Key Words:
Aluminosilicate
Neutralization
Uranium

Retention:
Permanent

RESULTS OF THE 2H EVAPORATOR ACID CLEANING AND IN-POT NEUTRALIZATION

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MAY 29, 2007

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Prepared for the U.S. Department of Energy Under Contract Number DE-AC09-96SR18500

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U.S. Department of Energy

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SUMMARY

The estimated 200 gallons of sodium aluminosilicate scale (NAS) present in the 242-16H Evaporator pot prior to chemical cleaning was subjected to four batches of 1.5 M (9 wt%) nitric acid. Each batch was neutralized with 19 M (50 wt %) sodium hydroxide (caustic) before transfer to Tank 38. The chemical cleaning process began on November 20, 2006, and was terminated on December 10, 2006. An inspection of the pot's interior was performed and based on data gathered during that inspection; the current volume of scale in the pot is conservatively estimated to be 36.3 gallons, which is well below the 200 gallon limit specified in the Technical Safety Requirements. In addition, the performance during all aspects of cleaning agreed well with the flowsheet developed at the bench and pilot scale. There were some lessons learned during the cleaning outage and are detailed in appendices of this report.

INTRODUCTION

The Savannah River Site (SRS) stores high level nuclear waste in 49 underground storage tanks. The wastes are to be vitrified in the Defense Waste Processing Facility (DWPF) for permanent disposal. The available tank space must be managed to ensure viability of the separation canyon to support nuclear material stabilization and continued operation of DWPF. Under normal operations, the wastes are evaporated to reduce volume. The SRS has three operational atmospheric-pressure high-level-waste evaporators. Two evaporators are located in H-Area and one is in F-Area. The 242-16H (or 2H) evaporator had not operated from October 1999 to September 2001 due to the presence of a large amount of sodium aluminosilicate scale that contained sodium diuranate.[1,2,3] The scale is very similar to that observed in the aluminum and pulp paper industries[4,5,6] and was produced at SRS by reaction of the aluminate supplied by the plutonium separations facilities and the silicate from recycle water from the DWPF. The chemistry of high level waste with elevated silicon levels thermodynamically favors the formation of aluminosilicates.[7] The 2H Evaporator was scaled to the point that the concentrated evaporator bottoms could not be removed through normal steam lifting protocols.

Work performed by the Savannah River National Laboratory (SRNL) during calendar years 1998-2000 had shown that dilute nitric acid was an effective chemical cleaning agent.[8,9] An overall cleaning flowsheet was developed in calendar year 2000 that addressed numerous safety issues associated with cleaning the pot, neutralizing the uranium-bearing acid and discharging the neutralized solutions to a waste tank. Beginning in May 2001, a depleted uranium and nitric acid mixture was added to the 2H Evaporator pot and heated to elevated temperatures. As a result of this action, the pot was cleaned and returned to service.

As a result of the formation of aluminosilicates when elevated concentrations of silica are a concern, SRS changed the operational requirements for the site's High-Level Waste evaporators. Wastes containing high silicon concentrations, e.g., DWPF recycle, would be concentrated in the 2H Evaporator. The criticality hazard for the 2H Evaporator was reduced by depleting the U-235 content of the waste to below acceptable levels. Waste containing aluminate would be processed in the 2F or 3H Evaporator and acceptance criteria were established to monitor for the possible formation of sodium aluminosilicate.[10]

Routine inspections of the 2H Evaporator pot have been performed periodically since the cleaning operations. In a recent inspection, evidence of scale growth has emerged. Additionally, difficulty in lifting the pot contents has been encountered along with a reduction in the pot siphon flowrates indicated an obstruction in the Gravity Drain Line (GDL). Hydro-lancing operations removed solid deposits from the GDL and samples were retrieved.

During 2005, SRNL, Liquid Waste Operations (LWO) and Planning Integration and Technology (PIT) personnel embarked on a program to develop a nitric acid-based flowsheet that would allow for in-pot neutralization of the spent acid prior to discharging to the waste tank, Tank 38H. This work included dissolution testing of actual scale samples,[11] neutralization of spent acid simulant containing uranium,[12] and pilot-scale neutralization of a non-radioactive spent acid simulant in a one-tenth scale evaporator mockup.[13,14] The result of this research and development effort was a flowsheet for implementation in the 242-16H Evaporator.[15]

As a result of successfully completing the research and development program, Liquid Waste Operations proceeded with an evaporator outage to perform the acid cleaning. Beginning on November 20, 2006, four acid treatments were completed. This report documents the cleaning results and provides discussion on the lessons learned throughout the outage.

CLEANING OPERATIONS

There are six basic steps in the cleaning operation and these are listed below:

- Acid Addition
- Heat up and dissolution
- Cooling
- Caustic addition and Neutralization
- Discharge to Tank 38
- Water Flush

The flowsheet utilized 1.5 M nitric acid to dissolve the aluminosilicates. Equation 1 shows the dissolution reactions for the major scale solids. The aluminosilicate reacts with nitric acid (HNO_3) to form sodium nitrate, aluminum nitrate and silicic acid (H_2SiO_3). For simplicity, the waters of hydration are not included. Clarkeite ($Na[(UO_2)O(OH)]\cdot H_2O$) reacts with nitric acid to form sodium nitrate, uranyl nitrate ($UO_2(NO_3)_2$), and water. Gibbsite ($Al(OH)_3$) reacts with nitric acid to form water and aluminum nitrate. The overall equations (from the crystalline phase to the solution phase) for dissolution of these three solids follow.

Equation 1. Dissolution Reactions for Primary Scale Solids with HNO_3

$$Na_8Al_6Si_6O_{24}(NO_3)_2 + 24HNO_3 \rightarrow 8NaNO_3 + 6Al(NO_3)_3 + 6H_2SiO_3 + 6H_2O \quad \text{(a)}$$

$$Na[(UO_2)O(OH)]\cdot H_2O + 3\ HNO_3 \rightarrow NaNO_3 + UO_2(NO_3)_2 + 3H_2O \quad \text{(b)}$$

$$Al(OH)_3 + 3HNO_3 \rightarrow Al(NO_3)_3 + 3H_2O \quad \text{(c)}$$

Figure 1 and Figure 2 show data for a number of parameters from the 2H Evaporator pot during the first and second heating cycles. As observed in these figures, the rate of heating the pot is fairly rapid and reaching temperature (~ 90 °C) within several hours. The pot pressure slowly rises and reaches about 4 in. water column. As expected, the specific gravity of the acid does not change as the scale dissolves. During heating the first batch of acid in the 2H Evaporator pot, the heating cycle was interrupted due to a cell sump alarm (see discussion in Appendix B and Data in Appendix C). Other than the sump issue, the other Batches 3 and 4 showed the same trends.

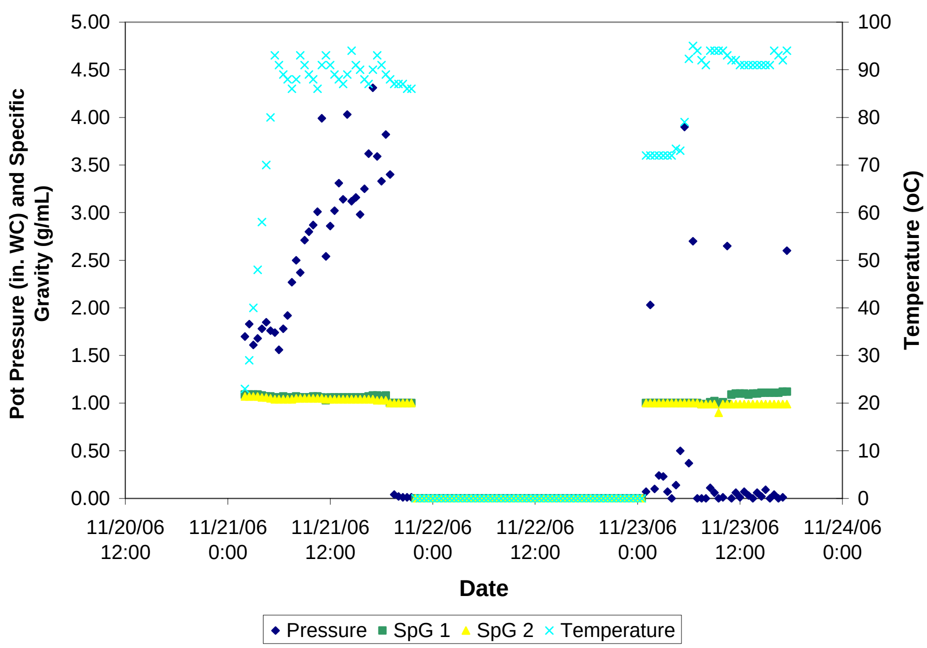

Figure 1. Plot of Data from Heating Pot during Batch 1

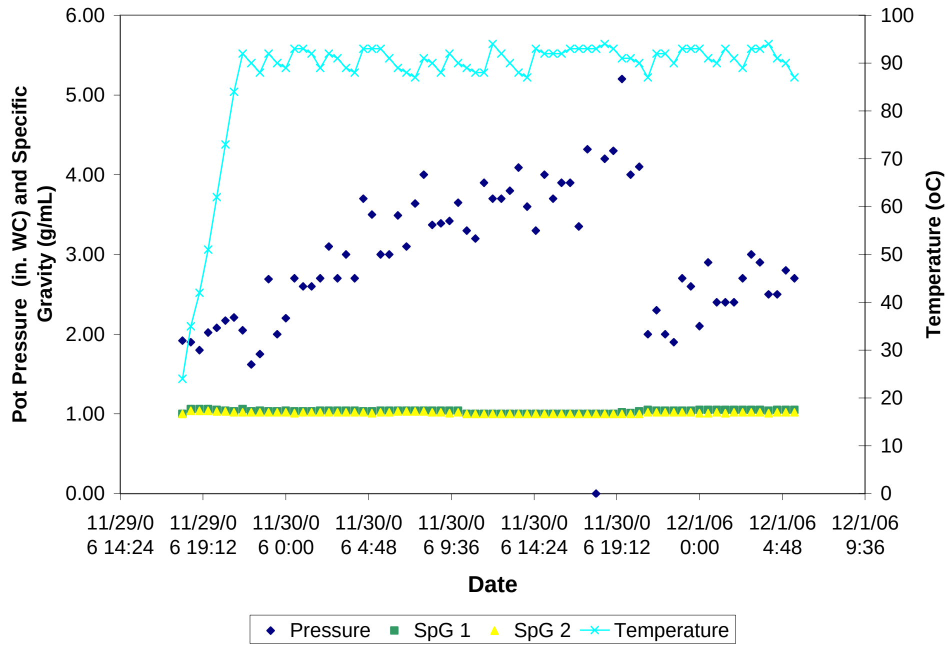

Figure 2. Data from Heating Pot during Batch 2

After the dissolution and heating cycle, the evaporator pot contents are cooled using water flow through the tube bundle. The contents are cooled to assist in reducing the maximum temperature reached during the neutralization step. This action is because of the exothermic reaction of the sodium hydroxide and nitric acid during neutralization. The desired effect will reduce the amount of aluminosilicate that reforms under the neutralized caustic composition. The cooling was modeled by Kwon[16] in 2000. Kwon used various calculational approaches to predict the length of time that it would take to reduce the evaporator pot temperature from the anticipated dissolution flowsheet temperature of 95 °C to 30 °C. The time required approximately 15 to 19 hours. In Figure 3, the cooling data are shown for the pot temperature for Batch 2. The duration observed agrees very well with the prediction and is well within the flowsheet duration of 32 hours. Batch 2 showed the longest time to cool to a nominal temperature of 30 °C. The other batches cooled within 7 – 10 hours.

