1 of 1

**DWPF RECYCLE MINIMIZATION - BRAINSTORMING
SESSION**

by

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10/27/93
DATE

Westinghouse
Savannah River Company

INTER-OFFICE MEMORANDUM

WSRC-TR-93-0531, Rev. 0

Keywords: DWPF, Recycle Minimization

Retention period: Permanent

cc: Distribution list

October 12, 1993

TO: F. F. CADEK, 719-4A

FROM: R. A. JACOBS, 704-T
M. R. POIRIER, 676-T

R. Jacobs
MRP

DWPF RECYCLE MINIMIZATION - BRAINSTORMING SESSION (U)

Introduction

A task team has been formed to study ways to reduce the amount of water recycled from the Defense Waste Processing Facility (DWPF) to the High Level Waste (HLW) evaporator system. [Task Team charter is Attachment 1; M. R. Poirier and D. F. Brown were added to the Task Team after the initial transmittal]. To provide expert input on ideas for consideration and to help with initial evaluation, a two-day brainstorming session was held on Friday, Sept. 24 and Monday, Sept. 27 at the Central Training Facility. Participatants were selected based on their expertise and knowledge of the subject areas. Attendees for all or part of the two-day session were

M. J. Barnes, SRTC/IWT
D. F. Brown, HLWE
A. S. Choi, SRTC/DWPT
H. H. Elder, DWPF T&E
J. A. Gentilucci, DWPF T&E
E. C. Guidotti, DWPF T&E
D. H. Miller, SRTC/DWPT
M. R. Poirier, SRTC/IWT
S. R. Young, SRTC/DWPT

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J. R. Fowler, HLWM/Reg Comp
J. M. Gillam, DWPF T&E
R. A. Jacobs, SRTC/DWPT
J. P. Morin, HLWE
A. W. Wiggins, ETF

The meeting was facilitated by J. M. Turner, Brookhaven and T. K. Snyder was recorder.

C. T. Randall, 704-T
Authorized Derivative Classifier

Summary and Conclusions

A total of 62 items for conservation of water within DWPF and for treatment/disposal of the recycle stream were generated and considered. Several of the highly rated ideas for conservation are: reduction of pump prime water and sample line flushes, higher precipitate concentration, reduction of water added for precipitate reactor heel makeup, modification of the film cooler to quencher offgas line to reduce steam requirements, optimization of the SAS (steam atomized scrubber) steam, water used for canister cleaning, and development of a internal recycle water system. Highly rated ideas for disposal/treatment are sending SMECT water directly to Tank 50 or a level level evaporator, installation of an evaporator within DWPF (or conversion of existing equipment to evaporation service) with overheads to ETF, and ion exchange treatment with product stream either to ETF or Tank 50.

Background

The recycle stream from the DWPF constitutes a major source of water addition to the High Level Waste evaporator system. As now designed, the entire flow of 3.5 to 6.5 gal/min (@ 25% and 75% attainment, respectively), or 2 gal/min during idling, flow to the 2H evaporator system (Tank 43). Substantial improvement in the HLW water balance and tank volume management is expected if the DWPF recycle to the HLW evaporator system can be significantly reduced. A task team has been appointed to study alternatives for reducing the flow to the HLW evaporator system and make recommendations for implementation and/or further study and evaluation. The brainstorming session was designed to produce the first cut options for the task team to further evaluate.

Discussion

First Day

The meeting began with the usual introductions, discussion of ground rules, and agreement on agenda and objectives. Then Doug Brown made a presentation on the tank farm water balance with emphasis on HLWM (that is, tank farm, ITP, late wash, ESP, DWPF, saltstone, ETF) as an integrated system and the impacts of DWPF recycle with and without the Replacement HLW Evaporator (RHLWE). [Attachment 2] In general, we concluded that a reduction of 50% or greater was a goal which would have substantial impact.

Following Doug Brown's presentation, Roy Jacobs presented information on the DWPF water balance which included brief descriptions of the DWPF processing steps as well as information on all the known water inputs, where and why they occur, their projected size, and a summary of the major contributors. [Attachment 3] Also included was information on the size and composition of the three streams going to

the Recycle Collection Tank (RCT) which is the point at which all recycle is collected, neutralized, and inhibited prior to transfer to the Tank Farm. The three streams are chemical cell condensate from the Slurry Mix Evaporator Condensate Tank (SMECT), condensate from the melter Off Gas Condensate Tank (OGCT), and occasional decon waste and filter dissolution waste from the Decon Waste Treatment Tank (DWTT).

After the opening presentations, we first brainstormed ideas to reduce or conserve water additions within the DWPF. We then brainstormed ways to segregate/divert/treat all or part of the DWPF recycle stream. These ideas were reviewed, consolidated where appropriate, and repeats eliminated. Two ideas were rejected as infeasible. While brainstorming, we also kept a "bin list" of ideas which were outside the scope of our task.

We concluded the first day with selection of two teams to evaluate 1) DWPF conservation ideas, and 2) disposal/treatment options. All the charts from day one are reproduced on pages 1-7 of Attachment 4. These include the consolidate lists, the bin list, the "infeasible" ideas, and the evaluation team members. (Attachment 4 reproduces all the charts from both days' sessions; editorial comments or additions are shown either in []'s or in *italics*.)

Second Day

The second day began with brainstorming and selection of criteria to be used and followed by selection of a point rating system. (Attachment 4, page 9) We then split into teams and evaluated the ideas from the first day. The charts from the conservation team and the disposal/treatment team are reproduced on pages 10-16 and pages 17-20, respectively, in Attachment 4. The entire group then reconvened, presented their findings, and agreed that it had met the objective of producing first cut options for the task team to consider further. A summary of the teams' findings is presented below.

Note: The scores appear inconsistent between the two teams. The reasons for this are

- The first team tended to be a little more liberal with high ratings than the second.
- The ideas considered by the second team were, by nature of the category, typically rated lower on criteria such as development and implementation cost/timing, facility impact, etc.
- Ideas considered by the first team (conservation) typically had a lower potential impact on the water balance than those considered by the second team (disposal/treatment). The teams rated from 0 to 4 (least to most impact) based on the range of ideas being considered by that team.

