaust Conditions

Temperature: ~20°F temperature rise

Airflow rate: 60 KSCFM

A conservative canyon flow rate during operation is estimated to be 30 KSCFM from A through F cell rat holes. With the balance of the 60 KSCFM airflow coming from cells downstream of F cell.

The steam evaporation rate can be optimized by increasing both the canyon air flow and temperature. The air flow can be increased by increasing the bulk air flow through the canyon, or by increasing the flow rate in vicinity of F cell via removal of an upstream cover block. The air temperature can be increased by pre-heating the canyon air. By heating the canyon air the relative humidity is decreased, thereby increasing the amount of water the air can hold.

Figures 9-12 show this for canyon flow rates of 25, 30, 40 and 60 KSCFM respectively. On these figures, the lower limit of 2 gpm corresponds to the minimum amount of steam routed into the air tunnel from just jet operation and the upper limit of 8 gpm corresponds to the maximum amount of steam that can be sent to the air tunnel (jet operation plus boil-off) without exceeding the jet's 900 #/hr capacity.

Process control is maintained by temperature and dew point indicators at the canyon and the filter inlets.

CONCENTRATOR E-F11 WATER TEST

APPENDIX 7

E-F11 BOIL-OFF RATE LIMITS

DON'T SAY IT --- *Write It!*

DATE: May 7, 1992

TO: P. R. Ethington S6-18FROM: [original signed by]
R. K. Bhatia S6-18Telephone: 3-4165

cc: B. G. Erlandson B2-19
D. B. Jensen B2-19
G. R. Tardiff S6-18
D. W. Reberger S6-18
D. J. Washenfelter S6-18 [initialed original]
RKB: LB

SUBJECT: E-F-11 STEAM FLOW RATE TO AIR TUNNEL

The table below summarizes the maximum allowable steam flow rate (GPM) into the air tunnel from the E-F-11 concentrator. The numbers were generated from a LOTUS 123 spreadsheet using the absolute humidity that corresponds to the inlet and outlet relative humidity. The steam flow rates were calculated based on the following:

- canyon air flow of 100,000 SCFM
- tunnel air exits at 90% relative humidity
- E-F-11 steam flow rate to air tunnel of 2 - 8 GPM

CONCENTRATOR E-F11 WATER TEST

Steam Flow Rate to Air Tunnel (GPM)					
	Relative Humidity Ambient Air				
Ambient Air Temperature (°F)	20%	30%	40%	50%	60%
30	2.4	2.0	1.8	1.4	1.0
40	3.4	2.9	2.5	2.0	1.5
50	5.2	4.2	3.6	2.8	2.2
60	6.8	5.7	4.9	4.1	3.0
70	9.7	8.3	7.1	5.6	4.3
80	13.5	11.9	9.7	7.8	5.9
90	19.0	16.5	13.7	11.1	8.3
100	26.4	22.6	19.1	15.4	11.7
110	35.5	33.8	25.9	20.9	15.5

The shaded portion of the table shows where the ambient air conditions limit the E-F-11 boil-off rate to maintain 90% relative humidity in the air tunnel. Outside the shaded region the equipment, not the ambient air conditions, limit the boil-off rate to less than 8 GPM total (2 GPM motive steam + 6 GPM evaporator boil-off). Operation under these conditions will allow water boil-off without condensation in the air tunnel or filter beds.

DATE

FILMED

8/25/94

END