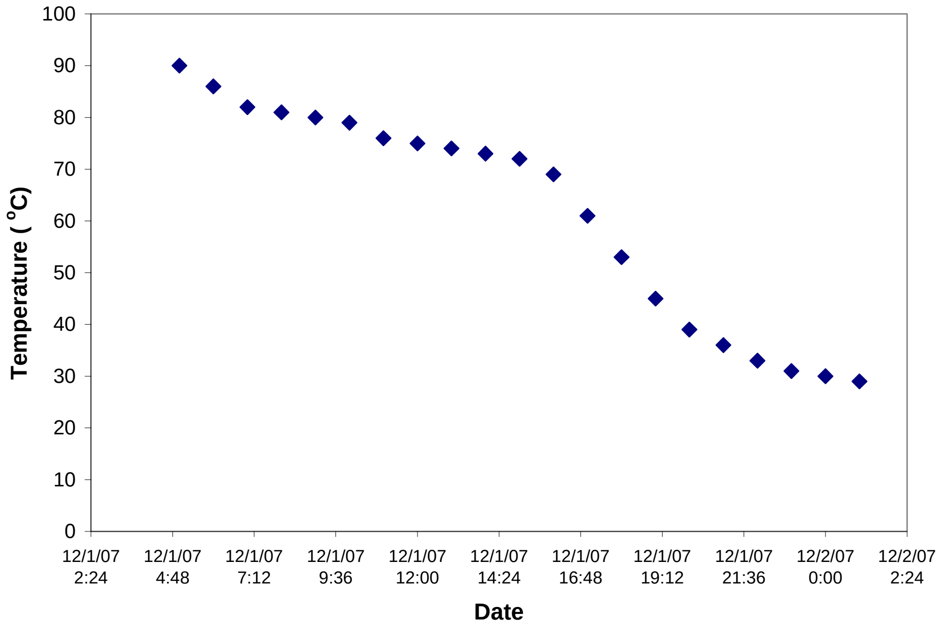

Figure 3. Cooling Curve for Batch 2

The spent acid solution cannot be added directly to a waste storage tank due to the potential for corrosion of the carbon steel by the acid, and is neutralized with sodium hydroxide prior to transfer to Tank 38H. To ensure complete neutralization, excess sodium hydroxide is added to drive the pH to14 reaching a free hydroxide concentration of approximately 1 molar.

Based on the products of the dissolution reactions shown, seven major chemical reactions occur during neutralization as shown in Equation 2.

Equation 2. Neutralization Reactions for Dissolution Products With NaOH

The following four reactions occur during neutralization to pH 7.

$$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O \quad (a)$$
$$Al(NO_3)_3 + 3\ NaOH \rightarrow Al(OH)_3 + 3\ NaNO_3 \quad (b)$$
$$UO_2(NO_3)_2 + 2\ NaOH \rightarrow UO_2(OH)_2 + 2\ NaNO_3 \quad (c)$$
$$H_2SiO_3 + NaOH \rightarrow NaHSiO_3 + H_2O \quad (d)$$

The following three reactions occur during adjustment to pH >13.

$$Al(OH)_3 + NaOH \rightarrow NaAlO_2 + 2\ H_2O \quad (e)$$
$$2\ UO_2(OH)_2 + 2\ NaOH \rightarrow Na_2U_2O_7 + 3\ H_2O \quad (f)$$
$$NaHSiO_3 + NaOH \rightarrow Na_2SiO_3 + H_2O \quad (g)$$

Figure 4 shows the measured evaporator pot parameters for the neutralization step. After the evaporator pot contents had cooled to approximately 30 °C, concentrated sodium hydroxide solution (50 wt %) is added to the 2H Evaporator pot with agitation provided by the air sparger. One can observe that the sodium hydroxide addition raised the volume of the pot from ~47 inches to 60 inches. The caustic addition was performed using two totes of 50 wt % sodium hydroxide as evidenced by the two step change in pot volume. The temperature rose from 23 °C to 39 °C following the first tote addition. The data show that during the change out of the totes the temperature fell below 30°C and rose only slightly during the second tote addition. The pot pressure was constant as expected. The specific gravity measurements differed with the lower tube showing an increase in specific gravity from 1.12 to 1.20 g/mL. The upper measurement did not show this increase. All of these trends were repeated in the other neutralization batches. The operation went very smoothly.

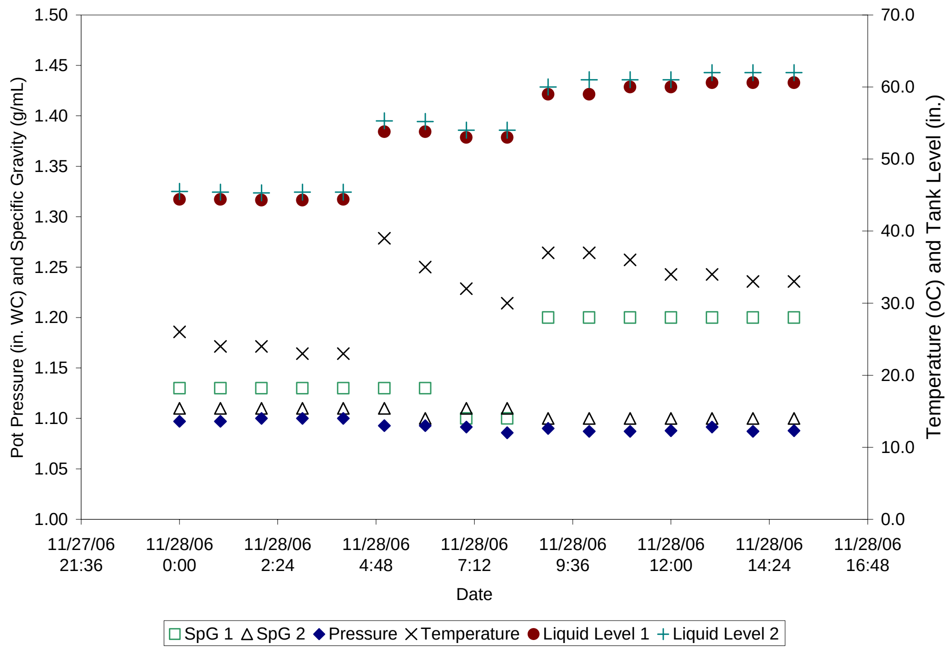

Figure 4. Data from Neutralization of Batch 1

RESULTS AND DISCUSSION

After two dissolution batches were performed, a video inspection was performed. The results indicated that the scale appeared to be dissolving slowly. As shown in the picture in Figure 5, the picture on the right shows some material still adhering to the wall of the pot. This picture looks similar to a picture taken from the pot in 2001 shown in Figure 5 on the left. In the cleaning that occurred in 2001, it was estimated that there were 3500 kg of scale in the pot.[17] Analysis of the data in 2001 showed only 350 kg had dissolved.[18]

This information implies that during the dissolution the scale was removed from the walls and piping and was removed from the pot by the pump rather than dissolution. It appears that in the 2006 dissolution campaign, the scale is adhering to the walls more than in 2001. This result is a similar behavior as that of the Gravity Drain Line. One aspect to remember is that in 2001, the scale formed in a rapid occurrence. The scale currently in the pot has been growing slowly and has been aged in place by the number of heating and cooling cycles. Additional acid treatment should further dissolve the scale.

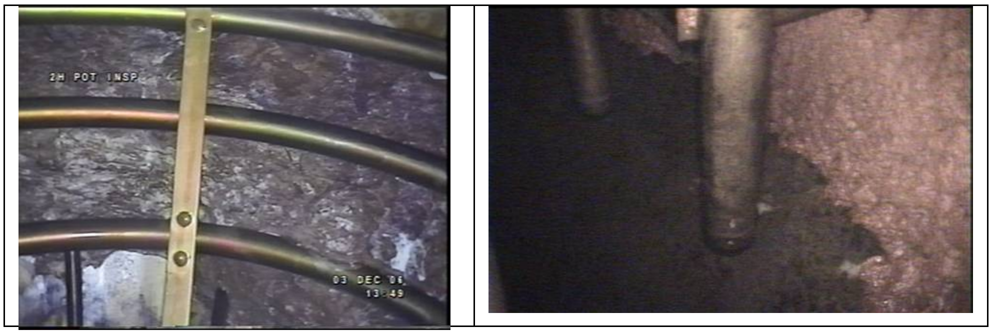

Figure 5. Partially Dissolved Scale

Figure 6 shows a photograph of the tube bundle and warming coil. A golden appearance is observed that is most probably an artificially induced by the lighting in conjunction with the digital photography that is now being utilized. SRNL did not see anything that would indicate corrosion or other concern. As shown in Figure 6, the color of the tube bundle changes significantly as one move from the left lower portion to the upper right portion.

Figure 6. Photograph of the Tube Bundle and Warming Coils

Figure 7 shows a portion of a photograph of the 2H Evaporator pot. SRNL was asked to comment on the nature of the material above the liquid level that had been cleaned. As we can not precisely know what the material is, we compared the nature of the material to the photographs that have been taken from the pot and GDL over time. Our opinion is that material likely contains sodium aluminosilicate scale. To reduce the salt content of this film, one could envision filling the pot with water, bringing it to a boil, then slowly raising the liquid level to as near the demister as possible to allow the hot water to dissolve the salt.

Figure 7. Photograph of Solids in the Vapor Space of the 2H Evaporator Pot

Two additional acid strikes were performed with their accompanying neutralizations and discharges to Tank 38H. The results of the video inspections of the pot following completion of acid cleaning showed that the majority of the scale dissolved and was removed. However, there was one spot within the pot that was rather resistant to the nitric acid treatment. This spot is shown in Figure 8. A small amount of scale remained between the wall and the warming coil.

To restart the evaporator for waste service, LWO personnel estimated the amount of scale remaining in the 2H Evaporator pot. This estimate is performed using the digital photography and video evidence and comparing this evidence of the know design of the evaporator pot. Shown in Figure 9 is depiction of the area of the evaporator where scale remains between the wall and the warming coil. Knowing the dimensions of the warming coil tubing and the distance between the coil and wall, the volume of scale can be estimated. Additionally, the bottom of the pot was not visible and was assumed to contain aluminosilicate scale. LWO engineering estimated 36.3 gallons of scale which is well below the limit of 200 gallons. Resumption of waste evaporation began shortly thereafter.

Figure 8. Scale Remnants in 2H Pot following Acid Cleaning

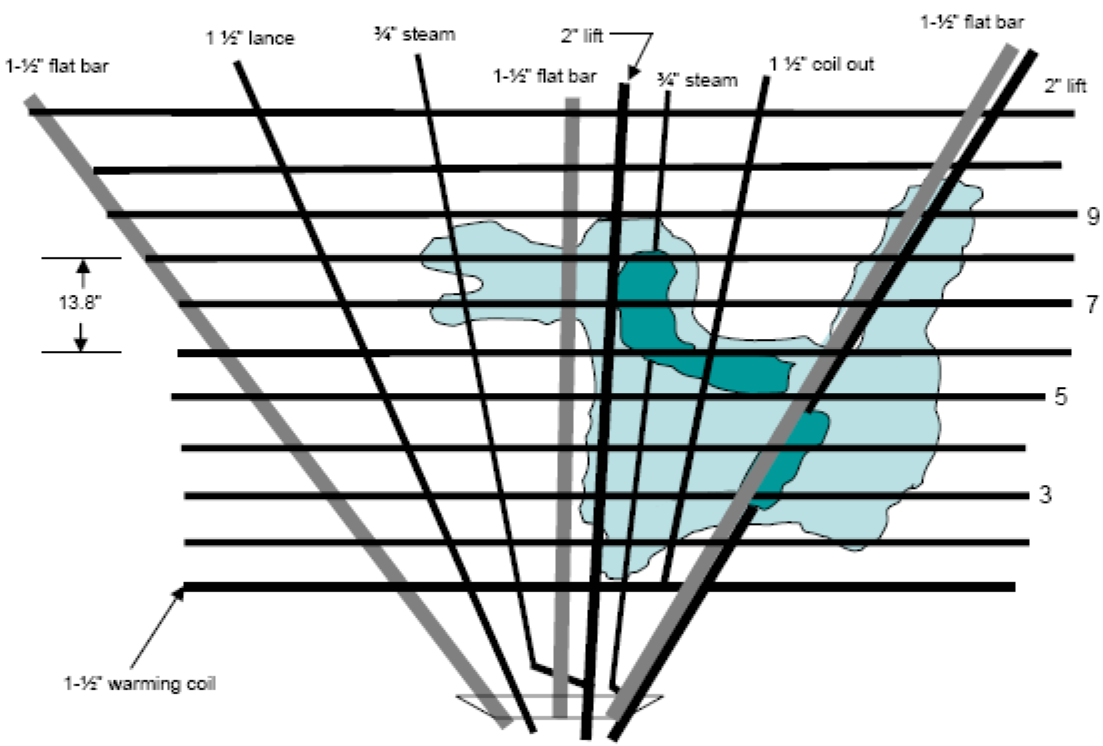

Figure 9. Depiction of Remaining Scale in 2H following Acid Cleaning

CONCLUSIONS

Processing of DWPF recycle through the 2H Evaporator will continue to generate the formation of sodium aluminosilicate scale due the large quantities of aluminum in the liquor and the saltcake and the legacy of silicon in the feed and drop tanks. This formation will continue until one of these two elements (Al and Si) is depleted. Therefore, sodium aluminosilicate scale will continue to deposit and acid cleaning will be necessary.