However, team ratings are internally consistent and, since there was no selection or comparison of ideas from the two categories, the inconsistencies do not affect the conclusions.

Conservation Team

Salt Process Cell (page 11, Attachment 4)

The ideas related to reducing or eliminating the pumping out of the PR heel all graded out quite high; they should all be considered further. It was agreed that concentrating the precipitate prior to feeding to DWPF was a good idea and should be encouraged - plans are already in progress to determine maximum operating concentrations and to evaluate alternate filters which may allow operation at higher concentrations.

Chemical Process Cell (page 12, Attachment 4)

The only item related to the chemical process cell was related to reducing or eliminating the water added with the antifoam. The potential water savings is small and several of the criteria could not be evaluated. It was felt this should be looked at quickly for an easy solution but that it does not merit a lot of attention.

Melter Offgas System (page 13, Attachment 4)

The potential savings here are the largest in the DWPF. Some options were not evaluated for the reasons shown. Options 1.a. and 2.b. (both related to substituting air for steam) graded out relatively low because they probably exceed the capacity of the offgas blowers with resulting high impact on timing and cost. Ideas which merit the highest considerations are modification of the offgas line (from the film cooler to the quencher), optimization of the SAS's, and mode-specific offgas system operation (on the assumption that steam flows can be reduced during idle periods).

Frit (page 14, Attachment 4)

The quantity of water added with fresh frit makeup is small and probably not worth significant effort. On the other hand, water addition associated with canister cleaning is substantial and several good ideas were proposed. However, we did not have sufficient expertise and experience to evaluate the proposals. We believe that a fair amount is known about the requirements for canister cleaning and that we simply need to follow up with knowledgeable individuals in order to make the evaluations.

Recycle water system & uses (page 15, Attachment 4)

Several ideas were advanced regarding the reuse of water within the DWPF instead of adding fresh water to the system. There are several considerations in evaluating these ideas: can the water be reused

within the canyon (so that it doesn't have to be cleaned up), does piping exist for internal reuse; if the water has to come out of the canyon to be reused, how clean does it need to be?; how difficult is distribution of "clean" water for reuse?; if the water is that clean, why not just send it to ETF instead?; substantial reductions in water addition at other points or development of a cost effective disposal option would significantly reduce the incentives for reuse. It was felt evaluation of these options should be deferred pending study of other options and better definition of expected reductions.

One idea that was generated during this phase of the session was added to the list and will likely be carefully evaluated: Convert the RCT to an evaporator and use the DWTT as a condensate collection tank. This water could be used either for recycle or, more simply, sent to the ETF.

General Ideas (page 16, Attachment 4)

The ideas shown here are self explanatory. The ones which merit further consideration are modification of pumps to eliminate primes, run bigger SPC and CPC batches, and reducing the amount of water used to flush the analytical cell drain line to the RCT. Idea 6) is considered to be equivalent to mode-specific offgas operation.

Disposal/Treatments Team (Michael Poirier)

All ideas shown on pages 3 and 4 of Attachment 4 were considered either separately or, in the case of items which treatment sub-steps such as filtration, in combination with other options. These were then evaluated using the agreed upon criteria and point system. Items which scored 12 points or higher are shown on pages 18 and 19, Attachment 4. Note: Options discussed below are numbered consistent with numbers shown on the flow/logic diagram shown on page 20, Attachment 4.

Disposal

The following disposal options were discussed and evaluated for the DWPF Recycle: Z-area, the ETF, the ETF evaporator, the CIF, the H-area low level evaporator, ESP, venting to the atmosphere, recycling to the DWPF, ITP, and the Tank Farm.

Option ①

Decontaminated salt solution from ITP and evaporator concentrate from the ETF are disposed in Z-area. Z-area (Saltstone) stabilizes concentrated salt solution in a cement which is stored in vaults. Z-Area is a viable option for disposal of the DWPF Recycle. The following concerns were identified and must be addressed before the recycle could be sent to Z-area: the large volume of water, the low salt concentration (very dilute stream), the Cs concentration, and

transporting the waste stream to Tank 50. The Cs concentration in the OGCT is too high for Saltstone, but the SMECT water may meet the Saltstone acceptance criteria without pretreatment. However, if the SMECT water contains much sludge due to foaming or entrainment in the SRAT and/or SME, then a solids removal step is probably needed. Disposing of the SMECT water in Z-area would reduce the volume of recycle sent to the Tank Farm by approximately 50%.

The ETF treats waste water from the separation canyons and tank farm which is primarily evaporator overheads as well as nonroutine waste streams such as storm water runoff and contaminated cooling water. The ETF influent is usually a dilute, low activity waste stream. The following concerns must be addressed before the recycle could be sent to the ETF: the high suspended solids levels (from the melter offgas condensate and possibly from the SMECT), the high sodium nitrate levels, and the high Cs levels. Also, a method for transporting the recycle from S-area to the ETF must be developed.

An alternative to processing the recycle through the ETF is to send it directly to the ETF evaporator. This treatment method would eliminate the suspended solids and sodium nitrate problems. The evaporator would concentrate the soluble and insoluble solids and send them to Tank 50 and Saltstone. The evaporator overheads which is primarily water and phenol would be routed to the organic removal system within the ETF. The concerns with this disposal method are the Cs and Hg concentrations in this waste stream. (With Cs and Hg removal, a solids removal step is probably also required.) Also, a method for transporting the recycle from S-area to the ETF evaporator must be developed.

The CIF was considered as a disposal option. It was rejected because of the very dilute concentrations in the stream and because the CIF could not handle this volume of water and waste.

Option (2)

The DWPF Recycle could be sent to the low level (general purpose) evaporator in H-area. The concerns with this treatment method are the Cs levels in the recycle and transporting the recycle from the DWPF to the low level evaporator. The Cs concentration in the OGCT is too high for the evaporator, but the SMECT water should have a low enough Cs concentration. Disposing of the SMECT water in the low level evaporator would reduce the volume of recycle sent to the Tank Farm evaporators by approximately 50%.