The intent of the latest flowsheet development and deployment was to show that acid cleaning followed by in-pot neutralization would successfully reduce the amount of scale efficiently. The results of the research and development, the facility design, and the facility procedures and operation collectively show success. This flowsheet deployment showed a steady and predictable dissolution of the scale. The facility installation and removal proved to be facile and can be re-installed as needed for future cleaning operations.

APPENDIX A. SHIFT MANAGER'S LOG ENTRIES

Log Entries from Shift Manager's Log Book

Date	Time	Activity	Source
11/20/06	16:50	Acid being added to pot.	SM
	17:40	Pump flow startup rate issue. Caused over flow of funnel. Flow rate 5 to 50 gpm.	SM
	22:30	Pumped acid into pot at 25 gpm.	SM
	23:37	Completed adding 2000 gallons of nitric acid.	SM
11/21/06	02:00	Placed steam on the tube bundle.	SM
	05:23	Started 32 hour simmer clock.	SM
	18:56	Completed shutdown of 2H Evaporator.	SM
	20:00	Issue with cell sump ARP.	SM
11/22/06	20:30	Completed adding caustic to 2H evap cell sump.	SM
11/23/06	00:53	Steam placed on 2H evap tube bundle.	SM
	05:38	Reached 85°C in 2H evap pot Simmer time begins now.	SM
	17:10	Completed 2H "Acid cleaning simmer time"	SM
	20:16	Flushed dip tubes.	SM
	20:50	Placed WW in 2H evap tube bundle. Current temp 82°C.	SM
11/24/06	00:35	Current pot temp is 43°C.	SM
	03:40	Problem with proper air flow for agitation. Current pot temp is 30°C.	SM
	09:30	Reworked pressure regulator. Replaced filter. Replaced globe valves with gate valves. Replaced with larger compressor. Finally realized that the flow meter scale was not proper calibrated for the actual conditions.	SM
11/28/06	04:15	Started adding first caustic tote.	SM
	04:55	Completed adding the first caustic tote.	SM
	08:16	Started adding second caustic tote.	SM
	08:45	Completed adding second caustic tote.	SM
	21:14	Initiated pumping 2H Evaporator pot to Tk 38.	SM
	21:48	Completed pumping 2H Evaporator pot to Tk 38.	SM
11/29/06	15:15	Initiated acid addition to 2H pot.	SM
	17:23	Completed flushing of acid addition lines @2H Evap.	SM
	18:00	Initiated heating of acid in 2H Pot.	SM
	22:22	Initiated 32 hour simmer time for 2H Evaporator. The pot temp is	SM

Date	Time	Activity	Source
		90°C. The simmer will be complete on 12/1/05 @ 5:22	
11/30/06	21:04	Completed flush of 2H Evaporator dip tubes using 38 gallons.	SM
12/1/06	05:30	Completed 32 hour simmer of 2H Evaporator pot with nitric acid. Secured steam to the pot.	SM
	16:17	Placed cooling water on 2H tube bundle. Current pot temperature 79°C.	SM
12/2/06	02:15	Cam lok fitting on caustic tote discharge leaked.	SM
	02:38	Started caustic addition to 2H Evap pot; 50.8 in indicated evap pot level. Temp 27°C.	SM
	03:25	Completed addition of 1st caustic tote to 2H evap pot.	SM
	04:19	Started addition of 2nd caustic addition of 2nd caustic tote.	SN
	05:02	Completed addition of 2nd caustic tote.	SM
	10:25	Completed pulling OH#1 sample at 2H.	SM
	16:40	Shutdown will water to 2H tube bundle.	SM
	17:01	Started pumping to Tk 38.	SM
	17:25	Completed emptying 2H pot.	SM
	17:50	Completed pumping out 2h OH Tk#1.	SM
	21:55	Started well water addition to 2H Evaporator pot to ~98 inches.	SM
	22:53	2H evap pot level reached 95 inches stopped well water addition to evap pot.	SM
	23:32	Started pumping down 2H evap to Tk 38. Initial level 95 inches.	SM
12/3/06	00:27	Completed pump down rate is ~81 gpm.	SM
	12:00	Started 2H Pot inspection between light rains.	SM
	14:10	Completed 2H pot inspection. Still see some scaling on the warming coils and the cone.	SM
12/4/06	21:15	Started adding nitric acid at 2H evap pot. Flow is being raised to a target of 20 gpm.	SM
12/5/06	00:50	Initiated steam to 2H evaporator pit tube bundle. Existing temperature 17°C.	SM
	4:10	2H evap pot reached 85°C. Start 32 hr clock for simmer (1210 12/6/06).	SM
12/6/06	13:10	Notified that the 2H Evaporator TCV is now full open supplying cooling water to tube bundle. Current temp is 84°C.	SM
	22:25	Started adding caustic to 2H Evap.	SM
	22:50	Completed adding the 1st caustic tote in 2H Evap.	SM
12/7/06	01:25	Completed adding 2nd tote to 2H Evap. The 10 hr agitation will be	SM

Date	Time	Activity	Source
		completed at 1125.	
	23:28	Placed steam on 2H to start heatup of the pot. Current temp 28°C.	SM
12/8/06	02:38	2H evap pot reached 85°C. 32 hour simmer started. Time will be up at 1038.	SM
	15:15	2H CRO reported, while trying to adjust steam to the tube bundle, they noticed that the AIV had closed. The tried to reset. Appears there is no power. Call E&I to trouble shoot. Current temp 89°C.	SM
	05:40	E&I found that the breaker may be bad. E&I opened the close breaker and power came back on. Power supplied from HM-242-16H-ELLVlPNL-LV-3 Breaker 3.	SM
	07:30	E&I to investigate 2H evap AIV breaker at LP-3 w/o 732923.	SM
12/9/06	04:31	Simmering of acid @ 2H evap. pot continues until 1040 hr this morning.	SM
	10:50	Completed 32 hr simmer at 2H evaporator between 85-95C.	SM
	14:10	Well water flow has been initiated to the 2H tube bundle for cool down. Starting temp was 77C @ 1332 and current temp is 71C.	SM
	21:52	Initiated caustic addition to 2H pot.	SM
	23:50	Completed emptying 1st caustic tote (~247 gallons).	SM
12/10/06	00:48	Completed addition of 2nd caustic tote to 2H evap. pot level is @71" – total caustic addition to pot is 434 gallons.	SM
	11:57	Secured cooling wtr to 2H evaporator tube bundle.	SM
	12:18	Started pumping neutralization pot contents to Tk 38.	SM
	12:53	Completed emptying of 2H evap pot to Tk 38.	SM
	13:12	Started filling 2H evap pot for well water flush.	SM
	13:45	Completed WW addition to 2H pot 91".	SM
	13:53	Started pump out of 2H evap pot.	SM
	14:32	Completed pump out of 2H evap pot. Performing Chem Clean Shutdown.	SM
12/11/06	10:06	Pulled pug for pot inspection.	SM
	11:35	Completed pot inspection.	SM
	16:08	Started adding the first caustic tote.	SM
	16:38	Completed adding the 1st caustic tote to 2H potl.	SM
	19:35	Completed adding 2 totes for caustic totes (521 gallons) Completed flushing of caustic	SM
	20:07	Completed dip tube flush @ 2H evap. (28 gals).	SM
	20:25	2H tube bundle covered with IW. (Really flush/well water.)	SM

Date	Time	Activity	Source
	20:44	Placed steam on to tube bundle.	SM
12/12/07	04:30	Shutdown steam to tube bundle @ 2H evap.	SM

Log Entries from 28H Control Room Log

Date	Time	Activity	Source
11/20/06	14:13	Initiating Sect 7.12 (Adding Nitric Acid to the Evap Pot)	28H CR
	16:15	Drain Valve to Tanker opened.	28H CR
	16:23	Pump shutdown due to splash at funnel; 1-2 gals on apron; no personnel injury; placing system in safe condition; do not meet entry requirements into AOP-005 due to containment in apron.	28H CR
	22:07	Nitric acid tanker drain valves opened.	28H CR
	22:09	Nitric acid pump started per section 7.12.	28H CR
	22:17	Increased nitric acid flow from 10 gpm to 15 gpm. No leaks or overflow observed.	28H CR
	23:37	Shutdown Nitric acid pump & closed NAS-V-7. Evaporator pot level now @ 61.0” per totalizer reading, 2000 gals nitric acid added/transferred, per conversion table 6.2, 2227 gallons nitric a received into pot, difference = 227 gals.	28H CR
11/21/06	00:05	Began flush of nitric acid addition system per section 7.20.	28H CR
	01:07	Completed section 7.20, Flush of Nitric Acid Addition System, 50 gals flush water used.	28H CR
	01:13	Initiated heating evap pot per section 4.4	28H CR
	02:00	Placed steam on tube bundle per Heating of Evap Pot section 4.4. Initial tube bundle steam flow @ 11 lb/hr.	28H CR
	03:00	Increased tube bundle steam flow from 11 lbm/hr to 100 lbm/hr.	28H CR
	04:01	Increased tube bundle steam flow to 200 lbm/hr, evap pot temp @ 61°C.	28H CR
	05:02	Increased tube bundle steam flow to 300 lbm/hr, evap pot temp @ 80°C.	28H CR

Date	Time	Activity	Source
	05:23	Evap pot temp now @ 90°C. S/M notified. Simmering period has begun.	28H CR
	08:15	Received "CRC FEED TK HI-HI LEVEL CONDUCTIVITY". Responded per ARP.	28H CR
	18:37	Received Evap sump HI LVL COND PROBE; entered 3.7.12 Cond A; Notified Shift Manager.	28H CR
	18:56	Completed shutdown per 4.4 of Chemical Cleaning, due to Evap cell sump cond. probe.	28H CR
11/22/06	04:30	Pump Overheads tank #2 to ETP.	28H CR
	14:06	E&I completed repairs to CRC Feed Tank level loop – low level alarm that had been interlocking pump is clear.	28H CR
	21:10	Completed caustic addition and sampling of Evap cell sump, results are approx pH-12.0.	28H CR
	23:20	Completed jetting Evap cell sump to Tk 43, jetted a total of 315 gallons to Tk 43.	28H CR
11/23/06	00:53	Began heating Evap pot per Sec 4.4 of Chem/Cleaning manual.	28H CR
	05:38	Reached 85°C on the Evap pot temp and began the 11.5 HR simmer time.	28H CR
	17:10	Shutdown Evaporator Pot Heating AIV Closed and Lance GV in AIR 32 hours heating with acid complete.	28H CR
	20:50	Began Evaporator pot cool down per Sec 7.14 of SW9.2-IOP-EVAP-16H(CC)-1 (Tube Bundle Cooling Water Operations).	28H CR
11/24/06	03:55	Due to observation of higher than expected pot press while agitation with portable through bypass in preparation for caustic addition, the decision has been made to secure cooling water flow and portable air compressor and consult engineering for path forward.	28H CR
	14:23	S/D portable A/C for Maintenance to change filter on lance GV.	28H CR
11/25/06	04:39	Started placing air on lance by portable air compressor.	28H CR
	05:30	Removed air to lance via portable air comp due to not achieving 45 scfm's. Lance reached between 25-30 scfm's and pot press reached 20" WC. Prior to putting lance on pot level is 44.1, flash tank ≈20", CRC pump tank 3.4 and after lance was removed, pot level 44.0, flash tank level 30", and CRC pump tank is 9.2".	28H CR
	05:43	Lance GV discharge pressure is still at 4 psi with compressor	28H