The DWPF Recycle could be used as wash water for Extended Sludge Processing (ESP). This option is beyond the scope of this task team and was placed on the bin list for future consideration.

Another disposal option is the DWPF. If the recycle was dewatered, the solids could be recycled to the DWPF. An adequate purge would be needed to prevent the buildup of any chemical species within the DWPF.

The ITP could be used to dispose of this waste stream. However, processing DWPF recycle through the ITP would limit its ability to process salt solution from the Tank Farm. Therefore, it would not alleviate the problem.

The recycle could be boiled and the clean steam vented to the atmosphere. This disposal method was rejected for the following reasons: difficulties with regulatory compliance and the SAR, the cost and time to develop and implement, the technical uncertainty, and problems with flowsheet compatibility.

Option ③

The final disposal option considered was the Tank Farm. All or part of the recycle could be processed through the Tank Farm; that is, the current process. HLWM plans to send all of the DWPF Recycle to the Tank Farm at the present time. However, Tank Farm space is limited and life cycle treatment costs are high.

Treatments

Before the DWPF Recycle can be disposed, a pretreatment may be necessary. The concerns with this waste stream are the large volume, the high water fraction, the Cs concentration, the high suspended solids concentration, the high NaNO_3 concentration, the high mercury concentration, and the organic constituents. If some or all of these problems could be reduced, several SRS facilities may be able to treat this stream; specifically, Z-Area and ETF.

Another consideration is treating the SMECT and OGCT streams separately. The SMECT stream contains organic constituents and high sodium nitrate levels. The OGCT contains high concentrations of Cs. Both streams contain cesium, suspended solids, mercury, and a large fraction of water.

Options which go to ETF

Option ④

An evaporator could be installed in the DWPF to treat this stream prior to sending it to the ETF. The evaporator overheads, primarily water and phenol, would be treated at the ETF and the bottoms, with most of the salt and solids, would be sent to the Tank Farm or recycled within the DWPF. An evaporator could provide a volume reduction of at least 10:1, which would significantly reduce the volume of recycle sent to the Tank Farm. Since the ETF currently treats evaporator overheads from the Tank Farm, it should be able to treat this waste stream.

Electrochemical Ion Exchange (EIX) followed by catalytic conversion would reduce the nitrate levels in the waste stream. The catalytic

conversion would convert any NO_x to N_2 . Reducing the nitrate levels would make this stream more acceptable for the ETF. However, Cs and suspended solids removal would be required before the ETF could treat this stream.

Option ⑤

A CRC (cesium removal column) could be used to remove Cs from the SMECT stream and make it acceptable for the ETF or Z-area. The CRC in the Tank Farm could be used or a new CRC could be added after the SMECT.

Electrolysis followed by catalytic conversion would reduce the nitrate levels in the waste stream. The catalytic conversion would convert any NO_x to N_2 . Reducing the nitrate levels would make this stream more acceptable for the ETF. However, Cs and suspended solids removal would be required before the ETF could treat this stream. Development of this process needs work.

Options which go to Z-Area

Option ⑥

A filter and ion exchange process could be used to treat this stream. The filter would remove suspended solids, while the ion exchange resin would remove Cs. The effluent would be disposed of in Z-area. The concerns with this pretreatment are the volume of elution water required and the effect of high levels of radiation on the organic resin.

Option ⑦

Since the SMECT may meet the Saltstone acceptance criteria without pretreatment, it may be desirable to treat only the OGCT water with a pebble bed ion exchange unit. The ion exchange resin would be expected to act as a filter. A zeolite resin would be used. The effluent would be disposed in Z-area. Again, a large volume of elution water may be required.

The solids in the recycle could be reprecipitated and recycled to the DWPF, with the water being sent to Z-area. This treatment could have a significant impact on the DWPF flowsheet.

Solvent extraction of Cs would reduce its concentration and make the stream more acceptable for Z-area. The secondary waste from this process could present problems.

Other options considered

Carbon beds or an organic removal system would remove the organic constituents present in the SMECT water. Other treatments such as

suspended solids removal, mercury removal, and Cs removal would be required to meet the acceptance criteria of many of the treatment facilities at SRS.

A reverse osmosis membrane could be added within the DWPF to enable the water to be recycled. The RO membrane would not work by itself. Suspended solids and organic constituents would also need to be removed from the waste stream.

Mercury could be removed from the waste stream by zinc amalgamation or used tires. This treatment method was placed on the BIN list.

Filtration and mixed bed ion exchange would removed suspended solids and cesium from the recycle. The effluent could be sent to Saltstone. Large volumes of elution water would be needed for this process.

The charts on pages 18 and 19 of Attachment 4 show the scoring of the most promising disposal and pretreatment options according to the criteria established. SMECT water could be sent to Tank 50 or the Low Level Evaporator without pretreatment. Evaporation and filtration + ion exchange are the most promising pretreatments. The product from the pretreatments would be sent to Saltstone or the ETF.

Page 20 of Attachment 4 shows a flowsheet of plausible pretreatments for the OGCT and SMECT waste streams.

Attachment 1

INTER-OFFICE MEMORANDUM
Savannah River Site

Attachment 1

Date: 15-Sep-1993 01:11pm EDT
From: J. P. MORIN
COFFEY-PS-W7860 AT A1 AT SLR6
Dept:
Tel No: 53659

TO: See Below

Subject: DWPF RECYCLE TASK TEAM CHARTER (U)

You have been selected by your management to participate in a task team to evaluate and recommend alternatives to reduce the DWPF recycle stream to the tank farm. This team will be lead by Roy Jacobs.

The recycle stream from the DWPF constitutes a major source of water addition to the High Level Waste system. As now designed, the entire flow of 3.5 to 6.5 gal/min (@ 25% and 75% attainment, respectively), or 2 gal/min during idling, flow to the 2H evaporator system (Tank 43). Substantial improvement in the HLW water balance and tank volume management is expected if the DWPF recycle to the HLW evaporator system can be significantly reduced.