Date	Time	Activity	Source
		shutdown.	CR
	09:21	PA-V-1159 & 2075 were manipulated closed & open respectively to support lance GV PA filter. Purpose is to check air flow.	28H CR
	09:28	With lance GV PA filter removed air flow read 50-75 scfm.	28H CR
	09:39	Closed WEE-V-25 & opened PA-V-1177 & opened WEE-V-22 for E&I/Maint to check air flow.	28H CR
	09:45	Air flow @ WEE-V-22 was 30 scfm.	28H CR
	09:53	The following valves were restored to previous position(s): PA-V-1159 OPEN, WEE-V-25 Open, PA-V-2075 Closed, PA-V-1177 Closed and WEE-V-22 Closed.	28H CR
	9:57	Maintenance informed CRO that they will troubleshoot four areas of concern for restriction of air flow. The four areas are PA-V-1176 (check valve), PA-V-1177 (Lance GV Bypass), PA-FO-13 (Flow orifice on Lance GV Bypass) & WEE-STR-4 (Strainer #4).	28H CR
	14:43	HLWM began troubleshooting cause of airflow restriction at 16H evaporator.	28H CR
	15:00	L/T HTF-06-0687 installed on for HLWM to T/S components of the 16H evaporator plant air system. (Checking for air flow restrictions).	28H CR
	15:10	HLWM reported that the (check valve) @ PA-V-1176 was removed, air compressor started to pressurize system.	28H CR
	15:54	HLWM informed 28H control rm that they were finished with the flow test on the 16H evaporator at this time. L/T HTF-06-0687 removed from 16H Evaporator plant air system. Check valve @ PA-V-1176 re-installed. Troubleshooting to continue.	28H CR
	19:28	The new portable air compressor SRO#5259 has been staged @ 16H Evap and is on progress of being hooked up.	28H CR
	22:30	Air comp #5159 @ 16H Evap has been replaced with SRO #5268.	28H CR
11/26/06	10:00	Completed troubleshooting A/C at 16H Evap.	28H CR
	13:50	Placed lance GV in airblow for pot agitation.	28H CR
	14:05	Placed lance GV in vent after a 15 minute agitation.	28H CR

Date	Time	Activity	Source
	22:05	Installing L/T HTF-06-0688 for Maint to remove bypass line @ lance GV for I&M to perform inspection to check for obstructions in lance line.	28H CR
11/27/06	01:54	Removing L/T HTF-06-0688 from Lance GV.	28H CR
	23:00	Completed putting air on Lance GV.	28H CR
	23:20	Completed putting water on tube bundle.	28H CR
11/28/06	4:59	Completed empting 1st 220 gals of caustic into pot.	28H CR
	8:45	Completed adding caustic, added 183 gal.	28H CR
	10:30	Started 10 hr agitation cycle.	28H CR
	15:33	Performed shutdown of cooling water to the tube bundle per 7.14.	28H CR
	20:30	Completed 10 hr agitation of pot content.	28H CR
	21:14	Began pumping evap pot content to Tk 38. Level 317.63".	28H CR
	21:52	Began adding well water to evaporator pot per sec 4.3.	28H CR
	22:30	Completed adding well water to evaporator pot 63.8".	28H CR
	22:34	Began pumping evap content to Tk 38.	28H CR
	23:02	Completed pumping content to Tk 38. level 318.25".	28H CR
11/29/06	15:15	Began acid addition into evaporator pot @ approx 5 gpm.	28H CR
	15:20	Increased acid flow to approx 10 gpm. per sec 7.12 of Chem Clean manual.	28H CR
	16:36	Unloading of the nitric acid tanker is complete. Evaporator pot level is 56.1" received 2,073 gallons of nitric into pot.	28H CR
	17:23	Completed shutdown of acid addition and nitric acid flush using approx 50 gallons of flush water for flush.	28H CR
	18:00	Placed steam on tube bundle per Sec 4.5 of Evap Chem/Clean manual.	28H CR

Date	Time	Activity	Source
	21:22	Began pot simmering period 32 hr simmering period ends 12/2/06 @ 5:22 hrs.	28H CR
11/30/06	19:18	Started adding well water to the pot per sec 4.3. This was done due to a decrease in pot level per sec 4.4.	28H CR
	19:37	Completed adding well water to the pot per sect 4.3. Temp of pot is 89.5. Did not go below 85° low limit.	28H CR
	20:41	Started automatic dip tube flush per 5.1 due to pot level comparison being > 3".	28H CR
	21:04	Completed automatic dip tube flush. Used 38 gals FW.	28H CR
12/1/06	05:30	32 hr simmer of evaporator pot completed. Began subsection 4.4.3, shutdown of heating evaporator pot.	28H CR
	14:10	Caustic has been added to evaporator cell sump (25 gals). Agitated for 30 minutes and sampled. pH results are 11.	28H CR
	15:33	Completed jetting 323 gals out of evaporator cell sump to Tk 43.	28H CR
	16:11	Tube bundle pressurized with water.	28H CR
	20:25	Evaporator pot temperature reached 39°C at 2000 hrs.	28H CR
12/2/06	01:25	Placed the lance portable air compressor on line; all parameters are within limits; pot pressure is varying between 19.1 and 19.6.	28H CR
12/2/06	01:30	Had to stop caustic addition procedure to have maintenance investigate leak discovered when unloading hose was pressurized with flush water.	28H CR
	02:25	Maintenance successfully repaired leaking cam-lok on caustic tote.	28H CR
	03:23	Shutdown pump due to loss of prime to empty tote; estimated of 220 gals of caustic added to pot; level is 59.1"; temperature is 48°C; R&HE has arrived to change out totes.	28H CR
	04:19	Started caustic pump to empty the second tote.	28H CR
	05:01	Pump shutdown due to loss of prime; pot level 64.8"; pot temperature is 54°C.	28H CR
	05:33	Estimated that a total of 459 gallons of caustic was added to the evaporator pot.	28H CR
	06:20	Initiated the 10 hour agitation time.	28H CR
	16:40	Completed removing cooling water from tube bundle per	28H

Date	Time	Activity	Source
		SW9.2-IOP-EVAP-16H(CC)-1 Sec. 7.14.3	CR
	17:01	Started to empty evap pot to Tk 38.	28H CR
	17:29	Completed empting evap pot to Tk 38.	28H CR
	21:55	Started filling the evaporator pot with well water.	28H CR
	22:13	Received OH cell sump HI Level bubbler. Stopped WW addition until source of leakage can be determined.	28H CR
	22:30	Sump increase was due to dip tube.	28H CR
	22:34	Re-initiated well water addition to evaporator pot.	28H CR
	22:53	Completed filling evaporator pot to 95".	28H CR
	23:42	Started pumping evaporator pot to Tank 38. Level 319.05.	28H CR
12/3/07	00:27	Completed pumping evaporator pot to Tank 38. Level 319.96 3194 gallons FW.	28H CR
	09:30	Completed prejob brief for I&M to install camera in 16H Evaporator pot to perform inspection.	28H CR
12/4/07	21:24	Nitric acid pump started.	28H CR
	21:25	Flow seen at the funnel; flow at 5.2 gpm.	28H CR
	21:37	Flow of nitric acid pump at 20 gpm.	28H CR
	22:58	Shutdown nitric acid pump due to levels between 53" and 61" (53.1" Blue and 54.2" Red).	28H CR
12/5/06	00:50	Placed steam on tube bundle to initiate heat-up portion of chem clean section 4.4.	28H CR
	04:10	Reached 85°C in pot; 32 simmer time initiated; end of 32 hour simmer is 12/06/06 @ 12:20.	28H CR
12/6/06	12:11	Completed heating evaporator pot per section 4.4.	28H CR
	17:45	Completed cooling the evaporator pot.	28H CR
	20:48	Completed installing portable air on the lance GV per SW9.2-IOP-EVAP-16H(CC)-1 section 7.23.	28H CR

Date	Time	Activity	Source
	22:24	Caustic pump started to empty 1st container into evaporator pot.	28H CR
	22:50	Completed empting 1st container into evaporator pot.	28H CR
12/7/06	01:04	Caustic pump started to empty 2nd container into evaporator pot.	28H CR
	01:23	Completed emptying 2nd container of caustic into evaporator pot. 10 hour simmer time has begun.	28H CR
	9:03	Secured cooling water to tube bundle.	28H CR
	11:26	Completed 10 hrs simmer of evaporator pot.	28H CR
	11:59	Begin pumping evaporator pot to Tk 38 level 319.86" pot level at 64.0".	28H CR
	12:22	Completed pumping evaporator pot to Tk 38.	28H CR
	12:26	Began filling pot with well water.	28H CR
	13:00	Completed filling evaporator pot with well water.	28H CR
	13:03	Began pumping evaporator pot to Tk 38 level 320.42".	28H CR
	13:45	Completed pump evaporator to Tk 38, also performed shutdown per sec 4.6.	28H CR
	20:21	Started adding nitric acid to evaporator pot.	28H CR
	21:45	Completed adding nitric acid to evaporator pot. Added 2060 gallons.	28H CR
	23:28	Placed steam on tube bundle pre section 4.4.	28H CR
12/8/06	02:38	Reached 85°C.	28H CR
	02:58	Removed steam from the tube bundle.	28H CR
	05:35	E&I found bad breaker for AIV.	28H CR
	08:58	E&I completed changing breaker that feed the AIV. Breaker was determined to be faulty by E&I on previous shift when AIV inadvertently closed during pot heatup.	28H CR

Date	Time	Activity	Source
12/09/06	07:35	Entered AOP-009 for loss of steam.	28H CR
	07:45	SUD reported that a transmitter had frozen causing steam supply valve to close. Steam being supplied manually by SUD.	28H CR
	13:32	Completed establishing cooling water flow through tube bundle.	28H CR
	18:07	Reached 39° on pot temperature.	28H CR
	21:52	Started adding caustic.	28H CR
12/10/06	00:48	Completed caustic addition to the pot, 434 gallons.	28H CR
	01:20	Completed flushing of the caustic line the 10 hour agitation starts now and will be up at 11:20 today.	28H CR
	11:57	Cooling water has been secured to the tube bundle.	28H CR
	12:18	Started pumping evaporator pot to Tk 38 per section 4.6.	28H CR
	12:53	Completed emptying evaporator pot per section 4.6.	28H CR
	13:12	Started filling evaporator pot with well water per section 4.3.	28H CR
	13:45	Completed filling evaporator pot with well water per section 4.3.	28H CR
	13:52	Started pumping evaporator pot per section 4.6.	28H CR
	14:33	Completed pumping evaporator pot to Tk38 per section 4.6.	28H CR
12/11/06	12:35	Completed camera inspection on 16H evaporator and riser plug has been installed.	28H CR
	16:08	Started adding first tote of caustic to pot.	28H CR
	16:38	Completed adding first tote of caustic.	28H CR
	17:36	Started adding second tote of caustic.	28H CR
	18:17	Completed adding 521 gals of caustic to evaporator pot.	28H CR
	19:43	Completed demister flush, used 337 gallons flush water.	28H

Date	Time	Activity	Source
			CR
	20:07	Completed flushing the evaporator dip tube, used 28.0 gallons.	28H CR
	20:35	Completed filling the evaporator pot, final level is 61.5 inches. Added approx 1642 gallons.	28H CR
	20:44	Started evaporator pot heat up per SW9.2-IOP-EVAP-16H(CC)-1, section 5.4 Starting pot temperature 40°C.	28H CR
12/12/06	00:30	Evaporator pot reached temperature of 100°C.	28H CR
	04:30	Shutdown steam to the evaporator tube bundle.	28H CR
	05:02	Completed operation of evaporator cell sprays per SW9.2-IOP-EVAP-16H, section 8.8. Added 196 gallons flush water to cell sump.	28H CR
	10:05	Completed adding 35 gallons of caustic to evaporator cell.	28H CR
	13:22	Completed jetting evaporator cell sump to Tank 43. Jetted 444 gallons.	28H CR
12/20/06	22:14	Steam on to tube bundle. Normal evaporator operation resumed.	28H CR

APPENDIX B. LESSONS LEARNED DURING OUTAGE

The Chemical Cleaning of the 242-16H (2H) Evaporator using nitric acid in December 2006 was the third pot cleaning. The second chemical cleaning used pure 19M sodium hydroxide (NaOH). This method was tried since the impact on the Documented Safety Basis (DSA) was minimal. The lesson learned from the use of NaOH was that although the scale dissolved, the rate was not fast enough to support the H Tank Farm (HTF) mission.

The differences between the acid cleaning evolutions are as follows:

May 2001	December 2006
Used 1.5M nitric acid containing depleted Uranyl Nitrate.	Used commercial grade 1.5M nitric acid.
The pot was cleaned to a true level of approximately 95 inches.	The pot was cleaned to a true level of approximately 55 inches.
Required the used of a 5,000 gallon neutralization tank.	Neutralization was performed in the pot.
Neutralized waste was transferred to Tank 42.	Neutralized waste was transferred to Tank 38.
Neutralized waste was discharged directly into the tank.	Neutralized waste was discharged below the waste surface.

To minimize cost and schedule, the May 2001 system design, equipment and arrangements were used. The same lift jumper was used except it was redesigned to connect to the wall nozzle to Tank 38 instead of Tank 42. In addition a second isolation valve was added to support a DSA requirement for double valve isolation when acid was in the pot. The only problem encountered during operation of the lift jumper is that it initially failed to pump waste from the pot. After much troubleshooting it was determined that there was blockage in the east lift line. The evaporator cell covers and the lift jumper had to be removed, and the lift line pressure washed to remove the plug. Once the line was cleaned, no additional problems were encountered.

It was determined that evaporator cleaning would be required on a periodic basis and that the acid/caustic cleaning system design should be revised to support repeated use. Whereas the 2001 system was considered to be a one time use only, system arrangement and extended operational life was not a consideration.

The caustic addition flow rate was required to be low to control the exothermic reaction between the acid and caustic. During testing a concern was raised that the pump head was not sufficient to deliver the caustic to the funnel because in 2001 the caustic was pumped to a temporary neutralization tank. Although the pump head was sufficient to handle the elevation difference, the total line losses were not known. To ensure that there was adequate suction and discharge head, the caustic pump was replaced with a higher capacity pump.

It was also learned during shop testing that the flow rate of water was not as expected considering the capacity of the pump. The original design required the use of cam lock connections without a check valve. Engineering decided to use Hansen quick disconnect fittings to reduce the possibility of acid and caustic leaks during hose disconnection. After the check valves in the Hansen connectors were removed, the flow was as expected. Additionally, since operational life of the original system was not a concern, the chemical compatibility of its gaskets was not evaluated. The increase in operational life identified various gaskets and seals which were not compatible for long term contact with either the acid or the caustic. It was discovered in the testing phase that the Hansen connector seal components contained some of these incompatible materials which required removal and replacement before the system could be placed in service. Vendor drawing did not show these O-rings nor did it provide a part number for the required O-rings. The need for EPDM gaskets for the Hansen disconnects was verbally communicated to Work Control. Work Control relayed the information to Procurement. Teflon gaskets were received instead and the EPDM gaskets had to be reordered. It is possible that the right gaskets were ordered but the wrong gaskets were sent by the vendor.

Although the flexible hoses did not leak during the evaporator cleaning operations, problems were encountered by the supplier. The flexible hose supplier claimed that the hoses were hydrostatically test and passed. But when Maintenance performed a verification hydrostatic test as part of the assembled system post modification test many of them leaked. Upon investigation it was learned that the first vendor did not have the capability of crimping the hose as required. Therefore, the work was subcontracted and the subcontractor did not hydrostatically test the hoses properly. In the future, when there is a requirement for adding hose ends and hydrostatic testing is required, the hoses will be ordered from a vendor who is capable of performing both tasks. This will ensure receipt of a quality product.

When the chemical addition skid was first positioned at the evaporator and the hoses connected, the hoses were to short. After rotating the skid 180°, the hoses were too long. Again, disciplined reviews by Engineering, Operations, and Maintenance were not adequate and caused rework.

Another Engineering lesson learned was associated with the air flow to the evaporator lance for mixing the acid and the caustic. The same flow meter was specified as used in May 2001. However, when air was applied, the desired mixing flow rate was not achieved. After much field testing it was finally realized that the flow meter was not calibrated for the pressure and temperature at which it was being operated. After the formula was obtained from the vendor to determine a correction factor, the equipment performed satisfactorily.

Since much of the process used for the December 2006 was the same as used in May 2001, many of the same procedures were used. The primary changes to the procedures were the result of the different DSA requirements and not using a neutralization tank. This led some operations personnel to believe that the water runs using the procedures were not required. As one can see by reviewing the Shift Manager's and control room operator's log books, water runs should have been conducted. Fortunately, only a small acid spill occurred during the cleaning activities.

In general, the problems encountered during the 2006 chemical cleaning of the 2H Evaporator pot were minimal in part due to reviewing lessons learned from 2001. The primary lesson learned from this cleaning effort is "Do not assume that what worked last time will work next time unless disciplined reviews by Engineering, Operations, and Maintenance are managed consistent with desired priorities."

APPENDIX C. 2H POT MEASUREMENTS

Batch 1 Heating

Batch #1 Duration	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	TUBE BDL FL #2 Ch2 RED	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0	11/21/06 2:00	1.70	1.09	1.07	23	10	62.5	63.7
0.5	11/21/06 2:30	1.83	1.09	1.07	29	11	62.6	64.0
1.0	11/21/06 3:00	1.61	1.09	1.07	40	101	63.1	64.2
1.5	11/21/06 3:30	1.68	1.09	1.07	48	106	63.2	64.7
2.0	11/21/06 4:00	1.78	1.08	1.06	58	106	63.4	64.9
2.5	11/21/06 4:30	1.85	1.07	1.06	70	201	63.9	65.5
3.0	11/21/06 5:00	1.76	1.07	1.05	80	203	64.3	65.7
3.5	11/21/06 5:30	1.74	1.06	1.04	93	203	64.4	66.6
4.0	11/21/06 6:00	1.56	1.06	1.04	91	0	64.4	66.1
4.5	11/21/06 6:30	1.78	1.07	1.04	89	0	64.0	65.8
5.0	11/21/06 7:00	1.92	1.06	1.04	88	0	64.0	65.7
5.5	11/21/06 7:30	2.27	1.06	1.04	86	0	63.7	65.3
6.0	11/21/06 8:00	2.50	1.07	1.05	88	89	63.9	65.2
6.5	11/21/06 8:30	2.37	1.06	1.05	93	0	64.0	65.5
7.0	11/21/06 9:00	2.71	1.06	1.05	91	0	63.4	65.1
7.5	11/21/06 9:30	2.80	1.06	1.05	89	0	63.3	64.7
8.0	11/21/06 10:00	2.87	1.07	1.05	88	0	63.2	64.6
8.5	11/21/06 10:30	3.01	1.07	1.05	86	0	63.0	64.7
9.0	11/21/06 11:00	3.99	1.06	1.05	91	84	63.0	65.1
9.5	11/21/06 11:30	2.54	1.03	1.04	93	0	63.0	64.6
10.0	11/21/06 12:00	2.86	1.06	1.04	91	0	62.6	64.4
10.5	11/21/06 12:30	3.02	1.06	1.04	89	0	62.5	64.0
11.0	11/21/06 13:00	3.31	1.06	1.04	88	0	62.6	63.8
11.5	11/21/06 13:30	3.14	1.06	1.04	87	0	62.1	63.6
12.0	11/21/06 14:00	4.03	1.06	1.04	89	85	62.2	63.2
12.5	11/21/06 14:30	3.12	1.06	1.04	94	0	62.7	63.9
13.0	11/21/06 15:00	3.16	1.06	1.04	91	0	62.7	63.0
13.5	11/21/06 15:30	2.98	1.06	1.04	90	0	62.6	63.1
14.0	11/21/06 16:00	3.25	1.06	1.04	88	0	61.6	63.1
14.5	11/21/06 16:30	3.62	1.07	1.04	87	0	60.6	63.1
15.0	11/21/06 17:00	4.31	1.08	1.04	90	70	60.3	62.9
15.5	11/21/06 17:30	3.59	1.08	1.03	93	0	60.0	62.9
16.0	11/21/06 18:00	3.33	1.07	1.03	91	0	60.2	63.1
16.5	11/21/06 18:30	3.82	1.08	1.03	89	0	59.4	63.1
17.0	11/21/06 19:00	3.40	1.00	1.00	88	0	59.0	63.0
17.5	11/21/06 19:30	0.04	1.00	1.00	87	0	59.0	61.0
18.0	11/21/06 20:00	0.02	1.00	1.00	87	0	59.0	61.0
18.5	11/21/06 20:30	0.01	1.00	1.00	87	0	59.0	61.0
19.0	11/21/06 21:00	0.01	1.00	1.00	86	0	59.0	61.0
19.5	11/21/06 21:30	0.01	1.00	1.00	86	0	59.0	61.0
20.0	11/21/06 22:00	0.00	0.00	0.00	0	0	0.0	0.0
20.5	11/21/06 22:30	0.00	0.00	0.00	0	0	0.0	0.0
21.0	11/21/06 23:00	0.00	0.00	0.00	0	0	0.0	0.0
21.5	11/21/06 23:30	0.00	0.00	0.00	0	0	0.0	0.0
22.0	11/22/06 0:00	0.00	0.00	0.00	0	0	0.0	0.0
22.5	11/22/06 0:30	0.00	0.00	0.00	0	0	0.0	0.0
23.0	11/22/06 1:00	0.00	0.00	0.00	0	0	0.0	0.0
23.5	11/22/06 1:30	0.00	0.00	0.00	0	0	0.0	0.0
24.0	11/22/06 2:00	0.00	0.00	0.00	0	0	0.0	0.0
24.5	11/22/06 2:30	0.00	0.00	0.00	0	0	0.0	0.0
25.0	11/22/06 3:00	0.00	0.00	0.00	0	0	0.0	0.0
25.5	11/22/06 3:30	0.00	0.00	0.00	0	0	0.0	0.0
26.0	11/22/06 4:00	0.00	0.00	0.00	0	0	0.0	0.0
26.5	11/22/06 4:30	0.00	0.00	0.00	0	0	0.0	0.0
27.0	11/22/06 5:00	0.00	0.00	0.00	0	0	0.0	0.0
27.5	11/22/06 5:30	0.00	0.00	0.00	0	0	0.0	0.0
28.0	11/22/06 6:00	0.00	0.00	0.00	0	0	0.0	0.0
28.5	11/22/06 6:30	0.00	0.00	0.00	0	0	0.0	0.0
29.0	11/22/06 7:00	0.00	0.00	0.00	0	0	0.0	0.0
29.5	11/22/06 7:30	0.00	0.00	0.00	0	0	0.0	0.0
30.0	11/22/06 8:00	0.00	0.00	0.00	0	0	0.0	0.0
30.5	11/22/06 8:30	0.00	0.00	0.00	0	0	0.0	0.0
31.0	11/22/06 9:00	0.00	0.00	0.00	0	0	0.0	0.0
31.5	11/22/06 9:30	0.00	0.00	0.00	0	0	0.0	0.0
32.0	11/22/06 10:00	0.00	0.00	0.00	0	0	0.0	0.0
32.5	11/22/06 10:30	0.00	0.00	0.00	0	0	0.0	0.0
33.0	11/22/06 11:00	0.00	0.00	0.00	0	0	0.0	0.0
33.5	11/22/06 11:30	0.00	0.00	0.00	0	0	0.0	0.0
34.0	11/22/06 12:00	0.00	0.00	0.00	0	0	0.0	0.0
34.5	11/22/06 12:30	0.00	0.00	0.00	0	0	0.0	0.0
35.0	11/22/06 13:00	0.00	0.00	0.00	0	0	0.0	0.0
35.5	11/22/06 13:30	0.00	0.00	0.00	0	0	0.0	0.0
36.0	11/22/06 14:00	0.00	0.00	0.00	0	0	0.0	0.0
36.5	11/22/06 14:30	0.00	0.00	0.00	0	0	0.0	0.0
37.0	11/22/06 15:00	0.00	0.00	0.00	0	0	0.0	0.0
37.5	11/22/06 15:30	0.00	0.00	0.00	0	0	0.0	0.0
38.0	11/22/06 16:00	0.00	0.00	0.00	0	0	0.0	0.0
38.5	11/22/06 16:30	0.00	0.00	0.00	0	0	0.0	0.0
39.0	11/22/06 17:00	0.00	0.00	0.00	0	0	0.0	0.0
39.5	11/22/06 17:30	0.00	0.00	0.00	0	0	0.0	0.0
40.0	11/22/06 18:00	0.00	0.00	0.00	0	0	0.0	0.0
40.5	11/22/06 18:30	0.00	0.00	0.00	0	0	0.0	0.0
41.0	11/22/06 19:00	0.00	0.00	0.00	0	0	0.0	0.0
41.5	11/22/06 19:30	0.00	0.00	0.00	0	0	0.0	0.0
42.0	11/22/06 20:00	0.00	0.00	0.00	0	0	0.0	0.0
42.5	11/22/06 20:30	0.00	0.00	0.00	0	0	0.0	0.0
43.0	11/22/06 21:00	0.00	0.00	0.00	0	0	0.0	0.0
43.5	11/22/06 21:30	0.00	0.00	0.00	0	0	0.0	0.0
44.0	11/22/06 22:00	0.00	0.00	0.00	0	0	0.0	0.0
44.5	11/22/06 22:30	0.00	0.00	0.00	0	0	0.0	0.0
45.0	11/22/06 23:00	0.00	0.00	0.00	0	0	0.0	0.0
45.5	11/22/06 23:30	0.00	0.00	0.00	0	0	0.0	0.0
46.0	11/23/06 0:00	0.00	0.00	0.00	0	0	0.0	0.0
46.5	11/23/06 0:30	0.00	0.00	0.00	0	0	0.0	0.0
47.0	11/23/06 1:00	0.07	1.00	1.00	72	99	59.0	60.0
47.5	11/23/06 1:30	2.03	1.00	1.00	72	99	59.0	60.0
48.0	11/23/06 2:00	0.10	1.00	1.00	72	99	59.0	60.0
48.5	11/23/06 2:30	0.24	1.00	1.00	72	191	58.0	60.0
49.0	11/23/06 3:00	0.23	1.00	1.00	72	290	57.0	60.0
49.5	11/23/06 3:30	0.07	1.00	1.00	72	294	55.0	59.0
50.0	11/23/06 4:00	0.00	1.00	1.00	72	392	55.0	58.0
50.5	11/23/06 4:30	0.14	1.00	1.00	73	400	56.4	57.2
51.0	11/23/06 5:00	0.50	1.00	1.00	73	500	54.0	55.0
51.5	11/23/06 5:30	3.90	1.00	1.00	79	500	52.0	53.0
52.0	11/23/06 6:00	0.37	1.00	1.00	92	0	51.5	52.2
52.5	11/23/06 6:30	2.70	1.00	1.00	95	0	51.2	50.7
53.0	11/23/06 7:00	0.00	1.00	1.00	94	0	51.0	51.4
53.5	11/23/06 7:30	0.00	0.99	0.99	92	0	51.3	51.9
54.0	11/23/06 8:00	0.00	0.99	0.99	91	45	50.8	51.3
54.5	11/23/06 8:30	0.11	1.01	0.99	94	40	49.0	50.6
55.0	11/23/06 9:00	0.06	1.02	0.99	94	0	49.7	50.4
55.5	11/23/06 9:30	0.00	0.99	0.90	94	0	50.0	50.4
56.0	11/23/06 10:00	0.01	1.01	0.99	94	0	49.0	50.6
56.5	11/23/06 10:30	2.65	0.99	0.99	93	0	49.5	50.2
57.0	11/23/06 11:00	0.00	1.09	0.99	92	0	45.0	50.1
57.5	11/23/06 11:30	0.06	1.10	0.99	92	0	44.9	50.1
58.0	11/23/06 12:00	0.01	1.10	0.99	91	0	45.4	50.6
58.5	11/23/06 12:30	0.07	1.10	0.99	91	0	45.5	50.7
59.0	11/23/06 13:00	0.03	1.09	0.99	91	0	45.9	51.0
59.5	11/23/06 13:30	0.00	1.10	0.99	91	0	45.6	51.1
60.0	11/23/06 14:00	0.06	1.10	0.99	91	0	45.6	51.1
60.5	11/23/06 14:30	0.02	1.11	0.99	91	0	45.6	51.3
61.0	11/23/06 15:00	0.09	1.11	0.99	91	0	45.7	51.3
61.5	11/23/06 15:30	0.00	1.11	0.99	91	0	45.7	51.3
62.0	11/23/06 16:00	0.04	1.11	0.99	94	0	46.2	51.6
62.5	11/23/06 16:30	0.00	1.11	0.99	93	0	46.0	51.4
63.0	11/23/06 17:00	0.01	1.12	0.99	92	0	45.1	51.2
63.5	11/23/06 17:30	2.60	1.12	0.99	94	0	42.9	51.2