The scope of the team activities will include:

- 1) Perform a study of alternatives to reduce DWPF recycle to the HLW evaporator system;
- 2) Select alternatives for development and/or engineering study considering
 - o impact on recycle volume
 - o chemistry
 - o operability
 - o mechanics/logistics/physical constraints
 - o technical feasibility/uncertainty
 - o compatibility with downstream processes
- 3) Produce a water balance algorithm for use in HLW system water balances which predicts DWPF recycle as a function of attainment, operating mode (sludge-only vs. coupled feed), and improvements.

Options considered shall include:

- o reduction/minimization of water within the DWPF including internal recycle
- o segregation of DWPF streams for alternate destination
- o treatment of all or a portion to allow alternate destination

Recommendations are expected to include

- o short term, minor DWPF modifications for minimization
- o research to evaluate alternatives and/or reduce uncertainties
- o engineering trade studies
- o potential commercial options for evaluation

Expected timing:

Develop first cut options

01 Oct 93

Attachment 1

Evaluate and prepare initial recommendations	15 Nov 93
Issue final report	31 Dec 93

Brainstorming sessions to develop the first cut options have been scheduled for Friday, November 23, and Monday, November 27, at the Central Training Facility. A detailed agenda for these sessions has been transmitted in a separate All-In-One.

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Attachment 2

DWPF Aqueous Recycle
&
HLW Tank Farm

overall flow paths

waste tanks & current "space available"

ways to get in "space" trouble

sensitivity scenarios

all credit for charts ---> Tim Pate, Bryan Steingard, Brent Boore, Roy Jacobs

any "boo's & hiss's" ---> Doug Brown 9/24/93

Tank Farms Operational Space

43% NOT REUSABLE FOR STORAGE

Attachment 2

Figures represent percent of TOTAL Operational Space in each category.

Tank Farm Available Operational Space Breakdown

Attachment 2

1H/
PHLWE

Attachment 2

space consumed:
 % available
 % super-saturated (* = hi sp.gr.)
 % salt/sludge

Tank Farm Evaporator Systems Summary

"Water Logged"

Definition:

"All Feed and Receipt Tanks are Full with No Space for Further Receipt or Transfer"

Solution:

- **Feed Evaporators**
 - **Must have space to receive Concentrate**
- **Move liquid to Old Tanks or Process Tanks**
 - **Regulator Constraint Anticipated**
 - **Impacts future processing ability**

"

W. B. Boore 7/14/92

"Salt Bound"

Definition:

"All Available Salt Receipt Tanks are Full, or Evaporators Have Concentrated Feed to the Extent Possible. Evaporator systems are shut down!"

Solution:

- **Transfer Salt from Receipt Tanks**
 - **ITP must be operational**
 - **Tank 49 must not be full**
 - **ITP Effluent Compatible with Saltstone**
 - **Appropriate Waste Removal Projects must be complete**

"Gridlock"

Definition:

"Evaporator Feed and Receipt Tanks are Full with No Available Salt Receipt Space." Some space may exist over several tanks but not where needed. (Water Logged and Salt Bound)

and/or

"Tank 49 is Full and there is no tank space available to handle DWPF Recycle"

Solution:

- **Transfer Salt from Receipt Tanks**
 - **ITP must be operational and Tank 49 must not be full**
 - **ITP effluent must be compatible with Saltstone**
 - **Appropriate Waste Removal Project must be complete and "Ready to Operate"**
- **Must have room to receive LW and DWPF Recycle to Feed DWPF**
- **When Salt Space is available bring evaporators on line**
- **Resume sludge removal only after sufficient evaporator feed and salt receipt exist**
- **Move liquid to Old Tanks (Regulatory Constraint!!)**

W. B. Boore 7/14/92

ESP Salt Generation

Building a New HLW Processing Tank

CDR & Est.

Congressional Authorization

Title I/II Design

Procurement

Construction

NEPA (EA)

Attachment 2

source,
basis,
date = •

"space available" -- sensitivity scenarios

("pos" = good, "neg" = bad)

(all assume evap productivity = 75% of plan)

<u>DWPF</u>		<u>w/o</u> <u>RHLWE</u>	<u>w/</u> <u>RHLWE</u>
<u>attainment</u>	<u>recycle</u>		
25/ 40/ 60/ 50/ 70% for batch 1/ 2/ 3/ 4/ 5.	full	minor pos til '99, then huge neg.	major pos.
same ramp-up	50% cut after '98.	minor pos till ~'03, then minor neg.	huge pos.
25%	full	minor pos til '99, then minor neg.	huge pos.
25%	50% cut after '98.	medium pos.	huge pos.

note: calcs by Tim Pate, summary by Doug Brown.

Attachment 3

Attachment 3

Late Wash

9/23/93

Data from Batch 1 Mat'l Bal, WSRC-TR-93-203, Rev. 0

<u>Stream Description</u>	<u>CPES Stream #</u>	<u>Flow - lbs/hr</u>
Precipitate feed from Tk 49	418	378
Wash water (w/ NaTPB)	457	1167
Flushes & cleaning solutions	458,662,664,665, 669,670,671,459	365.7
Recycle wash water	420	1508
Late washed precipitate	201	358
Atmosphere	456,461	48.8

Ins	1911
Outs	1915

Attachment 3

Salt Process Cell

9/23/93

Data from Batch 1 Mat'l Bal, WSRC-TR-93-203, Rev. 0

<u>Stream Description</u>	<u>CPES Stream #</u>	<u>Flow - lbs/hr</u>	<u>Update lbs/hr</u>
Late wash precipitate feed	201	358	
PRFT primes	216	3.9	49.2
Formic acid to PR	206	1.6	
Cu catalyst to PR	220	20.5	
Process wtr to PR	217	182	
PR primes	265,266	11.7	76.8
Process wtr to OE	232	71.3	
OE primes	264	3.9	
OECT primes	267,268	7.8	
Recovered organic to OWST	245	7.8	
PHA to PRBT	247	634	
			<u>744.4</u>
			$\Delta = 110.4$