Batch 2 Heating

Batch #2 Duration	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	TUBE BDL FL #2 Ch2 RED	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0	11/29/06 18:00	1.92	1.00	1.00	24	100	57.7	59.0
0.0	11/29/06 18:30	1.90	1.06	1.04	35	100	58.0	59.3
0.0	11/29/06 19:00	1.80	1.06	1.04	42	165	28.1	59.5
0.0	11/29/06 19:30	2.02	1.06	1.04	51	192	58.4	59.8
0.0	11/29/06 20:00	2.08	1.05	1.03	62	191	58.7	60.1
0.0	11/29/06 20:30	2.17	1.04	1.03	73	235	59.3	60.6
0.0	11/29/06 21:00	2.21	1.03	1.02	84	236	59.7	61.1
0.0	11/29/06 21:30	2.05	1.06	1.02	92	0	59.8	61.4
0.5	11/29/06 22:00	1.62	1.03	1.02	90	0	59.6	61.0
1.0	11/29/06 22:30	1.75	1.04	1.02	88	0	59.2	60.7
1.5	11/29/06 23:00	2.69	1.03	1.02	92	0	59.2	60.9
2.0	11/29/06 23:30	2.00	1.03	1.02	90	0	59.2	60.7
2.5	11/30/06 0:00	2.20	1.04	1.02	89	0	59.1	60.3
3.0	11/30/06 0:30	2.70	1.03	1.01	93	0	59.1	60.7
3.5	11/30/06 1:00	2.60	1.03	1.02	93	0	58.7	30.2
4.0	11/30/06 1:30	2.60	1.03	1.02	92	0	58.5	59.9
4.5	11/30/06 2:00	2.70	1.04	1.02	89	0	58.1	59.5
5.0	11/30/06 2:30	3.10	1.04	1.02	92	75	58.1	59.4
5.5	11/30/06 3:00	2.70	1.04	1.02	91	0	60.0	60.8
6.0	11/30/06 3:30	3.00	1.04	1.02	89	0	57.5	58.7
6.5	11/30/06 4:00	2.70	1.04	1.02	88	75	57.5	58.8
7.0	11/30/06 4:30	3.70	1.03	1.02	93	0	57.6	59.0
7.5	11/30/06 5:00	3.50	1.03	1.01	93	0	57.2	58.6
8.0	11/30/06 5:30	3.00	1.04	1.02	93	0	56.9	58.3
8.5	11/30/06 6:00	3.00	1.04	1.02	91	0	56.6	57.9
9.0	11/30/06 6:30	3.49	1.04	1.03	89	0	56.3	57.7
9.5	11/30/06 7:00	3.10	1.04	1.03	88	0	56.2	57.4
10.0	11/30/06 7:30	3.64	1.04	1.03	87	0	55.9	57.3
10.5	11/30/06 8:00	4.00	1.04	1.03	91	100	56.0	57.5
11.0	11/30/06 8:30	3.37	1.04	1.02	90	0	56.0	57.2
11.5	11/30/06 9:00	3.39	1.04	1.02	88	0	55.0	57.0
12.0	11/30/06 9:30	3.42	1.04	1.01	92	0	55.8	57.2
12.5	11/30/06 10:00	3.65	1.04	1.02	90	0	55.2	56.8
13.0	11/30/06 10:30	3.30	1.00	1.00	89	0	55.0	56.0
13.5	11/30/06 11:00	3.20	1.00	1.00	88	0	55.0	56.0
14.0	11/30/06 11:30	3.90	1.00	1.00	88	0	55.0	56.0
14.5	11/30/06 12:00	3.70	1.00	1.00	94	0	55.0	57.0
15.0	11/30/06 12:30	3.70	1.00	1.00	92	0	55.0	57.0
15.5	11/30/06 13:00	3.80	1.00	1.00	90	0	55.0	57.0
16.0	11/30/06 13:30	4.09	1.00	1.00	88	0	54.9	56.0
16.5	11/30/06 14:00	3.60	1.00	1.00	87	0	55.0	56.0
17.0	11/30/06 14:30	3.30	1.00	1.00	93	0	56.0	57.0
17.5	11/30/06 15:00	4.00	1.00	1.00	92	0	54.0	57.0
18.0	11/30/06 15:30	3.70	1.00	1.00	92	0	54.0	56.0
18.5	11/30/06 16:00	3.90	1.00	1.00	92	0	54.0	56.0
19.0	11/30/06 16:30	3.90	1.00	1.00	93	0	53.0	55.0
19.5	11/30/06 17:00	3.35	1.00	1.00	93	0	53.0	56.0
20.0	11/30/06 17:30	4.32	1.00	1.00	93	0	53.0	55.0
20.5	11/30/06 18:00	0.00	1.00	1.00	93	0	52.0	54.0
21.0	11/30/06 18:30	4.20	1.00	1.00	94	0	52.6	55.0
21.5	11/30/06 19:00	4.30	1.00	1.00	93	0	52.2	55.1
22.0	11/30/06 19:30	5.20	1.02	1.00	91	93	58.1	60.5
22.5	11/30/06 20:00	4.00	1.01	1.00	91	0	59.5	60.4
23.0	11/30/06 20:30	4.10	1.03	1.00	90	0	57.5	60.2
23.5	11/30/06 21:00	2.00	1.05	1.02	87	0	57.7	59.3
24.0	11/30/06 21:30	2.30	1.04	1.02	92	75	57.7	59.6
24.5	11/30/06 22:00	2.00	1.04	1.02	92	0	57.4	59.2
25.0	11/30/06 22:30	1.90	1.04	1.02	90	0	57.3	59.0
25.5	11/30/06 23:00	2.70	1.04	1.02	93	0	57.0	59.0
26.0	11/30/06 23:30	2.60	1.04	1.02	93	0	56.7	58.7
26.5	12/1/06 0:00	2.10	1.05	1.01	93	0	56.7	58.7
27.0	12/1/06 0:30	2.90	1.05	1.01	91	0	56.2	58.2
27.5	12/1/06 1:00	2.40	1.05	1.02	90	0	56.2	58.2
28.0	12/1/06 1:30	2.40	1.05	1.01	93	0	56.0	58.1
28.5	12/1/06 2:00	2.40	1.05	1.02	91	0	55.7	56.6
29.0	12/1/06 2:30	2.70	1.05	1.02	89	0	55.4	57.2
29.5	12/1/06 3:00	3.00	1.05	1.02	93	0	55.5	57.5
30.0	12/1/06 3:30	2.90	1.05	1.02	93	0	55.5	57.6
30.5	12/1/06 4:00	2.50	1.04	1.01	94	0	54.7	56.7
31.0	12/1/06 4:30	2.50	1.05	1.02	91	0	54.1	56.0
31.5	12/1/06 5:00	2.80	1.05	1.02	90	0	54.0	55.9
32.0	12/1/06 5:30	2.70	1.05	1.02	87	0	53.7	55.5