Ins	661
Outs	642
Update	
Ins	771
Outs	752

Attachment 3

Chemical Process Cell

9/23/93

Data from Batch 1 Mat'l Bal, WSRC-TR-93-203, Rev. 0

Stream Description	CPES Stream #	Flow - lbs/hr	Update lbs/hr
PR to PRBT	247	634	
PRBT primes	50,51	7.8	27.7
Washed sludge	1	402	
SRAT primes & antifoam	6,7	5.9	59
Nitric acid to SRAT	8	9.5	
Fresh frit to SME	27	101	
Decon frit to SME	26	215	375
SME primes & antifoam	29,30	4	59.3
Nitric acid to SMECT	106	5.1	
SMECT primes & scrubber circ	34,35	4.9	29.2
Melter feed loop flush	45	7	
SMECT condensate to RCT	43	1085	1421.1
MFT prime	46	2	25.5
Melter feed tube flush	49	1	
Melter feed	60	334	
		$\Delta =$	336.1

Ins	1399
Outs	1419
Update	
Ins	1735
Outs	1755

Attachment 3

Melter/MOG

9/23/93

Data from Batch 1 Mat'l Bal, WSRC-TR-93-203, Rev. 0

<u>Stream Description</u>	<u>CPES Stream #</u>	<u>Flow - lbs/hr</u>	<u>Update lbs/hr</u>
Melter feed	60	334	
Combustion water	70	22	
Steam to film cooler	72	250	500
Steam to SAS's	88,90	742.6	
OGCT primes	101,102	27.8	
Water to HEME	95,119	2.7	
OGCT to RCT	100	1386	1636
BUOGCT to RCT	120	9.6	
		$\Delta =$	250
		Ins	1379
		Outs	1396
		Update	
		Ins	1629
		Outs	1646

Attachment 3
DWTT/RCT

9/23/93

Data from Batch 1 Mat'l Bal, WSRC-TR-93-203, Rev. 0

<u>Stream Description</u>	<u>CPES Stream #</u>	<u>Flow - lbs/hr</u>	<u>Update lbs/hr</u>
DWTT			
Spent wash from SET	151	0.2	
Warm decon waste header	160	2.8	
Hot decon waste header	161	320	
DWTT primes	162,163	2.5	
NaOH to DWTT	165	8.3	
DWTT to RCT	167	337	
		Ins	334
		Outs	337
RCT			
DWTT to RCT	167	337	
Condensate from SMECT	43	1085	
Condensate from OGCT	100,120	1396	
Formic acid waste header	175	26	
RCT primes	170,171	6.3	158.5
NaNO ₂	173	13.4	
NaOH	174	73.4	
Condensate fr tunnel & stack	196,199	1	
RCT to LPPP	177	2935	3094
		$\Delta =$	152.2
		Ins	2938
		Outs	2935
		Update	
		Ins	3090
		Outs	3094

Attachment 3

DWPF Water Balance

Batch 1, Mat'l Bal, WSRC-TR-93-203, Rev. 0

9/23/93

	Salt Process Cell				Chemical Process Cell						Melt Cell				RCT		DWTT		Total water	Added water
	Precip	Cat & FA	Proc wtr	P & F	Sludge	Nitric	Fresh ftr	Dcn ftr	P,F&AF	to RCT	Film dr	SAS's	P,F,etc	to RCT	Adjnts	P,F,etc	Dcn hdr	P & F		
pph*	358	22	253	23	402	15	101	215	33	1088	250	743	82	1369	87	33	323	11	2931	2171
gpm*	0.716	0.044	0.507	0.047	0.804	0.029	0.202	0.430	0.065	2.178	0.500	1.485	0.124	2.777	0.174	0.067	0.648	0.022	5.86	4.34
Update - pph				134				375	209	1535	500			1839		186			3779	3019
				0.288				0.750	0.417	3.089	1.000			3.277		0.371			7.56	6.04

*These values are from the Batch 1 Material Balance which is based on design instantaneous rates equivalent to 228 Btu/hr glass (i.e., 100% attainment)

"Update" includes latest estimates for primes, flushes, antifoam additions, canister decon, and film cooler steam

Summary by Cell/Tank			Update			
	Total	%	Added	%	Added	%
SPC	657	22.4	299	13.8	409	18.9
CPC	785	26.1	363	16.7	699	32.2
Melt	1055	36.0	1055	48.6	1305	60.1
RCT	120	4.1	120	5.5	272	12.5
DWTT	334	11.4	334	15.4	334	15.4
Total	2931		2171		3019	

Summary by Type			Update			
	Total	%	Added	%	Added	%
Fixed	993	33.9	993	45.7	1243	41.2
Proportional	1815	55.1	855	39.4	1454	48.2
Variable	323	11.0	323	14.9	323	10.7
Total	2931		2171		3019	

Largest contributors			Update		
Flow	% of total	% of added	Flow	% of total	% of added
Precip & sludge	760	25.9	760	20.1	-
Proc wtr to SPC	253	8.6	253	6.7	8.4
Decon ftr	215	7.3	375	9.9	12.4
Film cooler	250	8.5	500	13.2	16.6
SAS's	743	25.3	743	19.6	24.0
Decon hds	323	11.0	323	8.5	10.7
Prms, flshs, etc	182	5.5	801	15.9	19.9
All others	225	7.7	225	5.9	7.4
Total	2931		3779

Late Wash		
	pph	gpm
Precip	378	0.758
Wash wtr	1167	2.334
P & F	368	0.732
Atmos	49	0.099
Wshd ppt	358	0.716
Spt wash wtr	1504	3.008

MAJOR STREAM TO RCT**SMECT to RCT (stream 43)**

1090 lbs/hr or 2.17 gpm

Primary constituents: (per mat'l balance)

Aniline	0.05 lbs/hr
Phenol	0.7
NHO ₃	3.5
NH ₄ NO ₃	0.7

 $\text{"sludge"}^1 = 0.0002 \text{ lbs/hr} \Rightarrow 0.00045 \text{ Ci/min}^2$ activity @ 2.17 gpm $\Rightarrow 0.002 \text{ Ci/gal}$

Uncertainties: 1) Quantity of sludge (foaming & entrainment)
 2) Antifoam(s) - kind & quantity

Per memo from JMGilliam (attached), TSS could be 850 ppm in recycle ~ 2000 ppm in SMECT condensate; this is ~4% of sludge fed
 $\Rightarrow 4.5 \text{ Ci/min}$ which in 2.17 gpm $\Rightarrow \sim 2 \text{ Ci/gal}$.

¹ Based on ratio of Group B radionuclides or Fe₂O₃

² Based on 133 Ci/gal in sludge feed (design basis for 5 year out-of-reactor sludge)

OGCT to RCT (stream 100)
1389 lbs/hr or 2.77 gpm

Primary constituents: (per mat'l balance)

Al ₂ O ₃	0.1 lbs/hr
B ₂ O ₃	0.2
Cs ₂ O	0.015
CsCl	0.020
Fe ₂ O ₃	0.2
NH ₄ OH	0.3
Hg	0.2
Hg ₂ Cl ₂	0.04
Li ₂ O	0.1
Na ₂ B ₄ O ₇	0.1
Na ₂ O	0.2
SiO ₂	1.3

10% of Cs fed $\Rightarrow$ 2.9 Ci/min ¹³⁷Cs (based on 36 Ci/gal ¹³⁷Cs)

1% of glass $\Rightarrow$ 1.1 Ci/min from sludge

Activity @ 2.77 gpm $\Rightarrow$ ~1.5 Ci/gal

Uncertainties: 1) Cs possibly much lower, especially during
melter feeding

DWTT to RCT (stream 167)

Intermittent stream/variable composition

- decon waste
- acid catch tank
- HEME/HEPA dissolution
 - + fiberglass
 - + NaOH
 - + some organics (?)
- should be small during initial operating periods

RCT

Uncertainties: lab wastes to RCT

Attachment 3

May 17, 1993

OPS-DTA-930006
Revision 0

To : Thomas M. Monahan, 703-H

Keywords: DWPF,
Recycle Data

From: Joseph F. Ortaldo, 704-S

DWPF RECYCLE WASTE COMPOSITION (U)

In order to provide a basis for Waste Management studies for disposition of the DWPF recycle stream, this letter provides the estimated stream composition for the cold chemical run stream. Below is the average and maximum concentrations anticipated after melter heat-up.

This estimate is somewhat conservative, in that the highest average concentration for each component is the highest seen in any of: Material Balance Tables for the Integrated DWPF Cold Chemical Runs (WSRC-TR-92-211, Rev. 1), analyses of selected TNX IDMS samples, and analyses of our first Recycle Collection Tank (RCT) batch.

The maximum values are generally estimated to be four times the average. This is estimated to account for the varying ratio of Melter off-gas condensate to Slurry Mix Evaporator condensate in the RCT, and other sources of process variability.

No detectable mercury is expected in the recycle waste routinely. Approvals from SCDHEC limit the recycle dispositioned to F/H ETF to 50 ppb. We propose that up to 50 ppm of mercury be evaluated for the contingency of disposition of recycle to the tank farm.

As more operating data is accumulated, this estimate will be refined as necessary. Jeff Gillam will be glad to answer further questions.

Attachment 3

DWPF Recycle Stream Composition

<u>Component</u>	<u>Avg conc.</u>	<u>Max Conc.</u>
TSS	850 ppm	3300 ppm
C6H6	1.2 ppm	10.0 ppm
(C6H5)2	2 ppm	4.0 ppm
(C6H5)2NH	3 ppm	10.6 ppm
C6H5NH2	30 ppm	128 ppm
C6H5OH	200 ppm	800 ppm
(NO2)C6H4OH	200 ppm	800 ppm
(C6H5)C6H4OH	27 ppm	54 ppm
NaCOOH	210 ppm	874 ppm
NO3-	2000 ppm	4000 ppm
NO2-	2000 ppm (as adjusted for Tank Farm)	
CsOH	15 ppm	62 ppm
Na2B4O7	43 ppm	168 ppm
Na2SO4	44 ppm	170 ppm
NaCl	156 ppm	602 ppm
NaF	25 ppm	96 ppm
NaI	6 ppm	24 ppm
OH-	8514 ppm (as adjusted for Tank Farm)	
Al2O3	39 ppm	152 ppm
B2O3	60 ppm	232 ppm
BaSO4	1 ppm	4.8 ppm
CaO	8 ppm	30 ppm
Ca3(PO4)2	0.7 ppm	2.6 ppm
CaSO4	1 ppm	3.6 ppm
Cr2O3	1.2 ppm	4.6 ppm
Cs2O	1.3 ppm	4.8 ppm
CuO	4.18 ppm	16.1 ppm
Fe2O3	92 ppm	356 ppm
FeO	15 ppm	56 ppm
K2O	21 ppm	82 ppm
Li2O	38 ppm	146 ppm
MgO	12 ppm	46.8 ppm
MnO	21 ppm	80 ppm
Na2O	72 ppm	280 ppm
NiO	9.2 ppm	35.6 ppm
PbO	0.05 ppm	0.192 ppm
PbSO4	1.3 ppm	4.98 ppm
SiO2	442 ppm	1706 ppm
SrO	0.4 ppm	1.66 ppm
TiO2	2.7 ppm	10.4 ppm
ZnO	2.58 ppm	5.00 ppm
ZrO2	10.7 ppm	41.4 ppm