Batch 3 Heating

Batch #3 Duration	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	TUBE BDL FL #2 Ch2 RED	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.5	12/5/06 1:00	2.10	1.06	1.04	19	10	54.6	55.9
1.0	12/5/06 1:30	2.20	1.06	1.04	27	11	54.6	56.1
1.5	12/5/06 2:00	2.00	1.05	1.04	37	101	55.1	56.3
2.0	12/5/06 2:30	1.9	1.05	1.04	47	39	55.4	56.7
2.5	12/5/06 3:00	2.10	1.05	1.04	57	47	55.5	56.5
3.0	12/5/06 3:30	2.30	1.04	1.03	69	85	55.9	57.3
3.5	12/5/06 4:00	2.50	1.03	1.02	81	90	56.9	57.8
4.0	12/5/06 4:30	3.01	1.02	1.00	92	160	56.9	58.4
4.5	12/5/06 5:00	2.17	1.03	1.00	93	195	56.5	58.3
5.0	12/5/06 5:30	2.80	1.02	1.00	90	225	56.1	57.9
5.5	12/5/06 6:00	2.80	1.03	1.00	89	243	56.1	57.6
6.0	12/5/06 6:30	3.70	1.03	1.01	90	0	55.7	57.6
6.5	12/5/06 7:00	3.50	1.03	1.01	90	0	55.8	57.3
7.0	12/5/06 7:30	3.60	1.03	1.01	88	0	55.5	57.1
7.5	12/5/06 8:00	4.00	1.03	1.00	90	0	55.5	57.0
8.0	12/5/06 8:30	3.50	1.03	1.01	89	0	55.3	56.9
8.5	12/5/06 9:00	3.80	1.03	1.01	88	0	55.0	56.7
9.0	12/5/06 9:30	4.50	1.03	1.01	92	0	55.0	56.8
9.5	12/5/06 10:00	3.50	1.03	1.01	90	0	54.9	56.6
10.0	12/5/06 10:30	3.30	1.03	1.01	89	0	54.8	56.1
10.5	12/5/06 11:00	3.50	1.03	1.01	87	30	54.3	56.2
11.0	12/5/06 11:30	3.60	1.03	1.01	91	0	54.3	56.1
11.5	12/5/06 12:00	3.40	1.03	1.01	89	0	54.2	55.8
12.0	12/5/06 12:30	4.10	1.03	1.01	87	0	54.1	55.4
12.5	12/5/06 13:00	4.50	1.03	1.01	91	0	53.9	55.7
13.0	12/5/06 13:30	4.30	1.03	1.01	93	0	53.9	55.8
13.5	12/5/06 14:00	3.70	1.03	1.01	90	0	53.4	55.2
14.0	12/5/06 14:30	4.00	1.03	1.01	89	0	53.1	55.0
14.5	12/5/06 15:00	3.60	1.03	1.01	87	0	53.1	54.7
15.0	12/5/06 15:30	4.30	1.03	1.01	86	23	53.1	54.7
15.5	12/5/06 16:00	4.50	1.03	1.01	90	21	52.9	54.7
16.0	12/5/06 16:30	4.00	1.03	1.01	92	0	53.1	54.7
16.5	12/5/06 17:00	3.60	1.03	1.01	90	0	52.8	54.2
17.0	12/5/06 17:30	4.10	1.03	1.01	88	0	52.5	54.1
17.5	12/5/06 18:00	4.20	1.03	1.01	87	0	52.3	53.7
18.0	12/5/06 18:30	4.32	1.04	1.01	89	0	52.2	53.7
18.5	12/5/06 19:00	4.49	1.04	1.01	89	80	52.0	53.8
19.0	12/5/06 19:30	3.66	1.04	1.01	90	0	52.0	53.6
19.5	12/5/06 20:00	4.93	1.04	1.01	88	0	53.6	54.5
20.0	12/5/06 20:30	5.15	1.04	1.01	91	0	52.7	54.2
20.5	12/5/06 21:00	3.44	1.04	1.01	90	0	52.8	54.3
21.0	12/5/06 21:30	4.23	1.04	1.01	89	0	52.2	53.9
21.5	12/5/06 22:00	4.22	1.04	1.01	88	0	52.2	53.9
22.0	12/5/06 22:30	4.21	1.03	1.01	89	0	52.2	54.3
22.5	12/5/06 23:00	3.83	1.03	1.01	88	0	52.3	54.1
23.0	12/5/06 23:30	0.02	1.03	1.01	91	0	53.3	55.3
23.5	12/6/06 0:00	3.48	1.03	1.01	92	0	53.6	54.9
24.0	12/6/06 0:30	4.05	1.03	1.01	90	0	53.0	54.7
24.5	12/6/06 1:00	4.20	1.03	1.01	89	0	53.0	54.5
25.0	12/6/06 1:30	3.80	1.03	1.01	87	0	52.8	54.4
25.5	12/6/06 2:00	4.20	1.03	1.01	86	0	52.7	54.3
26.0	12/6/06 2:30	0.02	1.03	1.01	89	0	53.5	55.5
26.5	12/6/06 3:00	4.10	1.03	1.01	92	0	53.9	55.3
27.0	12/6/06 3:30	3.70	1.03	1.01	91	0	53.5	55.2
27.5	12/6/06 4:00	4.00	1.03	1.01	88	0	53.2	54.8
28.0	12/6/06 4:30	0	1.03	1.01	90	0	53.7	55.9
28.5	12/6/06 5:00	4.09	1.03	1.01	91	0	53.9	55.4
29.0	12/6/06 5:30	3.50	1.03	1.01	89	0	53.7	55.0
29.5	12/6/06 6:00	0.02	1.03	1.01	91	0	53.8	56.2
30.0	12/6/06 6:30	4.10	1.03	1.01	90	0	54.1	55.3
30.5	12/6/06 7:00	4.20	1.03	1.01	88	0	53.7	55.0
31.0	12/6/06 7:30	4.00	1.03	1.01	87	0	53.4	55.1
31.5	12/6/06 8:00	4.90	1.03	1.01	92	0	53.2	55.2
32.0	12/6/06 8:30	3.80	1.03	1.01	90	0	53.2	54.9
32.5	12/6/06 9:00	3.70	1.03	1.01	88	0	53.0	54.7
33.0	12/6/06 9:30	4.80	1.03	1.01	89	0	53.0	54.7
33.5	12/6/06 10:00	3.80	1.03	1.01	90	0	52.8	54.4
34.0	12/6/06 10:30	4.10	1.03	1.01	90	0	52.4	54.4
34.5	12/6/06 11:00	4.00	1.03	1.01	90	0	52.5	54.1
35.0	12/6/06 11:30	3.80	1.03	1.01	90	0	52.3	54.1
35.5	12/6/06 12:00	3.90	1.03	1.01	90	0	52.1	53.9

Batch 4 Heating

Batch #4 Duration	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	TUBE BDL FL #2 Ch2 RED	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.5	12/7/06 23:30	2.20	1.05	1.04	18	100	62.2	63.7
1.0	12/8/06 0:00	2.10	1.05	1.04	26	92	62.4	64.0
1.5	12/8/06 0:30	2.01	1.04	1.03	34	189	62.9	64.3
2.0	12/8/06 1:00	2.16	1.04	1.03	46	194	63.2	64.7
2.5	12/8/06 1:30	2.27	1.04	1.01	58	190	63.5	65.3
3.0	12/8/06 2:00	2.40	1.02	1.01	71	300	64.2	65.8
3.5	12/8/06 2:30	2.90	1.02	1.00	82	297	64.5	66.2
4.0	12/8/06 3:00	2.80	1.02	1.00	92	0	65.0	66.5
4.5	12/8/06 3:30	2.30	1.02	1.00	91	0	64.5	66.2
5.0	12/8/06 4:00	2.70	1.02	1.00	90	30	64.1	66.1
5.5	12/8/06 4:30	2.80	1.02	1.00	91	0	63.9	65.9
6.0	12/8/06 5:00	2.70	1.02	1.00	89	0	64.1	65.7
6.5	12/8/06 5:30	2.70	1.02	1.00	85	0	63.9	65.8
7.0	12/8/06 6:00	3.00	1.02	1.00	92	0	63.9	66.4
7.5	12/8/06 6:30	2.60	1.02	1.00	90	0	63.7	65.7
8.0	12/8/06 7:00	3.10	1.02	1.00	88	0	63.4	65.2
8.5	12/8/06 7:30	3.50	1.02	0.99	92	45	63.5	65.5
9.0	12/8/06 8:00	2.90	1.02	1.00	94	0	63.6	65.5
9.5	12/8/06 8:30	2.80	1.02	1.00	92	0	63.2	64.9
10.0	12/8/06 9:00	3.00	1.02	1.00	90	0	62.7	64.7
10.5	12/8/06 9:30	2.70	1.02	1.00	89	0	62.5	64.4
11.0	12/8/06 10:00	3.20	1.02	1.00	87	0	62.3	64.2
11.5	12/8/06 10:30	3.00	1.03	1.00	86	0	62.3	63.9
12.0	12/8/06 11:00	2.60	1.02	1.00	86	0	62.2	63.9
12.5	12/8/06 11:30	3.10	1.02	1.00	92	31	62.9	64.6
13.0	12/8/06 12:00	2.70	1.02	1.00	95	0	62.4	64.4
13.5	12/8/06 12:30	2.70	1.02	1.00	93	0	62.5	64.1
14.0	12/8/06 13:00	2.70	1.02	1.00	91	0	61.8	63.6
14.5	12/8/06 13:30	2.60	1.02	1.00	90	0	61.6	63.6
15.0	12/8/06 14:00	2.90	1.02	1.00	88	0	61.7	63.4
15.5	12/8/06 14:30	2.70	1.02	1.00	88	0	61.7	63.3
16.0	12/8/06 15:00	2.80	1.02	1.00	86	0	61.4	63.1
16.5	12/8/06 15:30	2.90	1.02	1.00	86	0	61.3	63.1
17.0	12/8/06 16:00	3.10	1.02	1.00	91	32	61.6	63.3
17.5	12/8/06 16:30	2.50	1.02	1.00	94	0	61.3	63.1
18.0	12/8/06 17:00	2.50	1.02	1.00	92	0	61.0	63.1
18.5	12/8/06 17:30	2.60	1.02	1.00	91	0	60.7	62.9
19.0	12/8/06 18:00	2.80	1.02	1.00	89	0	60.5	62.5
19.5	12/8/06 18:30	2.90	1.02	1.00	88	0	60.0	62.3
20.0	12/8/06 19:00	3.10	1.00	1.00	87	0	60.0	62.0
20.5	12/8/06 19:30	3.00	1.00	1.00	92	100	60.0	62.0
21.0	12/8/06 20:00	2.80	1.00	1.00	92	0	60.0	62.0
21.5	12/8/06 20:30	2.70	1.00	1.00	90	0	60.0	61.0
22.0	12/8/06 21:00	2.60	1.00	1.00	89	0	60.0	61.0
22.5	12/8/06 21:30	2.90	1.00	1.00	87	0	60.0	61.0
23.0	12/8/06 22:00	3.00	1.00	1.00	86	0	59.0	61.0
23.5	12/8/06 22:30	2.40	1.00	1.00	95	0	60.0	62.0
24.0	12/8/06 23:00	2.20	1.00	1.00	94	0	59.0	61.0
24.5	12/8/06 23:30	2.00	1.00	1.00	92	0	59.0	61.0
25.0	12/9/06 0:00	1.71	1.00	1.00	90	0	59.0	61.0
25.5	12/9/06 0:30	1.90	1.00	1.00	89	0	59.0	61.0
26.0	12/9/06 1:00	2.60	1.00	1.00	88	0	59.0	61.0
26.5	12/9/06 1:30	0.00	1.00	1.00	95	0	60.0	61.0
27.0	12/9/06 2:00	2.50	1.00	1.00	93	0	60.0	61.0
27.5	12/9/06 2:30	2.40	1.00	1.00	91	0	60.0	61.0
28.0	12/9/06 3:00	2.90	1.00	1.00	90	0	60.0	61.0
28.5	12/9/06 3:30	2.00	1.00	1.00	89	0	59.0	60.0
29.0	12/9/06 4:00	2.50	1.00	1.00	87	0	59.0	60.0
29.5	12/9/06 4:30	2.60	1.00	1.00	86	0	59.0	60.0
30.0	12/9/06 5:00	0.02	1.00	1.00	95	0	60.0	61.0
30.5	12/9/06 5:30	1.70	1.00	1.00	95	0	60.0	61.0
31.0	12/9/06 6:00	0.04	1.00	1.00	93	0	59.0	61.0
31.5	12/9/06 6:30	2.50	1.00	1.00	93	0	59.0	60.0
32.0	12/9/06 7:00	2.20	1.00	1.00	91	0	58.8	60.4
32.5	12/9/06 7:30	2.40	1.02	1.00	89	0	58.8	60.7
33.0	12/9/06 8:00	2.30	1.02	1.00	88	0	58.6	61.1
33.5	12/9/06 8:30	2.60	1.03	1.00	89	0	58.7	60.5
34.0	12/9/06 9:00	1.30	1.03	1.00	88	0	58.6	60.3
34.5	12/9/06 9:30	2.20	1.03	1.01	87	0	58.4	60.1
35.0	12/9/06 10:00	3.40	1.02	1.00	88	0	58.8	60.4
35.5	12/9/06 10:30	2.70	1.03	1.00	87	0	58.7	60.2
36.0	12/9/06 11:00	2.60	1.03	1.00	86	0	58.4	60.1