Attachment 4

**CHARTS
FROM
FIRST DAY**

9/24/93

Summary of Initial Brainstorming

Conserve Water within DWPF

- Modify pumps to eliminate primes
- Different medium to blast canisters (CO₂; air + frit)
- Do not pump all of heel from PR
- Boil [actually, feed] PR below top of coils
- Spray water in film cooler instead of steam
- Internal steam generators [produce steam from waste water]
- Optimize SAS operation
- Cut cooling water flow to condensers & send steam out stack
- Modify offgas line - film cooler to quencher (air entry point)
- Mode specific offgas operation
- Run bigger salt cell and chem cell batches
- Don't run salt cell at all - use melter as incinerator (at low rates)
- Substitute air for steam on film cooler and/or SAS's
- Transfer acidic waste to tank farm
- Use recycle water for pump primes
- Produce (develop) recycle water system (reasonably clean water req'd)
- Find way to reduce water used for sample drain flush [to RCT] or use recycle water (don't forget pretreatment)
- Operate fastest attainment at all times
- Send more water to OWS
- Use recycle water for fresh frit makeup or for frit blasting
- Dry frit feed
- Concentrated frit feed (paste)
- Don't neutralize OGCT (*repeat of transfer acidic feed to tank farm*)
- Antifoam
 - reduce or eliminate use
 - feed in concentrated form
 - use recycle water
- Build a conical [bottom] PR or coils on the outside [reduces/eliminates heel]
- Add a condensate tank to salt cell [use for subsequent batch makeup]

- Concentrate precipitate in Late Wash (feed more concentrated precipitate]
- Recycle SMECT water to PR for PR heel makeup
- Adjusting acidity (*repeat of previous item*)
- Use DWTT as evaporator (belongs in both categories: conservation and treatment/disposal)
- Downsize Backup Offgas System (for use during melter idling'
- Turn OGCT into pebble bed scrubber & eliminate SAS's (ie, replace SAS's with something that doesn't use or generate so much water)
- Dry frit blast canisters

Different Disposal Options/Treatments

- Send to Z Area (some or all)
- Send to ETF (some or all)
- Reprecipitate & send solids back to DWPF (salt cell)
- Send straight to ITP (add evaporator between ITP & saltstone)
- Add evaporator to DWPF
 - overheads to ETF
 - bottoms to tank farm or partial recycle within DWPF
- Recycle Insoluble solids to SRAT }
- Centrifuge or settling tank or filter }
- Consider SMECT and OGCT stream separately
- Send low activity stream (SMECT) to Tank 50 - does not require neutralization
- Run straight to ETF evaporator (SMECT) - "off spec" batch (high solids) to tank farm (no pretreatment)
- IX & filter } then
- Filter } divert
- Cs solvent extraction (crown ethers or dicarbollide)
- Reverse osmosis within DWPF
- Electrolysis to remove nitrates - send to ETF (or other means of denitration)
- Electrolytically assisted ion exchange (EIX) followed by catalytic conversion
- Zinc amalgamation to remove Hg
- Use tires to remove Hg

- **Incinerate recycle stream in CIF**
- **Carbon beds/organic removal (pretreatments)**
- **Mixed bed resins**
- **IX of OGCT water (single stage, "tea bag")**
- **SMECT water to CRC in tank farm (then to ETF)**
- **Add CRC to SMECT (in line)**
- **Send to low level evaporator in 200 Area**
- **Treat and then send to ESP**
- **Boil and vent clean steam to atmosphere**

Bin List

- 1) Transfer acidic waste to Tank Farm (plenty of NaOH already there to neutralize DWPF recycle, would reduce salt made but essentially zero impact on water balance)**
- 2) Are there any other Internal Tank Farm streams that can be used for ITP so that Late Wash spent wash could go to ETF? (may require some treatment)**
- 3) Use F Area Type I or IV tanks to store DWPF recycle for use in salt dissolution**
- 4) Develop more efficient ESP (ie, filtration or centrifugation instead of very inefficient batch washing)**
- 5) Build new [above ground/low activity] tank for Z Area feed; use Tank 50 for other tank farm processes (eg, store DWPF recycle for use in salt dissolution or for ESP wash water - may require some treatment for organics)**
- 6) Ways to remove Hg, if needed**
 - zinc amalgamation**
 - used rubber tires**
- 7) Install evaporator between ITP and Z Area to reduce saltstone volume**

Ideas eliminated as infeasible

- 1) General downsizing of DWPF process (*not really feasible/cost effective*)
- 2) Replace continuous melter with "In-can" melter - shut off offgas system when not in use (*not really feasible/cost effective*)

Evaluation Teams for Monday, 9/27/93

Conservation

Joe Carter
Beth Guldotti
Don Miller
Steve Young
Alex Chol
Roy Jacobs (Facilitator)

Different disposal/treatments

Jane Bibler
John Fowler
Michael Poirier
Doug Brown
Hank Elder
Jeff Gillam
Mark Barnes
Marty Turner (Facilitator)

**CHARTS
FROM
SECOND DAY**

9/27/93

CRITERIA

1. Development time/cost
2. Implementation time/cost
3. Flowsheet/facility compatibility
 - chemistry
 - physical constraints
 - secondary waste
 - materials of construction
 - facility modifications
 - impact on attainment/facilities
4. Impact on regulatory compliance/SAR
5. Technical uncertainty/maturity
6. Impact on water balance
7. Operability/maintainability

Points

0	Doesn't meet criteria
1	Partially meets criteria
2	Meets criteria
3	Exceeds criteria
4	Significantly exceeds criteria
X	Not enough information to determine where it fits

**CHARTS
FROM
CONSERVATION
TEAM**

9/27/93

Salt Process Cell (0.5 gpm)

- 1) Reduce or eliminate water addition associated with the PR heel
 - a. Do not pump out all of PR heel
 - b. Feed below top of coils
 - c. Build conical bottom or put coils on outside
 - d. Install condensate tank to collect water for next batch
(ie, concentrate)
- 2) Send water to OWS (low impact, not practical, doesn't make much sense, not rated)
- 3) Concentrate precipitate in Late Wash
Good idea, already planned, will operate as high as practical, not rated)

Evaluation of Item 1)

<u>Criteria</u>	<u>1.a</u>	<u>1.b</u>	<u>1.c</u>	<u>1.d</u>
1)	3	3	4	4
2)	4	4	2.5	1
3)	4	4	4	2
4)	4	4	4	3
5)	2	3	4	4
6)	2	2	2	2
7)	3	3	4	2
Totals	22	23	24.5	18

Chemical Process Cell (0.12 gpm)

- Antifoam
 - reduce or eliminate
 - use concentrated feed
 - use recycle water (*this is dependent on development of a recycle water system*)

Criteria

1)	X
2)	X
3)	X
4)	4
5)	X
6)	0.5
7)	X

Totals

Small gain, not much value, too many unknowns to rate; this should be looked at quickly but does not deserve a lot of time or effort

Offgas System

1) Film cooler (0.5 - 1.0 gpm)

- Use spray water instead of steam (*already tried, didn't meet operating requirements*)
 - a. Substitute air for steam
 - b. Modify offgas line (film cooler to quencher)

2) SAS's (1.5 gpm)

- a. Optimize
- b. Substitute air for steam
- Replace SAS's with low water user (*deep bed scrubber has ΔP and DF problems, surging/unstable, Hanford may not use*)
Not rated because of too many unknowns; however, a search could be made to see if there is new technology, alternatives in this area

3) General

- Mode specific operation
- Downsize backup system (*full capacity required for switchover period; not rated*)

More air (in place of water) will have major design/cost impacts on the offgas system!!

<u>Criteria</u>	<u>1.a</u>	<u>1.b</u>	<u>2.a</u>	<u>2.b</u>	<u>3</u>
1)	2.5	4	2	2	X
2)	2	3	4	1	4
3)	1	3	4	1	4
4)	3	4	4	2	X
5)	3	4	2.5	1	1
6)	3*	2	2.75	3.5	1
7)	3	4	4	2	X
Totals	17.5	24	23.25	12.5	X

*less if offgas line modified to prevent increase in steam requirement

Frit

- 1) Canister cleaning/decontamination; ie, spent frit (0.4-0.64 gpm)
 - Different cleaning medium (eg, CO2 pellets) *still requires rinse step*
 - Dry frit blasting (*already tried?? requires rinse step*)
 - **ADDED IDEA:** *Optimize based on water instead of frit*
- 2) Fresh frit makeup (0.2 gpm)
 - Use recycle water (*moved to discussion of recycle water system*)
 - Dry frit feed
 - Feed concentrated frit (paste)

Did not have sufficient expertise to discuss and rate. However, much is probably already known about many of these ideas followup with further evaluation is recommended.

Recycle water system/uses**1) Recycle as-is**

- Are there any uses which can use streams as-is (ie, without treatment such as filtering, evaporation, etc)?

2) Recycle water "system" including treatment

- Treatment required? filtration? evaporation?
- How "clean" does it need to be?
- Tank, pump, distribution system required?
- Use only inside canyon?
- Recycle/purge/buildup?
- Reduction in inputs reduces/eliminates recycle uses; if treated (eg, evaporated, why not send straight to ETF? (bottom recycle to SRAT?))
- NEW IDEA: Move steam coil and condenser from DWTT to RCT and use DWTT as condensate tank (*use RCT as evaporator*) *This is really one of the disposal//treatment options*

3) Uses

- Pump primes and flushes (outside canyon)
- Flush analytical drain to RCT (outside canyon)
- Recycle SMECT condensate directly to PR to make heel
- Fresh frit makeup (outside canyon)
- Use for frit blasting *followed by clean water rinse* (outside canyon)

No formal rating was attempted on these options because of the large number of combinations and unknowns. With the exception of as-is recycle, most of the ideas require potentially expensive systems which may be of little value if other alternatives pan out.

General Ideas

- 1) Modify pumps/get rid of primes**
 - Recommendation already made by DWPF T&E
- 2) Internal steam generator**
 - High cost, high risk (both technical and safety), high facility impacts/ constraints, high time to implement, why make "hi" press steam? why not just condense and send to ETF or use for recycle
- 3) Cut cooling water to condensers and vent to steam to atmosphere**
 - Hg and benzene missions unacceptable
- 4) Run bigger SPC and CPC batches (many additions are fixed quantity per batch, this would decrease relative amount of water added)**
 - Agree this should be done
- 5) Feed precipitate directly to melter at low rates (quantity of combustible gases not a safety hazard)**
 - High impact on safety/SAR, incompatible with PCCS/waste qual, previously considered and rejected
- 6) Operate @ highest attainment (throughput, refers to melter feed rate)**
 - Depends on feasibility of "mode sensitive" offgas system operation; also depends on feed availability
 - Should be considered as part of "water conservation" program
- 7) Find ways to reduce water flushing of analytical drain line to RCT**
 - Needs to be looked at; likely to produce some results

**CHARTS
FROM
DISPOSAL/TREATMENTS
TEAM**

9/27/93

Disposal without Pretreatment

<u>Method</u>	Criteria							<u>Total</u>
	<u>#1</u>	<u>#2</u>	<u>#3</u>	<u>#4</u>	<u>#5</u>	<u>#6</u>	<u>#7</u>	
Send SMECT to Tank 50	2	1	2	2	3	2	3	15
Send SMECT to Low Level Evaporator	2	1	2	1	2	2	2	12

Evaluation of Pretreatments

<u>Method</u>	Criteria							<u>Total</u>
	<u>#1</u>	<u>#2</u>	<u>#3</u>	<u>#4</u>	<u>#5</u>	<u>#6</u>	<u>#7</u>	
Install evaporator in DWPF	3	2	2	2	3	4	2	18
Filter + IX + Hg removal??	1	1	2	2	3	4	2	15
IX of OGCT	1	2	2	2	2	3	2	14
EIX	2	1	2	2	1	4	1	13
Cesium Removal Column (SMECT)	2	1	1	2	2	2	2	12

Disposal/Treatment Flow Diagrams & Logic

**DATE
FILMED**

1 / 26 / 94

END