Cooling Batch 1

Cooling Batch #1	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	11/23/07 19:00	2.10	1.10	1.08	82	0	46.0	47.0
1.0	11/23/07 20:00	2.10	1.10	1.08	82	28	47.0	47.0
2.0	11/23/07 21:00	1.97	1.11	1.09	76	22	45.6	46.9
3.0	11/23/07 22:00	2.10	1.12	1.10	63	21	45.1	46.4
4.0	11/23/07 23:00	2.00	1.13	1.10	52	26	44.8	46.0
5.0	11/24/07 0:00	2.00	1.13	1.11	46	25	44.7	46.0
6.0	11/24/07 1:00	2.11	1.13	1.11	39	26	44.4	45.6
7.0	11/24/07 2:00	2.11	1.13	1.11	37	26	44.3	45.4
8.0	11/24/07 3:00	22.00	1.12	1.11	30	24	44.7	45.9
9.0	11/24/07 4:00	13.00	1.10	1.10	30	14	45.0	46.0
10.0	11/24/07 5:00	0.04	1.10	1.10	30	19	43.0	45.3
11.0	11/24/07 6:00	0.05	1.10	1.10	30	19	44.0	45.0

Cooling Batch 2

Cooling Batch #2	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	12/1/07 5:00	2.80	1.05	1.02	90	28	54.0	55.9
1.0	12/1/07 6:00	2.60	1.05	1.02	86	27	53.4	55.4
2.0	12/1/07 7:00	3.20	1.05	1.03	82	28	53.1	54.7
3.0	12/1/07 8:00	2.90	1.05	1.03	81	28	53.1	54.6
4.0	12/1/07 9:00	2.90	1.05	1.03	80	27	52.9	54.6
5.0	12/1/07 10:00	3.27	1.05	1.03	79	27	52.7	54.2
6.0	12/1/07 11:00	2.90	1.05	1.03	76	27	52.6	54.0
7.0	12/1/07 12:00	3.20	1.05	1.04	75	28	52.5	53.8
8.0	12/1/07 13:00	3.06	1.05	1.04	74	27	52.3	53.7
9.0	12/1/07 14:00	3.09	1.06	1.04	73	28	52.1	53.4
10.0	12/1/07 15:00	3.09	1.06	1.04	72	28	52.1	53.4
11.0	12/1/07 16:00	2.92	1.06	1.05	69	35	51.9	53.1
12.0	12/1/07 17:00	3.13	1.07	1.05	61	35	51.5	52.8
13.0	12/1/07 18:00	2.73	1.07	1.05	53	34	51.3	52.5
14.0	12/1/07 19:00	2.90	1.07	1.06	45	33	51.0	52.2
15.0	12/1/07 20:00	2.80	1.08	1.06	39	35	51.0	52.0
16.0	12/1/07 21:00	2.80	1.08	1.06	36	34	50.7	52.0
17.0	12/1/07 22:00	3.30	1.08	1.06	33	34	50.6	52.0
18.0	12/1/07 23:00	0.04	1.08	1.06	31	34	50.4	51.8
19.0	12/2/07 0:00	0.04	1.08	1.07	30	34	50.4	51.8
20.0	12/2/07 1:00	0.05	1.08	1.07	29	35	50.4	51.8

Cooling Batch 3

Cooling Batch #3	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	12/6/07 13:00	4.20	1.03	1.01	88	0	51.7	53.4
1.0	12/6/07 14:00	4.30	1.04	1.01	83	96	51.6	53.0
2.0	12/6/07 15:00	3.90	1.04	1.02	73	33	51.0	52.4
3.0	12/6/07 16:00	3.90	1.04	1.02	62	38	50.5	51.8
4.0	12/6/07 17:00	4.00	1.04	1.03	54	34	50.3	51.5
5.0	12/6/07 18:00	4.30	1.06	1.04	46	38	50.8	51.8
6.0	12/6/07 19:00	4.39	1.06	1.04	42	32	49.8	51.2
7.0	12/6/07 20:00	4.64	1.06	1.05	37	28	49.7	51.0

Cooling Batch 4

Cooling Batch #4	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	12/23/07 19:00	2.10	1.10	1.08	82	0	46.0	47.0
1.0	12/23/07 20:00	2.10	1.10	1.08	82	28	47.0	47.0
2.0	12/23/07 21:00	1.97	1.11	1.09	76	22	45.6	46.9
3.0	12/23/07 22:00	2.10	1.12	1.10	63	21	45.1	46.4
4.0	12/23/07 23:00	2.00	1.13	1.10	52	26	44.8	46.0
5.0	12/24/07 0:00	2.00	1.13	1.11	46	25	44.7	46.0
6.0	12/24/07 1:00	2.11	1.13	1.11	39	26	44.4	45.6
7.0	12/24/07 2:00	2.11	1.13	1.11	37	26	44.3	45.4
8.0	12/24/07 3:00	22.00	1.12	1.11	30	24	44.7	45.9
9.0	12/24/07 4:00	13.00	1.10	1.10	30	14	45.0	46.0
10.0	12/24/07 5:00	0.04	1.10	1.10	30	19	43.0	45.3
11.0	12/24/07 6:00	0.05	1.10	1.10	30	19	44.0	45.0

Neutralization Batch 1

Neutralization Batch #1	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	11/28/06 0:00	13.6	1.13	1.11	26	27	44.4	45.5
1.0	11/28/06 1:00	13.6	1.13	1.11	24	27	44.4	45.4
2.0	11/28/06 2:00	14.0	1.13	1.11	24	27	44.3	45.3
3.0	11/28/06 3:00	14.0	1.13	1.11	23	72	44.3	45.4
4.0	11/28/06 4:00	14.0	1.13	1.11	23	72	44.4	45.4
5.0	11/28/06 5:00	13.0	1.13	1.11	39	72	53.8	55.3
6.0	11/28/06 6:00	13.0	1.13	1.10	35	73	53.8	55.2
7.0	11/28/06 7:00	12.8	1.10	1.11	32	73	53.0	54.0
8.0	11/28/06 8:00	12.0	1.10	1.11	30	73	53.0	54.0
9.0	11/28/06 9:00	12.6	1.20	1.10	37	73	59.0	60.0
10.0	11/28/06 10:00	12.2	1.20	1.10	37	30	59.0	61.0
11.0	11/28/06 11:00	12.2	1.20	1.10	36	30	60.0	61.0
12.0	11/28/06 12:00	12.3	1.20	1.10	34	31	60.0	61.0
13.0	11/28/06 13:00	12.8	1.20	1.10	34	30	60.6	62.0
14.0	11/28/06 14:00	12.2	1.20	1.10	33	30	60.6	62.0
15.0	11/28/06 15:00	12.3	1.20	1.10	33	30	60.6	62.0

Neutralization Batch 2

Neutralization Batch #2	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	12/1/06 0:00	0.0	1.08	1.07	30	34	50.4	51.8
1.0	12/1/06 1:00	0.0	1.09	1.07	29	35	50.4	51.8
2.0	12/1/06 2:00	0.0	1.08	1.07	27	35	50.9	52.2
3.0	12/1/06 3:00	17.9	1.08	1.06	40	30	55.5	57.2
4.0	12/1/06 4:00	16.5	1.10	1.08	48	30	59.1	60.6
5.0	12/1/06 5:00	15.5	1.10	1.14	54	30	64.8	66.5
6.0	12/1/06 6:00	13.7	1.17	1.15	53	30	66.6	68.0
7.0	12/1/06 7:00	14.1	1.16	1.14	53	30	66.4	68.0
8.0	12/1/06 8:00	14.8	1.16	1.14	52	89	66.2	68.0
9.0	12/1/06 9:00	15.1	1.16	1.14	48	62	66.1	67.7
10.0	12/1/06 10:00	15.4	1.16	1.14	43	62	65.9	67.5
11.0	12/1/06 11:00	16.2	1.17	1.15	39	62	65.9	67.2
12.0	12/1/06 12:00	15.8	1.17	1.15	36	62	65.9	67.1
13.0	12/1/06 13:00	15.6	1.17	1.15	34	62	65.6	67.1
14.0	12/1/06 14:00	15.5	1.17	1.15	31	60	65.5	67.0
15.0	12/1/06 15:00	15.3	1.17	1.15	30	60	65.6	67.0

Neutralization Batch 3

Neutralization Batch #3	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	12/6/06 21:00	19.9	1.06	1.01	34	32	49.9	51.0
1.0	12/6/06 22:00	19.1	1.07	1.02	31	28	49.9	52.2
2.0	12/6/06 23:00	18.6	1.09	1.06	51	28	57.8	52.2
3.0	12/7/06 0:00	18.9	1.09	1.07	44	32	57.6	59.8
4.0	12/7/06 1:00	19.8	1.11	1.08	42	33	59.1	59.5
5.0	12/7/06 2:00	0.0	1.16	1.14	42	32	63.0	61.3
6.0	12/7/06 3:00	19.8	1.16	1.14	39	32	63.0	64.5
7.0	12/7/06 4:00	20.0	1.16	1.14	36	32	63.0	64.6
8.0	12/7/06 5:00	19.8	1.16	1.14	33	32	62.8	64.5
9.0	12/7/06 6:00	20.0	1.16	1.14	30	32	62.8	64.7

Neutralization Batch 4

Neutralization Batch #4	Date/Time	EVAP POT PRESS #1 Ch1 BLUE	SPG #1 Ch1 BLUE	SPG #2 Ch2 RED	EVAP POT TEMP #1 Ch1 BLUE	EVAP T-B PRESS #1 Ch1 BLUE	2H TRUE LVL #1 Ch1 BLUE	2H TRUE LVL #2 Ch2 RED
0.0	12/9/06 21:00	0.1	1.00	1.00	30	27	56.0	57.0
1.0	12/9/06 22:00	16.3	1.00	1.00	29	34	57.0	58.0
2.0	12/9/06 23:00	16.0	1.00	1.00	49	32	64.0	65.8
3.0	12/10/06 0:00	15.7	1.00	1.00	44	32	65.0	67.0
4.0	12/10/06 1:00	15.1	1.10	1.00	45	32	69.0	71.0
5.0	12/10/06 2:00	15.1	1.10	1.00	41	32	71.0	72.0
6.0	12/10/06 3:00	15.0	1.10	1.10	37	32	71.0	72.0
7.0	12/10/06 4:00	15.0	1.10	1.10	34	32	70.0	72.0
8.0	12/10/06 5:00	15.0	1.10	1.10	32	32	70.0	72.0
9.0	12/10/06 6:00	15.0	1.10	1.10	30	32	70.0	72.0

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